THE DISCUS THROWER & HIS DREAM FACTORY

by: GIDEON ARIEL, Ph.D &
ANN PENNY ARIEL, Ph.D
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Gideon Ariel, Ph.D. &
M. Ann Penny Ariel, Ph.D.
The Discus Thrower and the Dream Factory

Gideon Ariel, Ph.D. and

M. Ann Penny Ariel, Ph.D.
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Acknowledgments

Credit for this book is due to the many people who have contributed to my life, success, and the details of creating this manuscript.

The original idea for writing the book came from Gerald Astor. Gerald was the reporter from Esquire Magazine who was sent to interview me prior to the Montreal Olympic Games. His article focused on my predictions, based on biomechanical results, for the optimum performance which could occur in many specific track and field events. His story, “How to Know a Perfect Performance When You See One” was published in 1976. Although Gerald and I were unable to complete the manuscript, the idea to write this memoir was planted.

Without my early mentors, Dani Dassa, Yariv Oren, and LeRoy Walker, I would not have competed in the 1960 Olympics. These men possessed kindness and compassion for a young shy child and they shaped him into a confident successful adult.

Coach John Walker at the University of Wyoming provided the opportunity for me to obtain an education in the United States. His assistance and confidence in me allowed me to grow into a successful discus thrower and continue with my academic successes.

Acknowledgements must be given to my University of Massachusetts professors, Dr. Benjamin Ricci in Physiology and Stanley Plagenhoef in Biomechanics. These professors and their disciplines prepared me for many of my future activities. Their academic disciplines became intense focal points for me during my first years of graduate studies. In addition, Dr. Ricci was very supportive of my early days in Massachusetts when my wife, Yael, and daughter, Geffen, were new to the New England area.

Additional acknowledgements to Drs. Walter Kroll and Harry Campney at the University of Massachusetts. These two individuals greatly enhanced my knowledge and assisted my success with my graduate program.

Dr. Conrad A. Wogrin was the head of the computer sciences. Dr. Wogrin provided grants which enabled me to use the main computer in the University. Although all students and faculty were given these “grants”, Dr. Wogrin was fascinated by the uses that I made of the computer system. He was also my professor in several computer classes and continually encouraged me to use the computer to its fullest capacity. He once remarked that he wished everyone would use the University computer as creatively and extensively as I did. He was a wonderful and supportive person and I appreciate all that he did to help me in those early years. I will forever be thankful for Dr. Wogrin’s help and guidance.

Professor Michael A. Arbib in the School of Computer Science inspired me to pursue a Post Doctorate degree in Computer Sciences. Through his expertise, I enhanced my knowledge about the neurologic interactions of the brain and nervous system.
University of Massachusetts Track and Field coach, Ken O’Brien, was instrumental in connecting me with many individuals within the track world including the head coach at Dartmouth College, Ken Weinbel. Coach Weinbel invited me to work with the Olympic athletes at the throwing camp in Hanover, New Hampshire where Dartmouth College is located. Not only did I have the opportunity to work with many great Olympians, but met Mac Wilkins for the first time there.

With Coach Weinbel, Ann and I formed our first company, Computerized Biomechanical Analysis, Inc. (CBA). Coach Weinbel arranged for me to study computer science classes at Dartmouth. One class was taught by Dr. John G. Kemeny and his colleague, Dr. Thomas E. Kurtz who were the inventors of the BASIC computer language. BASIC (an acronym for Beginner’s All-purpose Symbolic Instruction Code) is a family of general-purpose, high-level programming languages whose design philosophy emphasizes ease of use.

Another important Dartmouth College connection was Mr. Carl Peterson. I met Carl at the Hewitt Computer Center and he helped me write my biomechanical programs in BASIC which could run on the Honeywell computer there. He also helped me establish a remote access so that I could use the computer in Hanover, NH from our CBA office there and in my home in Belchertown, MA. Carl’s contribution may appear small when viewed through the prism of 2017, but in 1972, this computer power and remote access were tools far ahead of their time and available mainly in science fiction movies.

Our first business project was with Spaulding Sporting Goods Company. We were approached by Mr. Egon Rowmacker who asked us to solve a basketball problem for them. We solved that problem and were happily and successfully able to work with Egon for many years. We gratefully acknowledge his involvement in these research projects.

The man that took us from amateurs and helped us build a real business was Mr. Larry Graham. Without Larry, our business would have been less successful and this book would have less material. Larry was a wonderful person and helped Ann and I in many ways. We will forever be thankful for his help and guidance.

Thanks to Mr. Bill Morrisroe at Wilson Sporting Goods for his belief in my abilities and his efforts on behalf of both of our companies. He supervised and assisted the growth and development of many research projects and the computerized Exercise Machine.

Shortly after establishing CBA, I met Mr. Alan Blitzblau at the University of Massachusetts computer center. Alan was a talented programmer and I hired him to translate my BASIC language biomechanical program running on the Dartmouth College system to Fortran on the University of Massachusetts system. Alan also wrote a Word Processor on the Data General Computer which CBA purchased. Our in-house Word Processor also had a sophisticated Spell Checker. Alan was a remarkable and gifted programmer who contributed greatly to the development of our biomechanical software capabilities.

Dr. Jeremy Wise must receive special recognition for his programming skills, his contributions to the physics and mechanics of our projects, the development of the computerized exercise machine. In addition, Jeremy has been a special friend for many years and we cannot thank him enough for his many contributions to our lives and business.

Mr. Justin Millium, and Mr. Peter Smart were also major contributors to the growth and development of both software and hardware developments. Peter and Justin developed for me one of the first personal computer. They were also instrumental in many of the early hardware refinements needed on my computerized exercise machine.

Another programmer who contributed to the development of my biomechanical software was Jim Walton from Penn State University. More recently, a programmer who added modules to our Motion Analysis System, is Rudolf Buijs. His contributions to our biomechanical software have been quite unique.

Several individuals were instrumental in developing the Olympic Training Centers. Dr. Irwin Dardik, Bill Toomey, and Russ Hodge listened to me as I described what I had seen in the East German
Olympic Sports Center in, then, communist East Germany. I explained that American athletes no longer had an edge on the world stage unless we began to train in a dedicated fashion. These men helped me start the Olympic Training Center, initially in Squaw Valley and later in Colorado Springs, CO. Without their devotion to the project, and the efforts of Colonel Don Miller, there would not have been a center for the Olympic athletes.

Another contributor to our success is the American hammer thrower, Mr. Ed Burke, who introduced me to the Universal Equipment Company. In addition, much credit must be given to Mr. Chuck Coker and Mr. Harold Zinkin for involving me in the development and improvement of the Variable Resistance Exercise system introduced by Universal Equipment Company.

Two unique contributors were William Simon, Secretary of treasury at the time, and William Casey, the former CIA Director. They formed a company with me and Dr. Dardik: “Life System Inc.” It was a special privilege for me to work with these two remarkable men.

Special acknowledgement is extended to the late Vic Braden. Vic invited me to Coto de Caza, California to visit him at his Tennis College. Ann and I moved shortly thereafter and enjoyed a long and personal relationship with Vic and his wife, Melody. We miss him dearly.

Many people joined us at the Coto Research Center. Dany Saar was my right-hand man for 10 years. Mr. Bo Friedman and Mr. George Otott were helpful in the early days of the Research Center. Ari Selinger, coach of the US Woman’s Volleyball team, worked with us for nearly eight years. His team won the Olympic Silver medal in the 1984 Games.

Special acknowledgement is extended to our long-time friend and colleague, Mr. Robert Wainwright. Bob has contributed and shared many parts of our life and we thank him for all of his help and effort over the years.

My accountant for nearly 40 years is Collin Hatch. He has worked with us throughout our time in California. Not only has Collin provided financial guidance but he been a dear friend as well.

It may strike some people strange to thank our lawyers, but we have had wonderful ones who have contributed to our lives. Mr. John Soja has also been our dear friend for nearly 45 years. Mr. Norman Zafman has guided us through our intellectual property efforts and has been a wonderful friend as well. Lastly, Mr. James Weisz has provided excellent guidance and has been another good friend to us.

We have worked with several editors over the years to help with photos and contribute to the text. Gay Waley, Virginia Thiele, and Robert Schumacher all contributed to the best of their abilities. However, none of them knew all of the stories necessary to include in this unique and untraditional book. None the less, I wish to thank them for the help they were able to provide.

Our current editor is A.J. Ducusin. A.J. had done an excellent job incorporating the many photos within in the text, creating the table of contents, indexes, and appendices. He also designed the cover pages. It has been an arduous task but AJ has been wonderful to work with and I thank him for his efforts.

Special thanks must be given to Dr. James Hackney who saved my life by donating a kidney to me. Without his loving kindness, I would not have survived to write this book. I will be forever grateful to him and his wife, Polly.

I am grateful to and thank Mount Sinai Hospital and the Kidney Transplant Center in New York City. Without the dedication of Drs. Ron Shapiro, Antonios Arvelakis, Rafael Khaim, and Veronica Delaney, and all of the staff at Mount Sinai Hospital I would not be here today. These doctors and their staff not only saved my life but were exceptionally kind and caring as well.

Special acknowledgement and thanks are also given to the wonderful people at Renewal who accepted me as a kidney recipient and helped find and support my donor, Dr. Hackney. They are a very special organization who donate their time and efforts to support kidney donations.

Lastly, the most important person in my life and contributor to this book is my wife, M. Ann Penny-Ariel Ph.D. Ann, not only knows the stories and details of my life, but she was able to “translate” my English
into what we hope is an informative and entertaining book. I value her contributions and dedication to this project and for her enduring love for me. I hope she knows how much I love her.
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Dedication

This book is dedicated to three beloved people; without whose influence, I would now be trapped in a black hole rather than fulfilling my dreams:

<table>
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<th>To my childhood hero, Dani Dassa, a creator of Israelis folk dances and my sports instructor at Hadassim. Dani introduced me to the discus, and strengthened my belief, as a child, that I could one day represent Israel in the Olympics. It was only by virtue of my athletic skills that a scholarship for studying in America -- and the infinite possibilities thereafter -- was granted to me. I have never looked back.</th>
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<td>To Yariv Oren (of blessed memory), my mentor and coach who befriended me as a young athlete, who encouraged me to overcome my shyness, and who gave me perhaps the greatest gift of all: self-confidence and hope.</td>
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<td>To Ann Penny, without whom I would never have reached the mountaintop. After 35 years of a creative collaboration, I finally married her, and I found her to be my everlasting joy — Ann Ariel.</td>
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<td>Dr. James Hackney, Professor of Physical Therapy and Biomechanics who saved my life by donating his kidney to me. Without him, this book would never see the light of sun. How do you thank a person like that? How do you thank someone that gave your life?</td>
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Foreword

Why at the age of 77, did I decided to write a memoir of my life? Actually, I started to write this book more than ten years ago, so it has taken me a while to finish it. There are a number of reasons behind my decision to document my life and a few of these reasons are listed below:

If you visit the United States Olympic Training Center in Colorado Springs, CO and ask the staff and administrators who started this beautiful training center, they will come with all different names. But Gideon Ariel will not be mentioned.

Establishing the Olympic Training Center with Tom Brokow
http://arielnet.com/ref/go/901

The Olympic Training Center in Squaw Volley
http://arielnet.com/ref/go/902

If you go to any gym or health club in the US or around the World and ask the trainers and the owners who developed the original machines and then employ cams to vary the resistance, they will mention many names, but Gideon Ariel will not be one of them.
If you go to any store for athletic supplies to buy running shoes and ask who developed the first “Air Shoe” you will hear many names, but Gideon Ariel will not be mentioned.
If you study the field of personal computers and ask who started it all, you will hear many names, but Gideon Ariel will not be included in the list of developers.
If you ask any of the engineers or sales personnel at Spalding, AMF, or Wilson Sporting Goods how the tennis racket developed from the head size of the 1970s into the newer, more modern ones with larger heads, many names will be mentioned but not Gideon Ariel’s.

If you travel to Adidas’ headquarter in Germany and inquire who developed their shoes, many names will be mentioned, but Gideon Ariel will not be one of them.

If you ask the engineers at NASA’s Johnson Space Center in Houston who developed the first Computerized Exercise Machine aboard the shuttles and the space station to prevent the deleterious effects of microgravity on the Astronauts, the name Gideon Ariel will not be mentioned.

**First Biomechanic Study in Space Utilizing High Speed Cameras and Electronic Digitizing - 1979**

![Astronaut running on instrumented treadmill](http://arielnet.com/ref/go/906)

![Technology Courtesy of Ariel Dynamics Inc, San Diego, CA](http://arielnet.com/ref/go/907)

http://arielnet.com/ref/go/908

http://arielnet.com/ref/go/909
If you ask who was the Chairman of Biomechanics was for the U.S. Olympic Committee for eight years, my name will not be included.

The site for the Modern Pentathlon in the Los Angeles Olympics in 1984 was in Coto de Caza. However, if you ask who arranged with that sports body and the LA Olympic Committee for this site to be chosen, no one would mention my name.
If you asked who adopted the Women Volleyball team and arranged for their residence and support in Coto De Caza for eight years and who went on to win the Silver Medal at the 1984 Olympics, you would find out in this book.
If you ask who had the patent for the Variable Resistance Device on the Universal Exercise Equipment, no one will know. It was me.


If you ask who developed the first Computerized Exercise Equipment, few people will know the answer. You will discover that I invented this system.

If you wanted to know who researched the first and, maybe the only studies, of the effect of Anabolic Steroids on Olympic athletes, you would find it in the *Journal of Applied Physiology* in 1972. I was the researcher and the paper’s author. 

![Image of effect of anabolic steroids on reflex components]

I was involved in many projects which readers of this book will discover in detail. Making a statement is easy and may even sound like a loud-mouthed braggadocio, but I have included documents and pictures to verify all these statements.

This book is unique since you can read many of the statements, studies, and publication in their entirety on your computer or tablet by following the URLs that are included in the text or under illustrations. Alternatively, by downloading a free QR reader, you can use your cell phone or tablet to capture a QR and read the complete material.

In many cases, I have used internet resources such as Wikipedia or Google search to locate information to supplement my own knowledge. For example, in the Chapter about NASA, I reported on the research with which I was personally involved. However, I utilized internet sources to supplement much of the information about the individual Astronauts. For many of the technical items, such as computer components, and for physical phenomenon such as force, velocity, and acceleration, I enhanced the information in my text with additional data which were gleaned from internet searches. Numerous television shows or documentaries about me or my company are also available. Many of these have been included via links to the internet. The intension with these resources was to better inform the reader with supplemental knowledge. The entire book and resources are included on a Flat USB card attached to the inside cover of this book.

I intended this book to be my memories and accomplishments. However, I wanted the reader to have as complete an understanding of topics or people by providing additional information about them. My intentions of including these additional resources and information were not to mislead or plagiarize but, rather, to enhance other people and their accomplishments.
However, one of the most important reasons I wrote this book was so my daughters, Tova, Nomi, and Ilana, could learn what their Daddy did during his lifetime. Since they are still relatively young, they are unaware of many of the things that their father accomplished. Perhaps this book will enlighten them about my life and achievements and they can be proud to be my daughters.
Introduction

If you want to run faster, throw farther or jump higher, call on this electronic mastermind, who will photograph you in action, digitize the moving parts of your body and feed the data into a computer, which in turn will spew out reams of athletic advice no human authority can provide by Kenny Moore, Sports Illustrated.

What a crazy title for a book. How do sports and fantasy share the same planet let alone merge into a book? It is easy for me to tell you because this is all about me – I am that discus thrower and my mind is that factory where all those dreams were created. To explain, you should know that with one sailing, floating throw off a discus in a single competitive event propelled me to become the successful person that I am today. Throwing the discus saved me from a life as a juvenile delinquent and one fantastic
victorious throw set me on the path to becoming the world, renowned biomechanist and operate my own dream factory.

In 2012 I received the highest award in Biomechanics as you read below:

The Geoffrey Dyson Recipient for 2012

http://arielnet.com/ref/go/1015

The recipient of the Geoffrey Dyson Award for the ISBS2012 Conference will be Dr. Gideon Ariel. Gideon is a well-known in the field of sports biomechanics, due to his extensive knowledge of how physics applies to human motion, as well as his expertise in computer science. He is a former Olympic Athlete, and completed his graduate and post-doctoral work at the University of Massachusetts, where he received a Ph.D. in Exercise and Computer Science. He has published numerous scientific papers, founded an independent laboratory devoted to biomechanical research relating to human performance, and was chairman of the U.S. Olympic Biomechanical Committee.
My special discus result sent me to the Rome Olympics in 1960. From there, it is as though the discus threw me to America, the land of dreams. Once I reached the great, vast, vistas that the United States offered someone like me, a young simple athlete from a tiny country, my horizons were limitless. Suddenly, that discus throw which had launched me into the world where dreams can come true, life became full of opportunities without end. No longer was I perceived as a skinny, shy, young boy who would probably never succeed. Now, I had been an Olympic competitor. There were no limitations to what one could learn or do in the magnificent land of dreams.

My first big dream grew from a seemingly miraculous discovery I made while in Graduate School. I learned that human motion could be scientifically measured. It was possible to combine the mechanics of Isaac Newton with the biology of people. What a fabulous tool! This dream of mine was no longer just a bubble on a wish list. Suddenly, I realized that a Coach could assist a discus thrower without looking where the discus landed. The combination of scientific quantification and the rapid processing of the computer meant that sporting activities could be assessed accurately and quickly. The concept was mind-boggling and floated on the air almost more as a mirage than just a dream. Could such dream really come true?

The answer resided in the sophisticated computer programming that I developed. The enhancements of sports techniques and performance analysis knew no bounds. “If it moves, it can be measured,” became a legitimate mantra. So, what could I do with this marvelous, newly computerized analysis system? In America, anything is possible. So, I created a company.

http://arielnet.com/ref/go/1016
Surprisingly for me, before we opened our office doors for the first time, we were swamped with projects. We had sporting goods companies clamoring for design assistance with golf balls and clubs, basketball structure and color designs, tennis balls and rackets, and ski boot release mechanisms. Owners of horses asked how to select the special yearling that would grow up to win the Kentucky Derby. A Shoe company sought help with athletic performance shoes, while another company wanted to improve their line of nursing and surgical shoes. These studies led my dream factory brain to invent an air shoe in 1974.

NASA posed many questions regarding performance and equipment needs for work in micro-gravity. How should astronaut suits be designed, what could be done to reduce or eliminate bone loss, and were there exercises and equipment for use in Space?

The list of applications seemed virtually endless. We worked on air bags for car safety, contributed to the development of prosthetic joints, performed forensic analysis in legal cases, and provided information for personal hygiene products as well as for baby diaper design.

My sophisticated analytic program grew and morphed into bigger and better dreams. Not just my dreams, but for everyone who worked with them. My dream factory, like the Sorcerer’s Apprentice, gave birth to more ideas, concepts, and dreams.

Our extensive work in NASA required me to fly on the KC-135 Zero Gravity plan.

Eventually, the U.S. Olympic Committee followed my recommendation to emulate the East German model for training athletes, without the drugs, of course. We established the first Center in Squaw Valley, CA, and then moved it to a large facility in Colorado Springs, CO, where it continues today.

After I had developed my dream to quantify movement, I wondered whether it would be possible to use the computer to train my muscles. Needless to say, the answer was “Yes” and what a fantastic device it is. The Computerized Exercise System (CES) is currently used to train athletes, rehabilitate injuries, and develop strength. Soon you will learn more about that big dream.

Dreams have no boundaries if you follow them. Imagination, luck, and hard work are necessary ingredients for success. But, if your mind bubbles, creates, and breathes life into dreams, then dreams can become real. The mind is the factory, which forges the dreams.

All these dreams would not be possible without my friend and wife, Dr. M. Ann Penny-Ariel.
Performance starts in the nervous system and propagates outward

MUSCULAR & NEURAL CONTROL IN SPORT

When athletes mention their physical goals, they're usually content to say that they would like to do their best—in incorporate their maximum speed, strength, endurance, and skill into the performance. Athletics can be likened to a spectrum. On one end are the explosive events such as throwing, jumping, sprinting, and weightlifting.

On the other end are the aesthetic events such as gymnastics, diving, and figure-skating, where success depends upon the ability to create movements pleasing to the judges.

In the middle of the spectrum are the endurance events, in which the athlete attempts to maintain muscular contractions at submaximal intensity levels for long periods of time.

In between these extremes are the events which require the athlete to repeatedly shoot or hit a target with a high level of consistency and accuracy.

Team sports incorporate many overlapping characteristics. The football player, for example, needs explosiveness, endurance, and accuracy.

The common denominator for all athletic activity is movement: the elementary requirements of which are the muscles and a signaling system that makes the muscles contract in an orderly fashion. (For an analysis of movement, see my article in last month's Scholastic Coach.) Athletic performance consists of many combinations of electro-chemical processes. The science which measures the resulting actions is called "biomechanics": the "bio" part perhaps more properly falls within the area of biology known as physiology—which deals with the functioning of living organisms or their parts.

The building frames of the body are the bones, which are joined by connective tissue known as ligaments and tendons. Bones have no power to move, however. Like the frame of an automobile, they provide the basic structure upon which the body or the engine which supplies the power to move, rests.

It is the 600 muscles of the body, accounting for about 40% of the total weight, which do the work. And it is these forces that constitute the "mechanical" portion of "biomechanics."

Muscles are made to contract by signals from the central nervous system. But the muscles do not respond unless they receive the appropriate stimulation—and they require a given signal every time they are expected to perform.

Muscular contraction causes the joint angles to change, according to the coordination of the varying amounts of tension produced in the individual fibers. Individual cadres of these muscles surround the various joints and control the segments so that the body's actions are like a mechanical link system moved by reciprocating engines.

This intricate arrangement of bones, muscles, and neural control accounts for all muscular activities.

Performance starts in the nervous system (or in stimuli that cause activity in the nervous system) and propagates outward from there according to physical laws of cause and effect.

N.A. Bernstein in 1915 compared the workings of this human machine to a symphony orchestra:

Each instrument plays its individual score. So, in the act of walking, each joint reproduces in its own curve of movement, and each center of gravity in sequence of accelerations, each muscle produces its melody of efforts, all with regularity changing but stable details, and in like manner the whole of this ensemble acts in union with a single and complete rhythm, having the whole enormous complexity into a clear and harmonic simplicity. The conductor and manager of the complex entity—the conductor and at the same time composer of the analyzed score—is, of course, the central nervous system.

In the 1700s, Galvani saw that frog muscles contracted when electrically

http://arielnet.com/ref/go/1023
Please note, this book does refer to a few religious contents, the following is an explanation of why G-d is written the way it is.

Jews never casually write any “Name of G-d.” This practice is not part of the commandment not to take the Lord’s Name in vain, as many assume. The thought behind this is that the commandment refers solely to taking that name in vain, or swearing by G-d’s Name.

Judaism does not prohibit writing the Name of G-d but does prohibit only erasing or defacing a Name of G-d. In response, many Jews try to avoid writing any Name of G-d, or avoid it completely, because of the risk of writing the Name may later be defaced, obliterated, or destroyed accidentally or someone else.

http://arielnet.com/ref/go/1024

Call him a man in motion

Editor’s note: “Who’s That?” is a weekly feature in which we profile local people with interesting jobs, hobbies or personalities.

Name: Dr. Gideon Ariel
Home: Coto de Caza
Age: 64
Biome: Tel Aviv, Israel Occupation: founder and CEO, Ariel Dynamics, Inc.

Picture teennis star Andre Agassi’s backhand, and you’ll likely envision a bold swing with the most dangerous serve return in the game. When Dr. Gideon Ariel shows Agassi’s trademark swing on a computer, it comes up in a complex graph of forces, velocity and acceleration.

Next, he pulls up a moving stick figure representing the very same swing, followed by actual footage of Agassi. If all goes well, he looks at an athlete in motion.

Ariel is one of the world’s leading experts in biomechanics, a field that applies the laws of physics to body movement. In 1958, he invented the first computerized system to analyze the performance of Olympic athletes, such as the motion and position of a discus thrower's body and sex.

Since then he founded Ariel Dynamics to develop products based on his work. Of the company’s 31 patents, one is a variable resistance, the basis for modern exercise equipment.

Ariel first began writing software to analyze human movement at the University of Massachusetts, Amherst, where he completed his graduate and post-doctoral studies. He got help from a fellow graduate student named Anne Henny, his romantic partner for 36 years now.

He switched events in 1979 to work with tennis instructor Vic Braden, whose prestigious tennis college and research center drew world-class athletes to Coto de Caza. In 1984, an influenza of the U.S. Olympic Biomechanical Committee, Ariel was instrumental in bringing the modern paradigm to Coto during the Los Angeles Games.

When the Coto Research Center was preparing to shut its doors in the late 80s, Ariel bought two houses in Coto, one next door to the other. His calls one home and runs his company out of the other.

He also travels a lot. Two weeks ago he was in South Africa, overseeing the opening of an innovative sports research center. It was here, in a gymnasium surrounded by lions and elephants, that he finally proposed to Anne. They plan to marry in October. A former Olympic athlete, Ariel said he plans to go to Athens this summer for the Olympics.

You were a discuss thrower and short-putter for Israel’s Olympic team. What brought you to the United States?

At the 1996 Olympics in Atlanta, a coach from the United States approached me and offered me a scholarship to the University of Wyoming. But I had to enlist in the Israeli army. After three years of service, I sent him a letter saying “Do you remember me? Are you still interested?” I got back an envelope with a letter... no letter or nothing. I told my friends I got a scholarship in the highest university in the U.S. because the elevation of the school was 7,200 feet.

What’s your company working on these days?

Basically, we’re selling software to analyze movement in many different fields. Lots of orthopedic surgeons use my software to monitor recovery from surgery. At the Olympic Training Center in San Diego, they’re using my software to analyze athletic performance. Our software has been used to analyze the golf swing of Tiger Woods.

One of the biggest things we’re doing now is workers’ compensation. Anyone can say they have a pain in their neck. We have software where if you really have a pain, there will be some sort of feedback in our graphs. If you’re a boss telling the truth, the insurance companies can tell, and we’re still designing exercises.
Dr. Gideon Ariel and his wife Dr. M. Ann Penny Ariel

http://arielnet.com/ref/go/1026
And now, the end is near
And so I face the final curtain
My friend, I'll say it clear
I'll state my case, of which I'm certain

I've lived a life that's full
I've traveled each and every highway
But more, much more than this
I did it my way

Regrets, I've had a few
But then again, too few to mention
I did what I had to do
And saw it through without exemption

I planned each charted course
Each careful step along the byway
And more, much more than this
I did it my way

Yes, there were times, I'm sure you knew
When I bit off more than I could chew
But through it all, when there was doubt
I ate it up and spit it out
I faced it all and I stood tall
And did it my way

I've loved, I've laughed and cried
I've had my fill my share of losing
And now, as tears subside
I find it all so amusing

To think I did all that
And may I say - not in a shy way
Oh no, oh no, not me
I did it my way

For what is a man, what has he got
If not himself, then he has naught
To say the things he truly feels
And not the words of one who kneels
The record shows I took the blows
And did it my way

Yes, it was my way
http://arielnet.com/ref/go/2001
Chapter 1: Family

I cannot say what my first childhood recollections are. I remember living in a small apartment in Tel Aviv and my family life was simply as people in Israel experienced at that time. We had a small kitchen, a tiny living room, and a small balcony with a few flowers. My mother worked full time as a secretary to the mayor of Tel Aviv. My father was the head of customs at the Jaffa port perhaps because of his fluency in seven languages, including English, since these were the days of the British mandate when the country was called “Palestine”.

My father, Moshe, was born in Poland in 1904. His father was a Rabbi but supported the family as a shoemaker. When Moshe was born, his parents were older and had thought their childbearing years had ended long before his birth. He was essentially raised as an only child, since most of his siblings had either died or moved away. Based on his subsequent behavior, towards my mother and me, I believe he must have observed and experienced both physical and emotional abuse. Years later, my cousin, Yaakov, told me that our grandmother was very strict, stern, and never smiled. Yaakov was a few years older than I was and he told me that he was scared of her. Perhaps he experienced the same emotions when he was young since our grandmother was my father’s mother. Throughout his life, I observed a man whose emotions were bottled up within him and who never learned how to appropriately release them.

![My Father, Moshe](image)

Moshe was extremely intelligent and excelled in all academic subjects, as well as artistically, mainly through his drawings. His exceptional intelligence was somewhat of a disadvantage for him in his youth. Because of his academic prowess, he was sent to the Gentile high school, called Gymnasium. Here, he was accosted and beaten regularly by the Gentile kids because he was Jewish, and then received the same treatment from the Jewish kids for attending a Gentile school. He never told me stories about
the kind of home life he experienced in Poland, but I suspect that it was not a particularly kind environment.

Some of the pictures he drew when he was 10 and 12 years’ old
In 1922, his parents sent him to the Holy Land – Israel. At that time, the country was ruled by the British and was known as “Palestine.” At that time, all ships arrived at the port of Jaffa, which is one of the oldest ports in the ancient world, and the only port for Palestine. While my father was traveling the relatively short distance from the landing dock to a hotel, he was attacked by thieves, who beat him and stole all of his possessions.
Luckily, someone helped him with food, clothes, and lodging. Life in Israel was quite difficult at that time in the nation’s history. The land was barren in many places and Tel Aviv was not the modern hustling and bustling city that it is today. My father joined the British Army shortly after arriving in Israel because it was a job.
My Father in the British Army

http://arielnet.com/ref/go/1028
Shortly after his Army service, life improved for him when he was hired as a busboy at a hotel in Jerusalem. At the hotel, he quickly improved his position because of his command of many languages and his ability to manage financial transactions.

Not long after starting his work at the hotel, he became acquainted with many of the British military personnel who resided there. At that time, the British controlled the activities at the port in Jaffa. Whether it was his command of English, Hebrew, and Arabic or because he was so skilled with math, he was offered a job in the Customs department at the Jaffa Port. My father’s primary responsibilities at the port were processing inbound freight so a command of both English, Hebrew, and Arabic was essential. He was also frequently called to assist with passengers arriving by ship who only spoke French, Yiddish, Polish or Russian. His language skills were clearly an asset.

My mother was a gentle, pretty, kind woman. She was born in Jerusalem to parents who were of Russian and German backgrounds. She had attended a seminary and received a teaching certificate for elementary school. I do not know, but I assume that her marriage to my father had been arranged since that was the custom of the time. What I mostly remember was her kindness and love for me. She took me to the ocean which was a short walk from our apartment. We would spend the day there while I built sand forts and played in the ocean. We would go to the park where I could play with other children. She prepared all of my favorite foods. Because of her teaching background, she had many children books which she read to me. I loved her very much and I know she loved me as well.
My Father and I, around 2 years’ old

My Mother and me few months’ old

http://arielnet.com/ref/go/1029
Unfortunately, my father was a tyrant. Many times I witnessed my father verbally and physically abusing my mother. She seemed to never be able to please him. He complained about everything from her cooking to how she cleaned the apartment. Nothing was to his liking. Since they argued in Yiddish and I only understood Hebrew, his complaints confused me as well. My father was ferocious towards me as well. It seemed that neither my mother nor I could anything that pleased him. He was always angry and expressed this with physical and emotional abuse.
Both of my parents worked, so they were gone during the day, my mother was a secretary and my father worked in the Customs at the port. The Jaffa port turned out to be an excellent posting for someone who was charged with assisting the Israel underground or resistance, who at that time were trying to create a Jewish State. I later learned that my sullen, angry, detached father was part of the Stern Gang, a violent group opposed to the British rule. This group, like others, shared the aspiration that Palestine would again be the Jewish homeland.
Trip from Jaffa to Tel Aviv 1922

The Jaffa Port
http://arielnet.com/ref/go/3016
It was a surprise for me to discover this detail about my father. Actually, it was quite by accident that I learned about his nationalistic sympathies. I was with him at the port one day when I was still a young child, and with my natural curiosity, began opening drawers, doors, and closets in search of a treasure or a toy. Imagine my surprise when I found some amazing oblong rigid pineapples and assumed they must be toys of some kind.

Most of the oblong pineapples were made up of Jaffa, it is true, but it must be remembered that they came from different parts of the world. The Jews from Turkey and Persia, the Jew from Poland, Russia, the Jew from America, British, the Jew from Russia, British, French, etc., were all regarded with suspicion. Differences in language led to differences of opinion. One group felt the superior of another. That is all I know. I only know that they were one group, guided by one purpose and one destiny.

"There is much that is hopeful in the young Palestine of today. My impressions of historic Palestine were not as happy, however. All the historic monuments are in the hands of the people. The site of Solomon's Temple, the traditional Mount Moriah, the famous Dome of the Rock. The promised land of the Hebrews is in a mosque at Jerusalem, and a Jew is only permitted to enter his land in a crevice—for a convenience. The Church of the Holy Sepulchre is the first of the Christian churches, and still the last temple enthroned on the Temple area. Now they still stand their temple in a mosque on Friday morning.

"But this discrimination is being removed, because it makes no more sense than the belief that all the oblong pineapples are kept by the Church and the Crescent. To the whole world, perhaps, that has been the case. It is associated with the title of one man—a Jesus or a Mohammed—but with a knowledge of the history of Palestine. Churches and mosques would have to be stipulated in the way they were not stipulated in the way they are now.
contraband and notify my father to “clear” the shipment. I later learned that the shipments were “signed for and received by” a delivery agent known as “Gideon Ariel.” The British could have hanged my father as a traitor for smuggling these weapons. I had never thought of my father as being a nationalistic underground fighter. His violent nature was obvious to his immediate family, but his working demeanor was clearly controlled and sophisticated.

Family life at home was terrible. My mother seemed to infuriate my father for reasons I could not understand, since a young boy frequently does not understand most adult issues particularly when the arguments are in an incomparable language. My father worked all week at the Customs Office, but when he came home or stayed home on the weekends, our exchanges were usually accompanied by abusive words or brutal smacks to my face or body.

My father’s anger confused and puzzled me then as it does until today. I knew that he loved me. His love towards me was never a doubt, but, for some unfathomable reason, he was unable to express his love in a way that I could recognize. The same held true for my mother. Undoubtedly, he loved her, but was not able to demonstrate this affection appropriately. Maybe he was inhibited, overwhelmed by family life, or merely lacked any comprehension of what he was supposed to do in this situation.

I knew my father had grown up surrounded by education. At that time, most pupils completed their education after tenth grade. He had received an exceptional education as a child in Poland since he had attended the Gymnasium for an additional two years of study. In addition to my father’s talent for languages, he was also reputed to be a gifted painter. I heard people throughout the neighborhood talk about his drawing talent.

In 1948, after Israel was declared a State, my father obtained a new position as an accountant. But his behavior was the same as it had been when he had worked for the Customs. I will never know what so bedeviled my father because he never spoke about such things. Israel, at that time, was full of people who could only lash out. There were those, of course, who turned their sadness into ferocious wit or goodness. But many people were marked by unspeakable memories of their own, or of those they loved. There is a theory that what you saw, heard, and experienced in your own childhood is what you repeat when you become an adult. In our more modern era, I think there would have been groups or government agencies, which would have intervened to help my family situation. Anger management, marriage counseling, and child-rearing assistance were all areas in which my family needed help. Sadly, for my mother and I, as well as, for my lost and confused father, such help did not exist at that time.

My mother continued working every day and I went to school. Although I was in fourth grade that year, my emotions and though processing were elsewhere. I was traumatized by my family situation. The school system was that students stayed in the same room and the teachers changed according to their specialty. Unfortunately, I “escaped” my family trauma during the lessons at school through imagination and day dreaming. For example, if the history teacher described an event which occurred in ancient times between the Greeks and the Persians, I sat in my school seat and imagined those events. I would develop complex war strategies or imagined conversations between Alexander the Great and his lieutenants. Suddenly, the teacher would call my name and I would be jerked back into the present day class without a clue about what had been discussed after the Alexander comment. However, the teachers never knew where my mind had been when then had been discussing other topics. I had been mentally absent during the intervening discussions. Therefore, when the question was posed to me and I appeared in a daze, the assumption was that I was stupid. Invariably, the teacher would embarrass or ridicule me for not knowing the answer to the question.

I played these mental games in my mind during most of my classes. Many other days, I skipped school and went to the beach instead. There I would construct complex forts and spend time in elaborate “war” games between imaginary groups. My grades suffered but none of the teachers ever took the time or made the effort to learn why a bright student was failing so badly. In retrospect, I suspect that if one or more of the teachers had worked with me on an individual basis, they would have discovered that I
had an excellent intellect but was in terrible emotional turmoil. I needed loving care and attention rather than ridicule and humiliation. Unfortunately, none of the teachers gave me this necessary help. At the end of the school year, rather than advancing to the fifth grade, I was given a failing grade. I would have to repeat fourth grade.

My father was so physically and emotionally abusive to my mother that she eventually turned to others for solace. These events eventually would create such a huge dent in my parents’ marriage. The situation was so unbearable for my parents that they divorced. I was ten years old at the time.

Divorce, of course, is never easy for anyone especially the children. Unfortunately, at that time in Israeli society, divorce was considered a scandalous act. It was so unforgivable that many parents forbade their children, my friends until then, from playing with me because of my parents’ divorce. What a dreadful situation for a young child to have to experience. First, violence at home, followed by confusion after the divorce, and then the loss of companionship. I had no one to talk to or with whom I could play. It was unfortunate that the weakest and most vulnerable, the children, should be doomed with sharing the terrible burden of divorce. Not only had I lost my family, but now I had also lost my friends. Needless to say, school life was worse than ever. I was considered by the children in the school to be a dummy since I was repeating fourth grade. My classmates were younger than I was which was another mismatch. As my family life had spiraled out of control, my school life deteriorated as well.

Mother and I stayed in the same apartment and my father moved elsewhere. It was traumatic for both of us. My father came to the apartment every day, stood downstairs and shouted my name. He prepared food for both of us but he made me come downstairs to get it so that he and my mother could avoid each other. In retrospect, this was a remarkable thing for him to do. He usually brought meat, vegetables, and milk they must have been obtained on the black market since food was rationed at that time. I never understood things that my father did, but acquiring, preparing, and bringing food to his family was an amazing thing to do.

My mother apparently continued to search for love. I was oblivious to these adult activities at that time. When her friend dropped by the apartment for a visit, I was usually sent on an important errand. Many times, I was given a few shekels to buy candy for myself.

Eventually, my natural curiosity rose and, on one occasion, instead of leaving, I hid in a closet. I peeked through a crack in the door and watched what they were doing. This was my first vision of sex, and although I did not understand what was transpiring, I knew it was something she was not supposed to do.

Eventually, my mother became pregnant. I came to understand that the man was already married and was going to take responsibility for the baby. My mother gave birth to a daughter, Nitza. Many years later, I learned that my father had gone to the hospital and put his name on the birth certificate, despite the fact that he was not the biological father, so that this innocent little girl would not be born without a father. This was another act which was unbelievably kind from a man who had so much difficulty in showing a softer side.

After she came home from the hospital, it was the three of us, my mother, the baby, and me, living together in the apartment. Imagine, at the age of ten, I was the man of the house.

Life went on with my mother tending to the baby and I. One day an ambulance came to the street, and to a young boy, this was very exciting. It was thrilling, until two uniformed men entered our apartment and forcibly removed my mother. My mother screamed and resisted this attack, but she was much too small and weak to fight two strong men. I stood at the door watching, crying and was left holding the baby. Some of the neighbors helped me with Nitza and with food.
but I did not understand what had happened nor why. All that I knew was that my mother had been taken away and Nitza and I were alone. I have no recollection of how many days and nights we spent alone, however, I do remember how frighten I was, especially at night. I did my best to conceal my fear from my sister, and to this day, I am not sure if she knew of the perils we faced on a daily basis.

About a month after my mother was taken away, two women had appeared at the apartment. They took my little sister away with them and would not tell anything other than that she would be kept safe. I tried to stop them, but a small boy was no match for two grown women. Now I was alone in the apartment with no mother, no sister, and no one to help me or explain what and why these events had happened. I was confused and scared by resolute to wait for my mother to return.

Finally, my father came and took me to his apartment which was in another part of Tel Aviv. When the door opened, I was stunned. Usually, when a neighbor would come by with food, or simply to look in on us, there would be a knock on the door. The only thing I can remember is asking him, “Where is my mother?” over and over again.

“She is in a hospital,” he finally answered. I didn’t know what that meant, but at least, he offered an answer.

“Where is Nitza?” I asked.

“I do not know, exactly, but I have been told that she is being cared for by loving people” was his answer. Now I had some information about my mother and sister.

Everything was so confusing to me at the time. I was in shock but had no information to consider or question. I had no idea what to ask and just retreated into my normal shell of quiet and confusion. My father told me that things would be a little different, for a while, and that I would live with him. No one would tell anything about my sister. Many years later I learned that an engineer, who was most probably her biological father and his wife, adopted Nitza from an orphanage when she was about six years old.

I constantly asked my father about my mother. Where was she? Why does she not come home? When can I see her? I was relentless with these questions to my father. Finally, my father told me the name and location of the hospital where she had been taken. After considerable pleading with my father, he gave the fare to catch a bus to go visit with her. I took the bus, by myself, to the hospital.

I recall following a nurse to a room where my mother was sitting. I wanted to understand what was going on. How could she be taken away from me like this? I was escorted to a large room and there was my mother. She was very happy to see me, held my hand, and asked me about school. I was confused about why she was there and what was happening. Her hair was messy and she had trouble concentrating. She would ask me the same questions, repeatedly. Eventually, a nurse announced to the whole room that visiting hours were over and we all had to leave. The nurse asked me to accompany her to her office probably because I was crying.

She was very nice and gentle with me. Clearly, she recognized that I was a vulnerable young boy, scared and with no idea what was happening or what I should do. The nurse told that my mother was quite ill and might be in the hospital for a long time. She explained that every human being was like a glass of water. Sometimes, the glass is too full and the water spills over the top edge. When this happens, they have to go to the hospital. This is what had happened to my mother. The nurse tenderly held my hand and told me that I needed to focused on my school work and to grow up to be a good boy. She told me not worry and about my mother and her illness. Otherwise, this obsession could make me sick as well. The nurse assured me that the hospital would take very good care of my mother, so I need not worry about her care. I left the hospital not knowing any more than when I had arrived about my mother’s
condition. At least, I had been able to see her and hold her hand for a few short minutes. My tears were many, but short lived as the winds of change continued in my life.

Now, I lived alone with my father. I had always been a curious child, and that created many problems and broken things. My mother had chalked up these accidents to the rambunctiousness of boys and ignored most of my behavior. My father, on the other hand, was very proper and neat. He had no experience with a boy who investigated the insides of a watch and then could not put it back together. Also, he did not like the messiness of collecting turtles, silk worms, and lizards.

In retrospect, I cannot imagine the difficulty my father must have experienced as his life and mine continued to spiral out of control. His wife was gone, and his son was difficult. It was not until fifty years later that I learned how deeply he had loved both of us but had been incapable of expressing that love. At that time, however, he was working full time, while I was wreaking havoc whenever and wherever I could. I did poorly at school, was truant many days, and was on the path to becoming a juvenile delinquent.

Not all of my activities were destructive, I delivered roses for money for one of the local florists. I would deliver a bouquet of flowers—utilizing my youth, good looks, and charm—and I frequently received a nice tip. At the same time, I was already becoming an entrepreneur since I usually kept one rose for myself. By the end of the day after delivering many bouquets, I had acquired a good supply of roses which I then sold for half price! I knew what I was doing was wrong, but I had observed that no one ever counted the flowers in the bouquets which I delivered to them. Today, I am embarrassed to admit to being a thief, but at that time, it seemed to be a creative way to supplement my tips.

Even though I was busy with my extracurricular activities, emotions of sadness began to take their toll, and I continued to do poorly at school. None of my teachers at school recognized my anguish and family difficulties. If I were daydreaming, instead of listening, the teacher would insult and ridicule my incorrect response to her question. There were never any words to encourage me, no extra help after class, or sympathetic understanding. Often, I skipped school altogether, preferring to build sand forts at the beach. This truancy led to skipped classes and failed tests.

In Israel, where academics are prized above everything, this was unforgivable. I was classified as a truant, a loser, possibly as crazy as my mother. None of the parents in the neighborhood would let their children interact with me. My father was, now, even more frustrated with me and told everyone, in front of me, that I was “lo utsloch” which in Hebrew meant that I was unsuccessful now and would continue to fail in the future unless I changed my behavior. He could not cope and was at a complete loss about what to do. He could not work full time and care for a young boy.

One of my family members that cared about me was my cousin, Miriam. Miriam was the daughter of my father’s sister, Bracha. She would often take me to the Yarkon River in Tel Aviv and I remember the thrill of riding with her on a boat. Miriam also took me fishing in the Yarkon River. It was a thrill for me, using my bamboo pole and line, to catch a fish. Of course, I always released the fish but, none the less, it was a great adventure for me. Miriam and I always had such fun together despite her being older than I was.

Sadly, if my father had looked more closely, he might have seen the burgeoning signs of a future. I loved to go to the arcades at the Tel Aviv beach and play with the mechanical machines. I took apart radios and watches and spent many pleasant hours fixing my round of endless bikes. Another of my entrepreneurial endeavors was fixing other people’s bicycles. What my father failed to see was my skill and fascination with mechanical things.

My upstairs neighbor was a young girl who had been adopted by her family after the European catastrophe. The adults were older and physically unable to properly raise and care for a young girl. They had sent her to a residential school north of Tel Aviv. I suspect they must have spoken to my father about me. I believe they are the ones who suggested to my father “Why not send Gideon to Hadassim?”
Hadassim was the small, rural residential school. It was an easy bus ride from Tel Aviv, so one day, my father visited the school. I can only guess what the conversation was like between my father and the administrator. As usually, my father made all of the decisions without discussing the idea with me. As time would reveal, my life would be completely turned from the negativity that it was, into a force of positiveness. The dean at Hadassim was quite willing and eager to accept me.

When my father told me that I was going to go to Hadassim, a residential school, rather than live with him, I was surprised and slightly confused. I was not enamored with the thought of “going away to school” as would be the expected response of most young children. My father never tried to sell me on the idea, it was more of a matter of fact, “You are going son, it is what is best for you.” At this age, there was little I could say or do, so off I went.
Chapter 2: Hadassim

From the moment I arrived at Hadassim, a scared and traumatized child, my world became brighter and my life blossomed into a garden of growth, happiness, and dreams.

The WIZO-Hadassim School Village, where I was sent, was a small collection of buildings near the town of Netanya, just north of Tel Aviv. It had been specifically created to educate traumatized children. One question that the Hadassah-WIZO Canada organization had wrestled with before the conclusion of World War II was what would happen to all of the Jewish orphans in Europe. One idea was to create special schools and home-like environments in Israel for these anticipated groups of children. The Hadassah-WIZO Canada organization financed the school in 1947 with approximately one million dollars in today’s economy. The school’s main mission was to house, restore, and educate Holocaust orphans. Some of these children had lived ten years in basements, boxes, window-less hiding places, in constant fear, hunger, and frequently without their parents. More than a few of them had witnessed their parents being murdered and a few had been the victims of medical experiments.

These Holocaust children were gathered at a transitional camp for war orphans on the Warburg Estate in Balkanza, which was near Hamburg, Germany. From there, they initially travelled to Paris and then on to Marseilles, France. In Marseilles, they boarded the ship Providence which sailed to what was then Palestine. After a short stay in WIZO-Achuzat Yeladim on Mt Carmel in Haifa, they boarded a train and arrived at Hadassim, in 1947. These were Hadassim’s first students and were mainly fourth, fifth, and sixth grade students.

Before these war orphans arrived, A WIZO general council in Jerusalem had decided these children should not be segregated from normal society and, therefore, other children were to be allowed to attend the school. Some of these other students
would be traumatized kids from homes with family problems. The problems could be divorce, as in my case, or where one of the parents had died and the surviving parent was unable to work and also care for the child. In addition, to balance the learning and emotional experiences for everyone, some children of diplomats and those from more financially privileged families were matriculated amongst the general population of the school. The idea from the WIZO general council was to integrate these disparate groups into an environment for academic learning as well as providing an environment to nurture emotional healing.

[Image of a landscape]

Hadassim
http://arielnet.com/ref/go/1036
http://arielnet.com/ref/go/1037
My own journey to Hadassim was from the second group, the traumatized. My parents were divorced and my father experienced numerous difficulties trying to care for me and having to work a full-time job. It was his decision to send me to Hadassim, since he believed that I would be cared for and educated in a better environment than he could provide for me living alone with him in Tel Aviv.

Hadassim was run as a kibbutz which is a collective community in Israel that was traditionally based on agriculture. Kibbutzim (plural for “kibbutz”) began as utopian communities and were a combination of socialism and Zionism.

The Hadassim dancers comprised one of the most accomplished dance troupes in Israel, during the 1950s. Students from Hadassim also achieved Israeli records in athletics and represented Israel in the Olympics Games. Each student at Hadassim pursued what was interesting to that individual. Some danced, others wrote stories or poems, many were interested in politics or scientific pursuit.

The first Kibbutz, established in 1909, was Degania. The members had emigrated to Palestine and wanted to be farmers. At that time, prior to World War I, the Ottoman Empire ruled Palestine. These early settlers/farmers were faced with was a harsh environment. The Galilee was swampy, the Judean Mountains rocky, and in the south of the country, the Negev, was a desert. To make things more challenging, most of the settlers had no prior farming experience.

The sanitary conditions were also poor. Malaria, typhus, and cholera were rampant. Bedouins would raid farms and settled areas. Sabotage of irrigation canals and burning of crops were also common.
Living collectively was simply the most logical way to be secure in an unwelcoming land. On top of safety considerations, establishing a farm was a capital-intensive project. However, collectively, the founders of the kibbutzim had the resources to establish something lasting, while independently they did not.

The fall of the Ottoman Empire at the end of World War I, followed by the arrival of the British, brought with it benefits for the Jewish community of Palestine and its kibbutzim. The Ottoman authorities had made immigration to Palestine difficult and restricted land purchases. Rising antisemitism forced many Jews to flee Eastern Europe. To escape the pogroms, tens of thousands of Russian Jews immigrated to Palestine in the early 1920s.

Zionist Jewish youth movements flourished in the 1920s, from right-wing movements to left-wing socialist groups. In contrast to those who came previously, these youth group members had some agricultural training before embarking. Members of the second and third waves of emigrants were also less likely to be Russian, since emigration from Russia was closed off after the Russian Revolution. European Jews who settled on kibbutzim between the World Wars were from other countries in Eastern Europe, including Germany.

In the early days, communal meetings were limited to practical matters, but in the 1920s and 1930s, they became more informal. Instead of meeting in the dining room, the group would sit around a campfire. Rather than reading minutes, the session would begin with a group dance.

The operational strategy for us at Hadassim was that of a traditional kibbutz. Each one of us participated in all activities. Students and teachers worked together in all areas. We had tasks to maintain the school and to keep our dorm rooms clean. We helped with the food production and farming jobs. In addition, we had to study and complete our lessons.

In the early years, there were few amenities such as no hot water, as well as no heat or air conditioning in the room, food was rationed at the time. However, the most important thing that we had at Hadassim was each other and the belief that we could become anything or anyone we wanted to be. There was never a hint or suggestion that we were damaged or deficient in any way. We were raised with the diametrically opposite concept – we were wonderful people in a beautiful, loving world.

The philosophy of the school was each child would be nurtured to develop his or her own particular gifts, be they in the humanities, science, sports, or art. Dialogue would be the main way of teaching. There was dialogue with each other and with the teachers.

To inspire the students, and try to alleviate the pain that so many had suffered, nearly every week some distinguished person would come to Hadassim. Many of the world’s finest artists appeared at Hadassim including the violinists, Yasha Heifetz and Yehudi Menuhin, the choreographer Martha Graham and her troupe, the harmonica player Larry Adler, and the comedian Danny Kaye. The students met Eleanor Roosevelt, wife of former U.S. President, Franklin Roosevelt, and with the scientist and the current President of Israel, Professor Chaim Weizmann. The best of Israel’s directors staged plays at Hadassim and the most talented musicians taught music there.

Dialogic concepts, inspired by Martin Buber, who was a secular Jew and believed in discussion rather than conflict or war, led us toward a humanistic, non-militaristic way of life. It should be noted that, although, Hadassim students fought in all of Israel’s wars, none tended to military careers and there were no generals among us. Buber’s belief about discussions rather than conflict apparently was successful, at least with the student graduates of Hadassim.

To know more about the Hadassim concept read my book with Uri Milstein “The Oasis of Dreams.”
The Oasis of Dreams - The Legend of Hadassim

http://arielnet.com/ref/go/1039
Even before I had gone to Hadassim, I was fascinated with exercise, physical strength, and the many ways I could enhance my muscular prowess. Perhaps this was reflective of my age as a young boy developing into a man or a nascent talent. I might have been inspired to emulate the abilities and accomplishments of the Israeli athletics I saw and read about in the newspaper. I remember that one of my heroes was Rafael Halperin, who was “Mr. Israel” and a world champion in professional wrestling.

Before I went to Hadassim, I had found a book among my father’s things called “My System” by J.P. Muller. Müller's book, first published in 1904, was little more than a long, bound pamphlet graced with an image of the Greek athlete Apoxyomenos naked and toweling himself. The exercise guide, which promised that just "15 minutes a day" of prescribed exercises would make "weaklings" into strong men (and women). A friend of mine, Yoram, could read English so he translated the text that appeared around each of the exercises presented in the book. I practiced many of the exercises and read this book repeatedly. I was fascinated by the story of Mr. Muller, who described how un-athletic he had been in his youth and how well developed he became using the exercises described in this book. This book was much more interesting to me than the school books I was supposed to read. I made sure to take the book with me when I went to Hadassim. After I had arrived at Hadassim, I continued to perform each exercise and supplemented them with other ones I devised for myself. I would do these exercises every day, seven days a week to the amazement of my classmates and some of my teachers.

In Hadassim, I continued to be interested and involved with exercise. One day, an American kid, Zvi, joined our grade. Zvi had been sent to Hadassim by his parents, who lived in New York. His parents had gotten a divorce so they sent their son to the dorm school in Israel to learn to be a good Jewish boy. Zvi was a small, skinny boy who was quiet and relatively passive. It was unclear whether this was due to the language barrier or just his natural character. He could not speak Hebrew at that time and I did not know English. However, Zvi was also interested in exercise.

One particular day, a group of us were exercising by lifting a weight consisting of two wheels attached to an axle that had originally been part of an old freight train. A big Israeli boy, Kombor, continually pushed Zvi out of his way. This was a real David and Goliath moment! A big bully...
taunting a little kid. Finally, Zvi had had enough of the bully’s aggression. He lashed out with his arms and legs flying in a whirlwind of motion. It turned out that because Zvi had always been small, his parents had enrolled him in judo, karate, boxing, kickboxing, and self-defense classes in the United States. In what seem like mere seconds, the bully was down and out! We, the onlookers, were more than stunned to have seen this transformation and the unqualified victory of the small, defeating the large. Then Zvi, calmly, extended his hand to help the wounded Kombor to his feet. Thereafter, these two unlikely adversaries became best friends.

One day Zvi gave me a new exercise spring device. The spring exercise device, also known as the spring chest expander, is actually an old-school piece of exercise equipment that engages your shoulders, chest, upper back and core, through resistance movements. This exercise apparatus traces its origins to England with a popularity boom by English gentlemen at the turn of the 20th century. The spring chest expander consists of three to five strands of steel springs or rubber cables that run together with handles on each end. Strongman cables, pulls or strand pulls are nicknames often given to the chest expander.

Although the device may have had a long history, it was a big, new apparatus for me. I could not read the English manual for the spring exerciser, but Zvi helped me. In addition to translating the manual, Zvi showed me the many ways and the different shapes that the springs could be stretched in order to exercise different muscle groups. This exercise device consisted of five springs, which could be attached, or detached; depending on the amount of resistance you wanted to create. It was possible to hold both handles in the hands and stretch the device or connect one end to the towel hanger and pull it on it. Because the handles and springs could be arranged for any number of exercises, I felt that this device had an advantage over the barbell weights I had created.

Previously, Dani Dassa and I had mixed concrete, poured it into canned fruit containers, and added a metal bar in the center. Once the concrete hardened in one can, we turned it over and completed the “barbell” by adding a second can. These cement-filled containers with a pipe were my weights before Zvi arrived with this new invention.

Almost immediately, I realized that exercising with this new spring exercise device necessitated much greater effort at the end of the motion, rather than at the beginning. When I worked with my barbells, I could not lift more weight than the weakest part of my movement could achieve. Therefore, I was only working part of my muscles when I did an exercise like the bench press. As some point in the movement, I was weaker than I had been at the beginning of the motion.

The new spring exercise device made the workout much more difficult throughout the range that the springs could stretch. I discovered that I was able to accomplish better results in my training with a more effective device. In other words, this spring device forced my muscles to work in the middle and at the end of the movement, as well as at the beginning of the exercise. It was much more difficult to pull at the end but produced more beneficial results. I was also surprised to discover, after working with this spring device, that I was able to lift more weights on the barbells than I had been able to do previously. I was extremely pleased that I was becoming stronger.

I used my set of homemade dumbbells and barbells during the afternoons after school and before going to Kibbutz work. I noticed that when I did various exercises, such as the bench press lying on a bench, the weight became lighter toward the end of the movement, unlike the spring device, where the resistance increased toward the end. This was my first biomechanical intuition although, at that time, I could not have explained it in those terms nor with the mathematical and mechanical knowledge that I acquired in later years.

One day, I had an inspiration. I decided to modify the barbell in a way to achieve the same effect that I experienced with the spring device. I hung chains made of heavy metal at each end of the barbell so that part of the chain would drag on the ground while I started the movements. As I pressed the dumbbell up, the motion pulled more and more of the chain off of the ground. In this way, the weight
became heavier toward the end of the movement. This created a variable resistance exercise but it was many years before I understood exactly what I had created. I was thrilled with my invention. I could feel how much harder I had to lift and discovered many new muscles that were sore, from the effort. The most amazing thing for me was the increase in the size of my muscles with my newly invented device.

A week before my thirteenth birthday, the lucky kids in Hadassim went home to their parents to enjoy the Pesach, or Passover, vacation. Although this is one of the most important Jewish holidays on the calendar, I had to stay in Hadassim with some of the other children, who also had no place to go.

The Pesach vacation was three weeks long. To keep us busy and our minds off our loneliness, we were given busy daily schedules consisting of eight hours of farm work on the Kibbutz. My duty was to cultivate the hard, dry soil of Hadassim for the next crops of corn and wheat. I would drive the Farmel Tractor that I loved so much. I may have been lonely, but I loved to drive that tractor.
On April 27, 1952, I was driving my tractor as usual. Suddenly, I was summoned to come to the main office for a visitor. I left the tractor with its engine running and walked up the pathway toward the dining hall. I was mildly curious as to who would be visiting me but I went where I was told to go.

When I approached the dining hall, I saw my father standing there with Rachel Shapira, the school principal. Although time can fade memories; there have been specific events in my life that have been burned into my memory much like a tattoo stains the skin. This was one of those many moments in my life. It had been a long time, since I had seen my father and I was certainly surprised by his presence. I vividly remember looking up into his eyes and noticed how they sparkled in the brightness of the day. I thought, at the time, that I had never seen anything like that. Now, as I remember the event, I know what caused his eyes sparkle; it was my father’s tears welling up in his eyes. It is only now, in my later adulthood that I realized so many more things that a ten-year-old boy would not understand. “Shalom Abba, what are you doing here?” I asked incredulously.

He leaned toward me and whispered, “Do you know what day it is today?” His voice was unusually soft, as I remember it.

“It’s my birthday,” I answered.

“Yes,” he said slowly. “It’s your Bar Mitzvah today, did you remember that?”

Well, of course I remembered that. What kid would not recognize one of the most important birthdays in their entire life? According to Jewish law, when Jewish boys reach the age of thirteen, they become accountable for their actions and become a bar mitzvah. Prior to reaching bar mitzvah age, the child's parents hold the responsibility for the child's actions.

Once a boy reaches the age of thirteen, he is responsible for Jewish ritual, law, tradition, and ethics and is able to participate in all areas of Jewish community life. Reaching the age of bar Mitzvah signifies becoming a full-fledged member of the Jewish community with the responsibilities that come with it. These include moral responsibility for one's own actions; eligibility to be called to read from the Torah and lead or participate in a minyan; the right to possess personal property and to be legally married according to Jewish law; the duty to follow the 613 commandments of the Torah and keep the halakha; and the capacity to testify as a witness in a Beth Din (Rabbinical court) case. Once a boy becomes thirteen years old, all of these responsibilities are his merely by having a birthday. No ceremony is required to become a bar mitzvah.

Although I was aware that it was my Bar Mitzvah birthday, I was a little surprised that he remembered, and was amazed that he made the trip to see me. I was continually unprepared and amazed by my father and his actions.

“I brought you a present,” my father said, handing me a small box wrapped in old newspaper. At that time in Israel, there was no fancy colored gift-wrapping paper, like we have now and I could not open it fast enough. I ripped the paper off and found a charcoal drawing of myself, which had been painstakingly sketched by my father.

“Is this my present?” I asked, trying desperately to hide my disappointment.

“Yes, Gideon, do you know how difficult it was for me to do this? It took me many hours to draw it. I hope you like it.”
“Thank you, Father,” I replied, thinking, how stupid it was to give me such a present. Most kids would get better presents and some money. I wished he had given me one Lira, which was an Israeli dollar, instead. I could do so much more with one dollar than with this stupid picture. Of course, now I see his incredible talent in being able to draw my likeness and the love that he felt for me in his careful rendering. He was incapable of expressing his love in a normal demonstration which other parents showed their children. But this picture showed his feeling in the best way he knew how to show his love. At that time, however, I was disappointed at his choice of gifts since I would rather that he would have given me a more age-appropriate gift, such as money or a toy.

I looked at my father, standing in front of the school’s dining hall, with his drawing of me in my hand. Maybe he was capable of drawing an accurate depiction of my outsides, I thought, but he could never draw a picture of what I felt or of what I was thinking. He had no idea who I was or what I dreamt of becoming. My father and I were worlds and miles apart in our understanding of each other. Neither of us could fathom what the other one thought or felt.

We walked together for a while and I was wondering the whole time why he had not hugged me. All my friends’ parents would hug and kiss them, whenever they came to see them on their birthdays. As we wandered through the schoolyard, passing between buildings along the flower-lined sidewalks, we approached the dining room kitchen complex. In front of the building was a group of people including the comedian, Danny Kaye. Hadassim always experienced visits from celebrities since our school needs donations from generating wealthy patrons. Of course, we children were never told about the need for financial donations, we merely enjoyed these visits from celebrities.

My father and I were introduced to Mr. Kaye and the others. Suddenly, from his coat pocket, Mr. Kaye produced a strange looking camera the likes of which we in Israel had never seen. It was a Polaroid and Mr. Kaye immediately took a picture of my father and I. When the picture developed in just a few short minutes, my father was enthralled. Both of us were amazed that a camera existed which could almost instantly provide pictures. This Polaroid camera was truly a fantastic mechanical device. My father had built a camera for me when I had been much younger. He had built many other things, such as a tricycle, so in retrospect, I realize that I must have inherited my love of gadgets from my father. That Polaroid camera, however, had been a revelation for both of us. Unfortunately, that early Polaroid pictures faded so that special photograph of us is gone.

After the meeting with Danny Kaye, my father, Rachel Shapira, and I we walked back to the front of the school. Rachel Shapira said to me, “You became a man today, Gideon. We hope you’ll be a very successful person. Your father is very proud of you.”

Then my father blurted out “You’d do better if you studied more, instead of playing with that discus and shot puts. Also, you should read more, instead of lifting all those weights.” I understood by his comment that I could have studied and read more. But how was I to measure exactly how much more, since, I was sure that whatever I did would still not be enough for him. Besides, he had no idea how much I studied and read at Hadassim.

“He’ll be fine. Don’t worry,” Rachel reassured my father.

“No! He does not do well at important things,” my father insisted with despair and shook his head. From my point of view, he looked at me with his eyes, but his mind seemed not to see me at all. I felt invisible as a real-life son. I was only a charcoal sketch; the sketch was good but the human would never succeed. He thought of me as a failure now and in the future as we walked back to the front of the school. My father insisted with despair and shook his head.

That moment changed my life. I loved my father and I knew that he loved me, but there was a great impenetrable mysterious void between us. Neither of us could comprehend the other. At that moment, I felt an enormous bolt as though I had been struck by lightning. An electrical surge galvanized by thoughts and I realized that I would have to show my father what I could achieve. I would prove to him that I was good and smart. I would be the best in many ways. One day he would see for himself what a smart, creative person that I actually was.
My father took the picture from me, wrapped it up again with the torn newspaper, and turned to leave. “See you next time, Gideon.” He left me there and rushed to the road to catch the last bus returning to Tel Aviv, a journey of approximately 30 kilometers.

Rachel held my hand and walked me back to the Kvutza, the house where my room was. I remembered that I had left the tractor running and told her that I needed to see to it. I walked slowly back to the orange grove, climbed onto my beloved Farmel, and drove it back to the Center.

Later, as I walked back to my room, I realized that I did not even have my gift which my father had made for me. I wondered if he had given me a dollar, whether or not he would have taken that back. It was at that point, that I realized that the portrait of me was not a gift for me at all. Rather, it was for him and he just wanted to show off his work to me. I felt an overwhelming sense of sadness that the day had left in its wake. I would not see my gift for another fifty years. I found it, after my father died, carefully wrapped among his other treasures which he had kept about me and my accomplishments over the years.

After dinner that day, I sat in my room alone with five empty beds around me. I wondered what my roommates were doing. They were probably playing with their families or traveling to interesting places. Maybe they were watching soccer games. I looked at the pictures of my heroes on the wall: Rafael Halperin, Mr. Israel in body building; Perry O’Brien, the gold medalist at the Helsinki Olympics in the shot put; and Baruch Habbas, the Israeli shot put champion, who broke the Israeli record at 15.07 meters. What distance had Perry O’Brien thrown, I wondered, and picked up the “Track Book” by Kenneth Doherty? This was an old book, which I had purchased with some money I had earned carrying boxes, and flipped through the pages searching for the record in the shot put section.

I was amazed to read that Perry O’Brien had thrown the shot put more than 18 meters, which is 64 feet using the English system. What an incredible difference between his throw and Israeli shot putter! Perry O’Brien’s had put the shot more than 3 meters (10 feet) farther than Baruch Habbas had thrown. What did O’Brien do which made him throw so much farther then Baruch Habbas? O’Brien was taller but he used a different throwing technique. In fact, he began his throw looking backwards. Wow, I thought, what an innovative style that must be. Why could Habbas not do the same? Maybe it was America that made the difference. I imagined that it must be a dream to be in America.

I jumped out of my chair to get my world map. As I looked at America, I realized that it was a huge country compared to Israel. It must be at least 100 times or even a thousand times bigger, I thought. At the bottom of the map, there was a picture of a family driving in a Cadillac car representing America. India had a picture of a cow walking down the street and for Africa, there was an elephant being ridden by a little child.

My conclusion was that everything and everyone in America were big, at least, bigger than in Israel. They had more land, bigger cars, and even larger people. Perry O’Brien was larger, stronger, and could throw farther than the smaller Israeli athletes.

My thoughts returned to the three-meter difference in the shot. I was unable to comprehend this fact. There was such a great discrepancy between the two athletics and their performances. Someone must be able to throw farther than Baruch Habbas. Maybe I could?
At that moment, I decided that I would represent Israel in the Olympics. What an amazing dream for me to represent Israel in the Olympics. If I were in America, I was convinced that I would be able to throw the shot at least 16 meters. I could see myself driving the Cadillac, and what an amazing car it was. I had never seen a Cadillac in Israel. I assumed you had to be a millionaire to be able to afford such a grand car. For a moment, I doubted myself. There was no way I could do this, I had failed 4th grade. How could I accomplish all that? Could it be possible, I pondered? I, angrily, wiped a tear from my eye off the map. I could not afford another map, so I had better keep this one clean. I put the map away but I kept the dream alive in my mind.

For the remainder of the Passover vacation, I thought about this dream, this Olympic idea percolating in my mind. Every minute, every hour, all day and night, I thought about the possibilities.

Two more weeks went by and at last, the vacation was over. I was so happy to see my best friends, Hillel, Yakir, Menachem, Eliyaho, and Yosef. My closest friend, Yakir, unfortunately, was not to live a long life. He was killed, later, flying a mission in the Israeli Air Force.

That joyful afternoon, when all my friends returned to school, they could not stop telling me how great their vacations at home had been and all the movies they had seen. I told them how boring it had been here, alone each day. Suddenly, Hillel, Yosef, and Yakir noticed the new pictures on the wall.

“What are those above your bed?” asked Yakir.

“Those are my heroes,” I replied.

“Why have you put them up there?” asked Hillel.

“I am going to beat them!” I answered boldly. There was total silence for a moment and then they all burst into uncontrollable laughter. Their reaction was more devastating to me than my birthday with my father had been. Not only had they laughed at me, ridiculed my dreams, but they were oblivious unsympathetic and unpersuaded with my goal.
Of course, I should not have been shocked at their reaction since I knew that I was not a particularly good athlete. In fact, Iris, one of my beautiful blonde classmate, whom I loved was too shy to tell her how I felt, could throw the baseball further than I could. Miriam Sidranski, who was younger and in the class below me, could sprint faster than I could dream of running. There was no sport in which I excelled. In fact, I was unable to defeat anyone, girls or boys, in any sport. So, now, I had made an outrageous announcement of unbelievable, unachievable proportions? Maybe they were right.

“Well, we’ll see,” I thought. I still remember how that ridicule fueled the early determination that I would need to accomplish many of my more memorable victories, both in athletics and in business. Determination would blossom within me and, to this day, continues to maintain my outlook on all of my new, revolutionary ideas.
After they had stopped laughing, I made it known of the things I was going to accomplish. I made a list of future accomplishments:

1. Break the Israeli Records in the Shot put and Discus  
2. Represent Israel in the Olympics  
3. Study in an American University  
4. Be a Multi-Millionaire  
5. Own a Cadillac

This was too much even for Yakir, Menachem, and Eliyahoo. They left the room to find other friends to talk about their Passover break. Hillel and Yosef tried, desperately, to change the subject without making me feel too bad or ridiculous.

I did not tell my friends about my last and most significant goal. This last one was the most important of all, but I did not tell them or anyone else. My main goal, for the rest of my life, was to prove to my Father that I was good and smart and I would achieve great things!
Chapter 3: Unexpected Feats

My quest began, and it was every bit as daunting as Don Quixote’s. I started training immediately. Fortunately for me, some incredible teachers were there to assist in achieving my goals. They remain, forever, lodged in my heart and mind. My first mentor at Hadassim was the physical education teacher, Dani Dassa. He was trim, muscular and a good-looking man in his twenties, and had heard about my devotion to bodybuilding exercises. One holiday period, Dani was the counselor for the students who stayed at Hadassim, rather than going home.

I was sitting on the grass in front of the dining hall. Dani, suddenly, came up to me on the grass, and asked me if I wanted to go run with him. I was surprised and immediately agreed. I got up, and together we started running toward the sand dunes bordering the Mediterranean beach. It was a pleasant day, cool, with a sea breeze, but after only five minutes of running, I felt that I could not go on anymore. However, I would never admit to Dani what I was sure was a fatal weakness. I never stopped running, but thought for sure that I would die soon, from exhaustion. Dani saw, out of the corner of his eye, that I was about to collapse and suggested, “Let’s walk for a while.”

“I’m sorry I interrupted your run,” I said. I felt I had let him down.

Dani stopped and put his hands on my shoulders, “Gideon, just run a little every day, and in no time you will be able to run as long as you wish.”
“Really?” I replied. “Then I am going to run every day from now on.” (Although I am now 77 years old, I have not stopped running. I still run five miles every day. On those rare occasions that I miss due to traveling or other reasons, I feel guilty.)

It was nearly six months later, after running every day, before I ventured out again with Dani. On this occasion, we ran approximately five kilometers (3 miles). After many months of training, it was much easier to keep up and, to my surprise, we ran farther than our first time.

I greatly admired Dani. He showed me new ways to exercise, and one day even showed me how to throw a discus, which was made out of hard rubber. I had longed to throw, since I spent evenings with my discus-throwing champions on the wall in my room. I think I threw the discus only 50 feet, while Dani threw it about 150 feet. The discus would fly flat and twist into wonderful patterns. These patterns played in my mind all day long. What a beautiful way of releasing an implement. What marvelous integration between body and nature, between physical laws of motion, and artistic dance-like movements.

Another friend of mine at Hadassim was Shevach Wise. Shevach is now a member of the Knesset, the Israeli Parliament, and the speaker of the house but when we were children, he was...
a great discus thrower. He threw nearly 140 feet and could easily compete against Dani. Shevach was a few years older than I was, but I was fascinated with this event and wanted to emulate his successes. I asked Shevach to let me know whenever he was going to throw the discus and I would help him by retrieving the discus after each throw. His discus throwing technique was an older style, but amazed me nonetheless. For several years and thousands of throws, I ran back and forth to retrieve Shevach’s discus for him. He was a wonderful individual, who I greatly admired, then and now.

In addition to the discus, Dani also taught me how to throw the shot put. I started with the 5 kg. (12 pounds) youth shot. The normal adult shot put weighs 7.25 kg. (16 pound.) After that, I threw the shot and the discus every day, during every break between classes, and every other opportunity I had during the day.

I practiced so much that one of the teachers brought a shot put into a class with a face drawn onto it. “This is Gideon Ariel,” he said. I was humiliated, but not the least bit deterred from throwing. All I cared about was to improve my throwing skills.
Years later, this teacher said he regretted embarrassing me in front of the class that way. He had meant it as a warning to me, he said, to focus on matters other than sports. His warning went unheeded, since I was out on the grass practicing every available chance, including 5-minute breaks. From today’s perspective, I appreciate that he was trying to have me focus more on academic subjects instead of focusing so much on athletics and training. I think I would have been more appreciative had he been more helpful, and less insulting.

On the other hand, Dani was, always, available to help me with throwing tips or training exercises. At that time in my life, any attention was more than special for me, since I had received so little positive encouragement, previously.

Dani was, also, the proud owner of a big American Harley Davidson. I was more than fascinated by this bike and willingly devoted hours to cleaning it. The motorcycle was not particularly dirty, however, since Dani did not have a license to drive it. At that time, I was a tall fifteen-year-old boy and, coupled with a forged birth certificate, was easily able to convince the woman at the Department of Motor Vehicles that I was 16 years old. So it came to pass, that I could drive Dani’s bike, while he could merely hang on as a passenger. What a terrific time I enjoyed with that magnificent machine.

On Friday nights after dinner, all of the students, from every grade and the teachers, participated in Israeli Folk Dancing. Folk Dancing was a very big event in Hadassim. I never danced, since I was too self-conscious and shy. But I always went to watch. My friends would be out all night under the Mediterranean star-lit night, clapping and kicking up their feet, and enjoying the fun and camaraderie.

Some of the students were great dancers, but Dani Dassa was a master. It was during my 10th grade that a visitor from the U.S. came on a Friday to watch the dancers. She was the famous dancer and choreographer, Martha Graham. She was slim and graceful with focused attention. Martha Graham had traveled to Israel in search of talent for her school and dance troupe in America. Hadassim had been suggested to her, as one of the places to look for talented dancers. Dani was superb that night, kicking up his heels, turning, spinning, and dancing expressively. He was so good that the next day he was offered a full scholarship from Martha Graham to come to America. What a dream for any Israeli man or woman.

So, I had lost my two heroes, Dani and Raphael to America. America became my dream; it became a land of heroes.

After Dani had left for America, Tomy Shwartz became the Physical Education teacher at Hadassim. Tomy was a survivor of the Holocaust in Auschwitz. I became his helper. I would clean the gym, the
halls, and his motorcycle. Any task Tomy wanted me to do, I would do with all my heart. I could not perform in sports very well, at that time, but I could be around sports helping Tomy to do his work. When I was in the tenth grade, Tomy learned that I very seldom went to visit my father during holidays or vacations. In the summer of 1956, he asked if I would like to take a course near Tel Aviv in the city of Holon, which would prepare me to be a Physical Education Teacher Aid. In this capacity, I would take the equipment to the field and be responsible for the various activities that the PE teacher organized. I was ecstatic! Instead of working eight hours a day at the school, alone and bored, this was a dream. So I registered for the three-week course, which was a type of summer camp for kids. The person, who was in charge of this camp, was Yariv Oren. Yariv was an athletic dark haired man with quick movements and penetrating eyes. When he had competed as an athlete, he had excelled in throwing the javelin and the shot.

I paid close attention to all the Teacher Aid instruction classes and was fascinated by the information. For the first time, I studied Anatomy and Physiology, and learned more details about various sports including soccer and basketball. I was riveted to all of these studies about athletic movements, and how the human body changed, adjusted, and adapted to performances.

In the evening, we all played basketball, tennis, soccer, and other games. I was not good at these activities, but tried to do my best and put my whole heart in everything. One night, one of the activities
was an arm wrestling competition. I knew, from my experience at Hadassim, that I was good at arm wrestling. In my group at Hadassim, no one had ever beaten me.

The competition began and I merely watched, but did not volunteer to participate. There was one young fellow, named Zitooni, who happened to be an immigrant from the Middle East. He was bigger than the rest of us, and beat every competitor in a matter of seconds. I decided to challenge Zitooni, since I wanted to know how long it would take him to defeat me and I wanted to feel the force that he could produce.

Yariv was the judge. I doubt whether he had ever noticed me before this competition. He held our arms together, making sure our elbows were on the table. At his command of, “Ready, go!” we started to arm wrestle. We struggled and strained for about two minutes, at full effort. To my shock and the amazement of the others, I won. Zitooni was as shocked and surprised as everyone else, since no one had ever defeated him. He even looked under the table to see if I had used any help. Then Zitooni asked for a second competition and asked that we change to opposite sides. We changed seats and started again. “Ready, go!!!” Yariv commanded. I beat Zitooni the second time. People around were clapping and started shaking my hand. I did not look at their faces, since I was too embarrassed and shy.

As I was leaving to return to Hadassim, I heard a voice call out to me, “Hey, you, what is your name?” It was Yariv Oren, the principal of the camp and the referee for the arm wrestling competition. I told him who I was and where I lived. Yariv told me that, in addition to conducting this three-week training camp, he was the Track and Field coach in Kfar Saba, a small village about 20 miles from Hadassim. He asked if I would be interested in training with him in Kfar Sabo.

I was too shy to look directly at his face, but asked, “What would I do?”

Yariv asked, “Do you do any event in Track and Field?”

“I try to throw the discus and shot, but I’m not very good at either one of them,” was my response.

“Your arm seems strong enough to throw,” he said, thinking out loud. “Come, join our club and we’ll get you started. I am sure that we will find something, in which, you will do well.”

For the first time in my life, someone told me that I could be good at something.

“I’ll be there,” I said smiling for the first time. In fact, I could not stop smiling.

A few weeks later I received my certificate for the course I had taken with Yariv in Holon. I had successfully completed an entire course. This was a unique accomplishment for me. I became somebody, rather than just another child in the village. I was proud of myself for accomplishing this feat and achieving an academic goal. This certificate and the invitation from Yariv to train with him changed my life.
As soon as I returned to Hadassim, I went to Tomy to tell him about Yariv’s invitation to train with him at Kfar Saba. Tomy’s reaction was very positive, and he thought that this would be a wonderful opportunity for me. Although he did not tell me, I suspect that my enthusiasm for sports and the elevation that the certificate from the Teacher’s Aid course had on my self-confidence were factors in his response.

On Tuesdays and Thursdays, school classes were finished at 1:00 p.m. Usually, the students had to work on farm chores for four hours. Tomy Schwartz arranged for me to go to Kfar Saba to practice with Yariv. Kfar Saba is a small town approximately 20 kilometers northeast of Tel Aviv. However, to reach Kfar Saba from Hadassim, I had to walk one kilometer to the main road that connects Tel Aviv to Haifa in the North. Then I had to catch a tramp, meaning hitchhike, in Hebrew. At that time in Israel, it was a relatively common and safe practice for young people, who had little or no money, to hitchhike. Usually within ten to fifteen minutes a kind person would stop and give a lift even for a short distance. The trip to the entrance to the town of Kfar Saba usually took about 30 minutes, then, I had another 20-minute walk to the stadium. The stadium was actually a soccer field with a sand track around it surrounded by bleachers. There were no modern tracks in Israel in the 1950s.

That first Tuesday when I arrived at the Kfar Saba stadium, there were many young men and women already running around the track. Some were practicing long and high jumping, while others were throwing the javelin, discus, and the shot. I walked, slowly, toward Yariv Oren, who was coaching one of the jumpers.

“Shalom, Gideon,” Yariv greeted me. I was too nervous to answer and kept my eyes focused on the ground. “Come along, Gideon,” Yariv said, and paternally put his arm around my shoulders. Although he was only eight years older than me, for a fifteen-year-old kid, Yariv was a grown up and more, he was the Head Coach. “Let’s start with a warm up. Why don’t you run three laps around the track?” I ran the three laps, in bare feet, of course, and waited for the next task. At that point, Yariv instructed all of us to follow him in various warm up exercises. There was quite a number of stretching and jumping routines. It felt so good to be part of a group, and to be using my body.

During the warm up exercises, I could see a young man throwing the discus at the other corner of the stadium. I think the discus went about 160 feet. I had never seen a person throw so far. I discovered that this was Yehuda Hoz, who was the record discus thrower for the youth age group and represented the Kfar Saba team. Yariv introduced me to Yehuda, and then began to instruct me in how to throw the discus. Yariv told me, “You need to learn how to throw it from a standing position, before you learn the turn.” I obeyed as perfectly as I could, and never stopped practicing until the day ended. This was, now, becoming one of the best days of my life.

There was a beautiful sunset by the time practice concluded. “Gideon, how are you going back to Hadassim? Is someone coming to pick you up?” Yariv asked.

“No one is picking me up,” I replied. “I am going to catch a tramp, back to Hadassim.”

“Well, will I see you again in two days?” Yariv asked.

“Yes, sir, I will be here.” I had never felt so happy. Happiness enveloped me like never before in all my memory. During the entire tram ride back to Hadassim, I could feel the fingers on my right hand burning a little from throwing the discus so many times. I was too shy to converse with the man who had picked me up in his car, although I longed to tell him about my extraordinary day. Instead, I imagined myself throwing the discus as far as Yehuda had. How long would it take me to be that good? One year? Two years? Tears ran down my cheeks. I could picture myself throwing the discus farther than it had ever flown before, and I knew there were many hours of training ahead of me.
When I arrived at Hadassim that evening, it was quite late, but one of my friends had brought some food for me to eat in my room. Sleep eluded me, but visions of my throwing the discus did not. I thought and practiced the throws all night, and when I finally fell asleep, I continued throwing in my dreams. The next morning I couldn’t wait to meet Tomy and ask him if I could have a discus of my own. To my surprise, Tomy immediately gave me one of his rubber discuses. It was the same discus that Shevach Wise and Dani had thrown, those many afternoons near my dorm when I had watched them throw and merely retrieved the discus.

The next morning, school started at eight in the morning as usual. I carried my books and my discus to class. Some of the kids asked me what that thing was that I was carrying. Proudly, I told them what it was. As usual, everyone thought I was just too obsessed with exercise training and athletics. At the class break, I ran into the yard and started throwing. Hillel and Asher joined me. I babbled on telling them about my first practice in Kfar Saba. We threw during the 15-minute break, and then the bell rang to go to the next class. During every break, I threw the discus, and this pattern continued for the next two years.

Although I had a tremendous drive to perfect my fitness, shot putting, and discus throwing skills, this did not negatively affect my school activities. I had the same drive and dedication to those subjects that were interesting me. I loved biology, chemistry, math, trigonometry, and physics.

In one of the classes, I created a Nature Corner, where I raised rabbits, snakes, lizards, frogs, as well as flowers and vegetables. There was an indoor and outdoor portion of this Nature Corner, which was inspired by the teachers, who taught us to value the natural world. Many of the kids at Hadassim had projects, but I was especially drawn to the biological and physical sciences.

I also loved chemistry and found nearly every aspect fascinating. The day that the professor warned us to never ever open the sealed beaker of the hydrochloric acid (HCl) and mix it with sodium sulfide power (Na2S) was a great day for me as a budding scientist. His challenge could not go unanswered, so I mixed the two compounds at the first opportunity. The combination created hydrogen sulfide (H2S), which resulted in a terrible stink. The smell of rotten eggs permeated the air so horribly, that the building had to be closed for two days.

Chemistry also fascinated my friend, Gideon Lavi. We decided to build our own chemistry laboratory in an old, deserted shed, about a half a mile from the rest of the school. We liberated small quantities of various compounds and elements, as well as, the necessary laboratory equipment. We even hung Mendeleev’s periodic table of elements on the wall. Any element we could get our hands on was carefully and loving stored in our own lab. One day, we decided to create nitroglycerin. We were both curious and intellectually challenged boys, who thought they had an especially fantastic idea. We mixed and weighed and balanced the various chemicals. Unfortunately, we had neglected to liberate the small metal tong used to hold test tubes. Perhaps it was fortunate rather than unfortunate, as things developed. As our mixture began to bubble on the way to becoming nitroglycerin, the tube increasingly became hotter and hotter. When the glass vial was just too hot to hold with his bare hands, Gideon Lavi, dropped the partially created mixture and we burst out of the door of our chemistry lab as fast as we could. Just as we got outside, our entire laboratory exploded and blew a huge hole in the ground! People from all over Hadassim, kids, teachers, workers, and visitors ran to the location of this explosion. Gideon and I were basically unhurt, except for a few hairs and our clothes that were singed. The most damaged were our egos and our poor laboratory. Needless to say, we were expressly forbidden to have another one.

Despite this setback, Gideon and I remained close collaborators in chemistry class. Both of us enjoyed the work and the mystery of the science itself. Gideon Lavi later became a gifted chemist at the Technion in Haifa and had several inventions, as well.

Hadassim was a wonderful place for children to explore their academic interests. Usually these challenges were in the more normal classroom settings, rather than Gideon’s and my elicit, laboratory. I thrived in the math, trigonometry, and geometry courses. I was enthralled with the formulas and the
people who had invented the many items we studied. I dreamt of one day going to the Technion and studying various biological and physical sciences.

The one drawback of the school was they did not stress the need to study things that a child might not want to learn. For example, I was not at all interested in Bible studies or in learning English. Neither subject seemed necessary for my life, nor did the contents appeal to my imagination. Eventually, this reluctance to apply myself in those areas cost me dearly.

The Israeli system for advancing to college was based on the English system. Students across the country take a series of standardized matriculation exams in each subject. The scores in the matriculation exams for all colleges, including the Technion, dictated which students will be accepted. Therefore, high, test results are required in every subject, not just the sciences. At that time very high scores in math and chemistry did not balance a poor score in Bible. Perhaps my future would have been something else under a different educational system.

As is typical of most residential school, Hadassim tried to balance the life experiences of the children. We were exposed to first-rate teachers in our academics because, at that time in Israel, the world situation was quite unique. The teachers who were drawn to our school were an idealist, and previously, had been experts in their area of study. Therefore, we had a world-renowned physicist working in the fields and teaching the physics courses, because that was his way of helping the world.

One day, I was talking with one of the older teachers, while he repaired a fence around the animal enclosure. I asked him what he had done before he had immigrated to Israel.

“I taught history and philosophy at a great university in Europe,” he answered.

“Why are you here at a dorm school fixing the fence?” I asked.

His answer amazed me, “Because Israel needs me to fix this fence, not teach school in Europe.”

Another one of our teachers was a gifted violinist teaching music. Unfortunately, we were oblivious to the greatness and depth of the teachers, as so many children are, but in retrospect, we all realized how lucky we were, the damaged and lost children of Israel.

As part of the balanced life of study, work, and physical effort, I continued to exercise and throw the shot and discus. Between classes and my chores, I was completely dedicated to these endeavors. One day, an errant discus throw crashed through a window. I cleaned up the mess and, undeterred, returned to my throwing practice.

When I returned to Kfar Saba the following Thursday, Yariv was amazed at how much I’ve progressed. Seeing my fingers completely bruised from the friction with the discus, Yariv encouraged me that I would start turning soon.

“Why don’t we also try to improve how you put the shot?” he asked.

“Absolutely!” I replied.

He took me to the shot put ring and showed me how to throw from a standing position. I spent the rest of the day practicing the way Yariv had instructed me. I was so happy to be in this wonderful place and thrilled that an adult was encouraging me with praise.

I continued to work, exercise, and train every day by running long distances and sprinting. I also continued to lift weights in a special program that contributed to the throwing movement. After a few months, I was starting to notice a huge difference when it comes to everyday tasks, lifting certain things with ease. After one year of unrelenting effort, I realized that the secret to success was a dedication and efficient training.

I was completely obsessed with my quest to be on the Olympic Team representing Israel in the upcoming 1960 Olympic Games to be held in Rome. Although I probably did not need more stimulation, I decided to change my name to reflect this goal. I now called myself “1650.”

“How can your name be that?” asked one of my friends.

I answered, “It’s obvious, I am going to throw 16 meters in the shot put and 50 meters in the discus. These results will break the current Israeli records and then I can represent Israel in the Olympics. Therefore, my name from now on is ‘1650.’”
I was becoming obsessed with the idea of throwing 16 meters and 50 meters that I was starting to sign my schoolwork as 1650.

“Gideon, I will not accept your papers with this signature,” said the same teacher who had drawn my face on the shot put. “I don’t know anyone called ‘1650’. Please sign your proper name, if you plan to have your classwork reviewed.”

“Then don’t look at my work. It is your choice. However, that is my name,” I answered.

This teacher and I had many disputes during my years in Hadassim. Another battle was about a pin my father had given me. Although I was not close with my father, he had given me a pin that represented the Stern Group. It was an arm holding aloft a rifle with the slogan, “ONLY THIS WAY” to represent their thinking on how to get the British out of Israel. I wore this pin, proudly, for its defiance and for how it represented one way I could admire my father. The teacher was from the Palmach group. The Palmach were diametrically opposed to the philosophy of the Stern Group. The Palmach were more moderate in their politics, and eventually became part of the Israeli Defense Forces. It should have been no surprise that the teacher ripped my father’s symbol from my shirt. He never returned my pin. Since I had received so few things from my father, it terribly hurt me to lose this pin.

Another example of these feuding philosophies was when I had gone swimming at the beach in Tel Aviv. I had found an old, defunct gun that had sunk when a boat of Israeli rebels came into the harbor to deliver guns to the Stern Group. The rebels were killed by more moderate Israelis, for their violation of the laws that the new Israel was trying to establish. When my father saw my proud new possession, he began shouting and went berserk. He wanted no memory, he said, of how these people had been mercilessly slaughtered for the Palmach ideology. This incident sheds some perspective on the passion of political feeling in Israel, at that time, and the setting, which influenced all of us.

My “1650” name may have been a source of many jokes in my class, but it demonstrated the power of positive thinking and my dedicated effort. I was determined not only to work to achieve this goal, but to claim the name as well as the ideal.

Meanwhile, I continued to grow taller and stronger. On holidays when I was in Tel Aviv with friends, I still trained in the Raphael Halperin Gymnasium. One of the trainers there was another dedicated lifter named Deen, and he spent long hours helping and encouraging me. My strength and form were greatly enhanced, which improved my self-confidence. I now looked more like a body builder, compared to when I was a skinny little boy.

At school, I also practiced my throws at every opportunity during each and every day. I would perform shot put glides, while I was going to the dining room. I would twist and turn throwing the discus, while going to work at the farm. It looked to all as if I had gone crazy, but my technique continued to improve. One Friday, after the training at Kfar Saba, I walked with Yariv to the bus station on my way back to Hadassim. We were discussing my progress and he told me that he wanted me to start competing in the upcoming meets. I looked at Yariv and asked him, “Yariv, do you think if I train hard I could break the Israeli Record and represent Israel in the Olympics?”

Yariv stopped, took my hand and held it against his chest, and said to me, “Gideon, if you will want it hard enough, you will achieve it.” For me it was like a
message from G_d. Another sleepless night of dreams followed, as I held the discus and the shot in my arms in bed.

Unknown to me, Yariv had contacted my school’s head principal to learn about my family and on his own time, visited my father. Yariv told my father that I was a good hard-working kid and a dedicated athlete, urging my father to encourage me in my efforts. Apparently, my father was reluctant to embrace this idea. My father could not understand the merits of throwing iron, as he called it, but after that visit, he did not interfere with my efforts in athletics nor from attending the study courses that I began to take.

My classmates began to notice the changes in me, as my physical shape became more pronounced and my attitude was more positive, as I gained in confidence. They began to cheer for me in my performances of the shot and the discus. Some of my friends traveled with me to Kfar Saba to train in other events. Hillel, Miriam, and Asa all became serious sprinters.

Yariv organized a National Competition for adults. I was still a youth and was unable to participate. However, I learned that Uri Galin, the Israeli record holder in the discus, would compete. I gathered all my courage and went to see Iris, the beautiful blonde that I had secretly loved for so long. I knew Uri Galin was a distant family member of hers.

She was in her room. I knocked. “Hi, Gideon,” she said.

I got right to the point, so there would be less room for error. “Would you like to come with me to Kfar Saba for the Track and Field competitions? Uri Galin will be there to throw the discus?” To my amazement, she agreed.

On the day of the competition, we took a bus to the stadium. When we got there Yariv welcomed us, which made my heart swell with happiness and helped my self-confidence. Mainly because I was sitting there with a girl! During the meet, I could not believe how graceful Uri Galin was in throwing the discus. In fact, he broke the Israeli Record in this completion and raised the record to 48.03 meters. All the media pushed to interview Uri and he became surrounded by photographers.

I turned to Iris, “Iris, would you introduce Uri Galin to me?”

“Of course,” she said sweetly.

Once the meet was over, Iris and I walked over to Uri and he hugged her and said, “Hey, Iris darling, I am so glad to see you here.”

“Iuri, this is Gideon, my friend from Hadassim,” she said, introducing me. Uri shook my hand and I was ecstatic with joy and, to a certain degree, shocked to be shaking hands with the Israeli record holder in the discus.

Iris and I rode the bus back to Hadassim arriving after dark. It had been a long day, but we had both thoroughly enjoyed the experience. I thanked Iris for taking the trouble to introduce me to Uri.

She smiled up at me and said, “Well, Gideon, when are you going to throw against him?”

I laughed and replied with all the assurance of youth, “Soon! Plus I am going to break his record!”

“All right then,” she nodded her head, “Good luck.”

For me, life at Hadassim continued as before, and was full of study, work, my athletic endeavors, and fun with my friends. All of us were pretty energetic and sometimes this excess energy, especially among the boys, may have become excessive. One adventure involved my friend, Moomi. For years, Moomi and I had visited his uncle and, at night when his uncle was asleep, we borrowed his car. We drove around the country by ourselves to explore and see things despite our lacking any particular plan of what to see or do. Surprisingly, his uncle and the car mechanic were never able to discover what happened to the full tanks of gas that kept disappearing! One day, Moomi and I decided to accept the challenge of going to visit Petra. Petra is a famous, world-renowned historical site in Jordan. Many of the city’s ancient buildings were carved directly into the beautiful, reddish colored stone of the hills. It was a sight to behold, except that Israelis were not allowed into Jordan, at that time, because a state of war existed between the two countries. It was considered, by teenagers, as a special achievement to go to Petra and return with proof that you had actually been there. Moomi and I arrived at the border between our two countries one dark night, crawled under the fence, and removed our shoes. The Jordanian soldiers, who
patrolled the area, knew that Israelis wore shoes, and bare feet indicated local Bedouin tribes. We walked for many miles and reached as far as Wadi Musa, local which is a steep-sided valley. This was close to our destination, but not close enough to win. Suddenly, from above the cliffs, soldiers began shooting at us. We turned and ran as fast as we could. We never looked back and prayed, as we raced, that we would not be caught or shot dead. Miraculously, we made it back to the border, crawled under the fence, and were met by some irate Israeli border guards. These guards were almost more frightening than the Jordanians because they would take us back to Hadassim for even worse punishment. Fortunately for Moomi and me, the school was so relieved that we had survived, our punishment was not too severe.

On a Saturday, following my trip with Iris to see one of my heroes, Uri Galin, Tomy organized an internal competition at Hadassim. This competition was only for the Hadassim kids. At that time, I was in the 11th grade. The entire day was to be a very special event. All the kids in Hadassim came to see the first Track and Field competition in their school. There were judges and the track was marked with chalk. Everyone was looking forward to the competition. I competed in both the shot and discus against my friends in my class and the older students in the classes above me. I was so excited that my hands were shaking. My best discus throw was for a distance of 42.35 meters. This was good enough to win that day’s event, but not enough to break the record.

The next day all the newspapers in Israel reported these results:

In a Track and Field competition at Hadassim, there were excellent results. Gideon Ariel, 17 years old, surpassed the Israeli record in the shot by throwing 16.55 (54'4") meters.

In both the shot put and the discus, competitors were allowed six attempts. The day’s competition began with the shot put event. When it was finally my turn, I was so nervous that I fouled. However, on my second attempt, I threw 13 meters. Then I fouled the 3rd and 4th throws, as well. Asher, my classmate, was in the lead with a 13.5 meters throw. I knew that Asher was much bigger than I was, but I believed that my technique would prove to be the differential and I could win. My fifth throw was more than 14 meters, so I passed Asher in distance. In addition, this distance was the Hadassim record. I was quite happy, at that point. But there was one more throw for all of the competitors and the winner was the person who threw the farthest, on any of the attempts. I held my breath as each athlete threw. I never hoped another competitor would perform poorly, only that I would do my personal best. After all of the other throwers had finished their sixth throw, I was still in the lead. Now it was time for my sixth throw. Since I had already won the competition, I had nothing to lose by going all out. I concentrated and put all of my ability into this last throw. The shot left my hand and kept going, as if it would never come down. The entire crowd gasped as one. The shot landed. I could not believe it; I had thrown the shot 16.55 meters and shattered the Israeli Record for the Youth age.

My five years of non-stop training had been worth all of the effort. I felt rewarded for the devotion and dedicated training. I could not wait to tell Yariv about my success. As soon as he learned of my achievement, Yariv initiated me as an official member of the Kfar Saba Track and Field Team. Tomy, my physical education teacher, was also proud of me. This child whom he sent a few years before to learn to be his aid had become his best athlete. I remember wishing that Dani Dassa would hear about it, since I owed so much to him for the help and guidance he had given me all of those years before. I wanted to
thank him and let him realize that I had finally achieved a worthy goal that he could appreciate. I wrote him the following letter:

I got your address from Shimale and immediately I sat down to write you a letter. I wish you good luck and hope you are very happy. I heard you have a very good life in the United States. In a few years, I hope to meet you there. Are you still continuing with sports? I didn’t stop even one day from my training. I made progress in my throws. In the Macabean games, I took a gold medal in the shot put for youth, 15.63 meters. In the discus, silver medal 43.72 meters. In my training, I already broke the Israeli record 16.21 meters, in the Israeli championship. I was number one only 16.10 meters. After the Macabean is finished, I will be an adult and I will have to use the 16 pounds shot put. People tell me that I have a chance and since I am a little bit faster in the discus than the shot put, I think I will do better in the discus. So far, I took about 30 medals this season. I was never beaten in the shot put. In the discus, I was number 2 only once. It is very hard to train since I am in the 12th grade. But every break I train. You should see how my body has changed, and my weight is now 86 kg. I am not fat and my height is 6 foot. I hope you will answer this letter. I will send you pictures soon. At Hadassim there is no difference in the sports from when you were here. They put lights on the basketball court and there is a new teacher, Tomy Shvartz, who was the lifeguard in the summer with Franklyn. Tomy is in volleyball and he brought many things to Hadassim, including Agness Keleti, who was world champion in gymnastics and won 5 Gold Medals for Hungary in the Olympics. And your Harley Davidson is not as clean as I used to keep it for you. Shimi is riding it. I hope that you answer my letter. If I achieve anything, it’s only because of you. How good it is to remember the tradition we had near Bet Hanun when we were training with weights and shot put and discus. I will never forget.

All the best, your student Gideon Ariel

In 1979, I was reacquainted with Dani, while on a trip to California. On that visit, he went to one of the drawers in his desk and brought out my letter. He had kept it for twenty-one years. I was so touched by his friendship and attention, when I was young and traumatized. Now, in 1979, I was again moved by his retention of this letter.

When I graduated from Hadassim, I was a well-known youth athlete. I had used what little I had understood of science to training myself, and now I dreamt of going to Israel’s Technion College, the MIT of Israel. I had very high marks in Biology, Physics, and Math on the matriculation exams, as well as, from my Hadassim grades. But my Bible, Literature and English scores were sorely lacking. Despite my strong showings in the sciences, I was not accepted at the Technion.

Yariv, still my mentor at Kfar Saba, suggested that I apply to the two-year Physical Education program at Wingate College. I had to take a psychoanalytic test for acceptance into the program. I have no recollection of what they asked, since I have forgotten the details, but I failed that test. However, Yariv was the Officer and Minister of Sports at that time and he informed the school, “You’re going to accept him,” so they did.

During my first year at Wingate College, I biked to school every morning from my apartment in Tel Aviv. I had moved back in with my father, after finishing at Hadassim. We did not speak much, but I was so busy that it was a bearable situation. In Wingate, I studied some familiar topics, as well as being introduced to some new subjects, such as: statistics, anatomy, physiology, psychology, and kinesiology. Afternoons were spent in the Tel Aviv sports stadium training for three to five hours every day. I was dedicated to my studies and to my continuing athletic pursuits. By this time, I realized that I needed both to be successful.
During my second year, in 1959, the Wingate School of Physical Education moved to a location next to the sea, near the city of Netanya, about twenty miles north of Tel Aviv. There were thirty students, representing the first and second class; all lived in a dormitory, ate, studied, and trained at Wingate.

The curriculum at Wingate primarily focused on studies of human anatomy, especially those involving the biological aspects of training and the mechanics of movement. We studied English textbooks for most of the subjects. One book, which had a powerful impact on me, was *The Mechanics of Athletics* by Geoffrey Dyson.

According to John Disley, one of Geoffrey Dyson's favorite pupils, "He devoted his life to making coaching a science and to exposing the charlatan whose only effective advice was "Do it again, but harder". The Geoffrey Dyson Award of the International Society of Biomechanics in Sports recognizes sport scientists who, throughout their professional careers, bridge the gap between biomechanics research and practice in sport. It is the most prestigious award of ISBS because it is a recognition of individuals who embody and carry out the primary purposes of the Society. The recipient of the Geoffrey Dyson Award delivers a keynote lecture on the opening night of the ISBS annual conference.
Training at Wingate College

Israeli Track and Field Team in Cyprus
For the first time, I realized the connections between mechanics, physics, and the human body. Every athletic movement could be analyzed through its components to decide the physical limits that control the movement. I realized that I could analyze my events by studying photos and trying to find in what ways I could improve my technique. This book was my Bible for years to come. The biomechanical factors are an essential aspect of every athletic movement. In other words, you could be sad and depressed with perfect mechanics and win. I realized that if your psychology is good and you have all the want in the world to excel, but the physics of your movement is faulty, you will finish as a happy loser.

My time at Wingate involved schooling, training with the Israeli Track and Field team, and competing. One of the first National Competitions was held in Cyprus. I was not the leader in the shot. The best thrower in that event was Uri Zohar, a colleague three years older than I and was the Israeli national champion in shot put.
One of our competitions was in Greece and I was amazed, since it was held in the Marble Stadium in Athens. The Greek Olympic Games of 1896, which gave birth to the Modern Olympic Games, were held in this stadium. The historical significance of this locale was especially meaningful to me, since I dreamt of competing in the Olympics representing Israel.
For all the Track and Field events, there is minimum Olympic qualifying distances or times, for the running events. During the discus competition in the Marble Stadium in Athens, I threw farther than this required minimum with an Israeli record of 51.51 meters. I made my history in this historic venue. My discus result was the required distance needed to qualify for the next Olympiad to be held in Rome in 1960. As soon as my throw was declared an official result, Yariv and all of my Israeli teammates swarmed onto the field. They hugged me and cheered as a group for my marvelous success. As excited as we all were with this result, I actually finished third in the competition with Konadis from Greece in first place with a throw of 56 meters. This was my best throw and, with it, I had achieved the opportunity to go to the Olympics. I felt my heart would burst with joy! Part of my name, “1650”, had come true and I was ecstatic after all those years of effort!

Competitions continued throughout the following year. Although I held the Israeli Championship in the Discus since 1958, I could extend my distance results during the intervening years. However, in the shot competition, Uri Zohar still held the Israeli record with a distance of 15.98 meters.
In 1960, prior to the Olympic games in Rome, Israel conducted Olympic Trials. These trials were held to determine which athletes would be sent to Rome to represent our country, Israel. Since I already had the Israeli Record in the discus, I hoped I would continue to do well enough to be sent to take part in that event. However, now I was training to break the Israeli Record in the shot put. After all, I was still “Mr. 1650.” In the shot put, Uri Zohar was the record holder and a serious contender. He was, also, a good friend, since we had been teammates in the competitions against other countries. We had frequently discussed the merits and deficiencies of the various techniques available to us. Uri threw with the traditional technique, gliding from the side. I had adopted my hero, Perry O’Brien’s, technique, which started the glide with the competitor, at the rear of the circle facing away from the field. It may have seemed an awkward and unusual starting position, but it had worked for Perry O’Brien and I hoped it would do the same for me.

During this training time, when all of us were focusing our efforts on the upcoming Olympic Trials, the United States Department of State sent an advisor, Leroy Walker, to help coach us. Later on, Mr. Walker became the Olympic Coach for the United States. As soon as I realized how much knowledge Coach Walker had in my events, I attached myself to him like a shadow. Wherever he went, I followed, listening closely and asking questions. I think that he was impressed by my devotion, because he spent extra time to help me understand the basics of throwing any implement. We did not have such a knowledgeable coach in Israel. Yariv Oren was a talented coach and motivator, but he lacked technical expertise in the events. Coach Walker was much more advanced, than all the Israeli coaches in techniques and in the required training routines. His suggestions and coaching hints helped me, to dramatically improve all of my skills, but especially in my shot put performance. The time for the Olympic Trials finally arrived. The shot put competition consisted of each athlete having six throws. The trial recorded with the farthest distance, regardless of the sequence of the number of that particular throw, is declared the winning throw. Uri

Competing in Greece, 1959, breaking the Israeli Record at 51.55 meters, the first record over 50 meters for an Israeli. The winner in the Discus, Konadis, the European Champion Second place to the World Record Holder, Gubner in the Macabian Games, 1961
Zohar was leading after four rounds. However, in the 5th throw, I broke his record by throwing 16.28 meters. I was the first Israeli athlete to throw more than 16 meters. This was the longest throw of the event, so I was declared as the shot put winner. My name “1650” had finally achieved its first two digits! My teammate, Uri, could not believe that he lost. He had been confident that he would win the event and go to Rome. When I walked into the dressing room after the competition, I was told that Uri had been crying, since he would be unable to compete in the Olympic Games. I felt very sorry that Uri would not be able to compete in Rome, but I was thrilled and proud of myself for reaching a goal set so many years ago in my childhood. The next day, I broke my own record in the discus with a throw of 52.78 meters. Thus, in the Olympic trials of 1960, these two days in the discus and the shot put events had completed my high school name of “1650.” After training so diligently and intensely since 1955, I could now reclaim my own name, Gideon Ariel. At that time, had no idea that my discus record would last for 30 years from 1960 to 1990. It was eventually, broken by an athlete from another generation of throwers.

Olympic Trials Records Broken in Discus and Shot Put.
Chapter 4: An Olympic Effort

The day finally arrived for the Israeli athletes to board the airplane for Rome and the Olympic Games. Friends and family members were there to wave goodbye and wish everyone success. It was a special moment for me to see my friends there. These were the friends who had initially laughed at my statement that I was going to compete in the Olympic Games but were now proud and excited for me. I carried my official Israeli Olympic bag filled with the competitive and dress uniforms which all the members of the team had been given to wear at the Games. My long-held dream of representing my country had finally materialized.

Carrying the Israeli Flag at the Rome Olympics
http://arielnet.com/ref/go/1051

The 1960 Rome Olympic Games were the 14th occurrence of the modern Games. Surprisingly, Rome was hosting the games 54 years later than they had originally been scheduled. The city had been awarded the 1908 Summer Olympics but nature had other ideas. After the 1906 eruption of Mount Vesuvius, Rome was forced to decline the opportunity of hosting the Games and passed the honors to London.

However, no volcanoes had interfered with these Games. New construction created the Olympic Stadium, which was home to both the opening and closing ceremonies as well as the track-and-field competition, and a Sports Palace for events such as basketball. Several ancient sites had been restored and were to be used as venues. These sites included the Basilica of Maxentius, for the wrestling competition, and the Baths of Caracalla were the site of the gymnastic events. The marathon was to be run along the Appian Way and end under the Arch of Constantine.

In addition to our relatively small Israeli delegation, more than 5,000 athletes representing 83 countries participated in the Rome Games. There were competitors who were well-known prior to the Games, but many amazing events occurred to make the Games miraculous achievements for others. The track-and-field competition would star Abebe Bikila of Ethiopia, who, with his victory in the marathon, would became the first black African to win an Olympic gold medal. Women’s athletics would be dominated by American sprinter Wilma Rudolph. Wilma Rudolph had formerly suffered from polio but she would win three gold medals in sprint events on the track. She would be acclaimed as "the fastest woman in the world". The American, Cassius Clay, would win boxing's light-heavyweight gold medal. He later changed his name to Muhammad Ali. Jeff Farrell would win two gold medals in swimming for the United States. Amazingly, Jeff had undergone an emergency appendectomy six days before the Olympic Trials. The decathlon would feature a tightly contested battle between Rafer Johnson of the United States and Yang Chuan-kwang of Taiwan, close friends who both attended the University of California at Los Angeles and trained under the same coach. Although Yang outperformed Johnson in
seven events, the American’s dominance in the throwing events made the difference and he outscored Yang by 58 points to win the gold medal. Middle-distance runner Peter Snell of New Zealand would win the first of his three career gold medals. The United States men's national basketball team would be led by future Basketball Hall of Famers Walt Bellamy, Jerry Lucas, Oscar Robertson and Jerry West and capture its fifth straight Olympic gold medal.

Another amazing feature of the Rome Olympics was television coverage. This was the first Summer Olympic games to be telecast in North America. In addition to CBS in the United States, the Olympics were telecast for the first time in Canada, on CBC Television and in Mexico, through the networks of Telesistema Mexicano. Since television broadcast satellites were still two years into the future, CBS, CBC, and TSM would have to shoot and edited videotapes in Rome, feed the tapes to Paris where they would be re-recorded onto other tapes which were then loaded onto jet planes to North America. Planes carrying the tapes would land at Idle wild Airport in New York City, where mobile units fed the tapes to CBS, to Toronto for the CBC, and to Mexico City for TSM. Despite this arrangement, many daytime events were broadcast in North America, especially on CBS and CBC, the same day they took place.

CBS paid $394,000 ($3,150,000.00 in today's dollars) for the exclusive right to broadcast the Games in the United States. The TV rights have become more expensive with each successive Summer Olympics. In comparison, fifty-six years later, NBCU paid $1.226 billion for rights to the Rio Games, slightly more than the $1.18 billion it paid for rights to London four years ago, and well above the $900 million it paid for Beijing.

When the Israeli plane landed in Rome the week before the Games began, I was oblivious to external events such as media coverage and could only anticipate the many amazing performances and records which were to come. I knew that I must concentrate on my own performance and was anxious to begin practicing.

However, there were many new experiences for me and for most of my Israeli friends on the team. For example, we Israelis were shocked and unprepared for the vast quantities of food available to all the athletic competitors in the athletes’ cafeteria. In the athletes’ cafeteria, there were long tables with huge mountains of food representing types and flavors from every part of the world. It was an Olympic Game of food and preparation!

At Hadassim and in most of the Israel, at that time, we had never had very much food. During most of my childhood, there had been food rationing. However, in Rome, any competitors could eat anything and everything. Shockingly, it was also possible to have second and third helpings. All the Israeli athletes were foolish in how we filled our plates. In the long run, it may have been delicious, but was probably detrimental to our collective performances. I would never blame anyone else for my performance, but I believe that we should have been “coached” not to overeat or eat unfamiliar dishes. I know that I stuffed myself with so much delicious food and then I could hardly walk never mind try to throw a shot or discus. In retrospect, I was definitely an Olympian in food consumption.

Another unique feature for the athletes was our alarm clock. Everyone morning in the Olympic Village, we were awakened by the Tarzan yell provided by the American pole vaulter, Don Bragg. At six o’clock in the morning, Don would belt out the Tarzan yell and each athlete knew it was time to wake up. Don went on to win the Gold medal for pole vaulting although he never became Tarzan.

Prior to the competitions, athletes could train every day at the Training Stadium which was open to all competitors. Many observers came to watch the athletes and here was where I was able to meet, face-to-face, some of my childhood heroes. I met the World-Record holder in the shot put, Perry O’Brien, as well as the World-Record holder in the discus throw, Al Oerter. Both of these American throwers had been long-term residents in pictures on the walls of my dorm. Al Oerter had won the Gold medal at the Melbourne Games in 1956 and Perry O’Brien had won two gold medals in 1952 and 1956.

It was thrilling to train with them but I was embarrassed to see how much better they were than I was. I had known for many years that these throwers could throw greater distances than I could. But to
be on the same field and with my eyes wide open, the distances they could throw were mind-boggling. Oerter was throwing the discus about 200 feet while my practice throws were only about 170 feet. Prior to the Games, my best throw was the 173-foot Israeli Record, which I previously set during the Olympic Trials.

I had no illusions that I would actually win a medal in the Olympics, however, I had dreamt of being there and participating in this thrilling adventure. I had dreamed and trained for nearly eight years to represent Israel at the Olympic Games. I had achieved my dream which is probably the ultimate achievement for any Israeli discus thrower and shot putter to be part of Olympics. Actually, I was an example of the Olympic ideal that participation in the Olympics is the most important criterion. I suspect that in every competitor’s heart, there is an undeclared yearning, a secret passion to win the Gold in spite of overwhelming odds. I know that I wanted to win, to get the “gold”, and to prove to myself and everyone else that I could win. These dreams and yearnings aside, I knew that realistically the mere fact that I was participating was my “gold”.

The week before the Opening Ceremony, which are the official beginning of the Games, were filled with a variety of opportunities for the participants. One unique event was an invitation for the athletes on each country’s team to visit the Vatican and to meet the Pope. Needless to say, this was a rather unusual opportunity for the Israeli team. There were athletes representing some 15 countries on the day we were scheduled to visit the ancient Cathedral and to meet Pope John XXIII.

When the Pontiff came into the small white room to bless us all, everyone knelt as His Holiness went from athlete to athlete, putting his hand on each person’s head and saying a prayer. The Israeli team had been previously instructed not to kneel or bow since Jews kneel only to G_d.

When the Pope approached me, I decided to kneel. I do not know why I did it since I had not considered it before that instant, but I did not want to be different from everyone else in the World. My friend and teammate, Amos, kept pulling on my arm to stand up, and I remember telling him, “When in Rome, do as a Roman.”

After the ceremony, the head of the Israeli delegation lectured me about this inappropriate and unacceptable behavior. I told him again that when in Rome, I wanted to be like everyone else. We could give respect to the Pope without betraying our own sacred Jewish beliefs. He agreed with my argument, and the case was closed.

Wilma Rudolph winning the Sprints
http://arielnet.com/ref/go/1052
Finally the day for the Opening Ceremony arrived. The Israeli Olympic Committee had decided that I would be the athlete to carry our country’s flag. As I led our athletic delegation into the stadium, my heart pounded in my throat. I held the flag with one arm and it waved high above my head as we marched into the Olympic Stadium that momentous day in Rome in 1960. The Israeli delegates walked in their dark suits behind me as we proudly represented a country that had not even existed when I was born.

I could not believe I was actually marching among men and women who had individually excelled in their chosen sport and were here in Rome with me and my friends to participate in this glorious adventure. Even more awe-inspiring to me was that many of these athletes had been my childhood heroes. To carry the flag for my country, to stand in the oval of the stadium shoulder-to-shoulder with all of these marvelous athletes, was so unbelievable that I had to pinch myself to know whether this was the most marvelous dream I had ever dreamt or was actually happening! It was only six years since I had asked my
coach, Yariv Oren, if he thought that I could compete for Israel in the Olympic Games. His affirmative answer had inspired me to train with enthusiasm and devotion and now here I was!

Although I was proud to represent my country, I believe the humanistic teachings at Hadassim had influenced my perceptions. For example, everywhere I looked there were flags of different countries, here a Russian flag, there an East German, and so on for country after country. It seemed that this carrying of flags was a bit like war. This nationalism reflected in the blatant separation of countries into competing units seemed to me to be inconsistent with the ideals of the Olympics. The Olympic Games should not be about nationalism, but mirror the original Greek philosophy which focused on athletic strength and skill. In fact, the ancient Greeks were to set aside all wars and conflicts for the duration of the competitons and, in fact, performed in the nude so they would not be identified as representing a specific State. The goal for the ancient competetors was just that – competition. Nonetheless, I loved my country and considered carrying the flag and being an athletic representative as an honor. I was ecstatic to have this opportunity and I have continued to enjoy the thrills I felt that wonderful day in Rome.

The achievement, effort, and years of work were part of the preliminary Olympic experience. Being introduced to the World in the Opening Ceremony was a fantastic event. Now that the Games had officially begun, I would have to focus my training while waiting for the day of my event to arrive.

I went to the Training Stadium every day to practice my throws. One day while I was training, one of the coaches who had been allowed into the stadium, introduced himself. He inquired about my future plans. I told him I wanted to study in the U.S., but that I would have to complete the mandatory three-year Israeli Army service first. He nodded and said that if I was still interested after the army and had made progress in my throws, I should contact him. I immediately assured him that I would love to compete for his University. Deep down in my heart, I feared this would be a missed opportunity since who knew what would happen in three years. However, for a chance to study at a university in the United States would be a dream come true. It was almost a bigger dream than competing in the Olympics, so why should I stop dreaming now?

I continued to practice until the first day of the discus throw arrived. The order of competition in the Olympics Games differs from ordinary meets. Normal competitions have all of the athletes throw 6 times and the longest throw wins. Olympic events are organized with all throwers initially having three throws to qualify. Then the 18 throwers who threw the longest distances advance to the next round. In this round, all of those athletes throw three times and the 6 throwers with the longest distances advance to the final round. The three top throws in the final round are awarded the gold, silver, and bronze medals.

Finally, it was my turn to compete in the discus event. I was extremely nervous, despite having received a papal blessing! I was unprepared for the sequence of events that occur in Olympic discus competition. I did not know that you had to warm up before your turn came to throw and then wait, frequently more than an hour, before you had your next throw. I was familiar with the smaller meets in
which all of the throwers completed the six throws within an hour. I warmed up for my first throw and threw terribly. I had been nervous before competitions in the past, but nothing prepared me for this major stage in front of huge crowds and with my childhood heroes in the same event.

I may have broken records in Israel, but the strain of the fierce rivalry in Rome, the newness of everything, the vast amounts of food, the pressure, which I felt from my childhood, and the hopes of my entire country, were enormous burdens. The pressure was more than I could cope with and, unfortunately, I continued to have one of my worst performances.

I was devastated by my atrocious performance but was elated that my hero, Al Oerter, won the discus Gold medal. He threw 194.16 feet and set the Olympic record as well. The silver and bronze medals were also won by Americans.

I also completed in the shot put event. Unfortunately, I did not perform as well as I had hoped in that event either. My results were less than I had thrown in other meets. My Olympic performance could only be described as woeful. I was disappointed, but hardly surprised, since even my 53.37-foot throw which I had made before going to Rome, was far shorter than Bill Nieder’s gold medal put of 64.56 feet.

I do not try to make excuses for my poor results. I had gone to the Rome Olympics and fulfilled my long-held dream to do so. But I was disappointed in myself for performing poorly and embarrassed that I had let down all of my friends and fellow Israelis. I could only hope to return home and redouble my efforts to perform well in the future.

Upon my return to Israel, I received vigorous and relentless criticism in the newspapers and from my coaches about my abysmal performances in the Games. However, in the next competition in Israel, I broke the discus record again and, once more, received favorable headlines.

In Israel, military service is mandatory for all men and women at eighteen years of age. On my eighteenth birthday, I had received a deferment to attend Wingate College and to compete in the Rome Olympics. After the Games had ended and I returned to Israel, it was time for me to join the Army.

The Israel Defense Forces (IDF) has a unique rank structure. Because the IDF is an integrated force, ranks are the same in all services. In other words, there is no differentiation between army, navy, air force, etc. The ranks are derived from those of the paramilitary Hagenah developed during the British Mandate period (1920 to 1948) to protect the villages. This origin is reflected in the slightly compacted rank structure; for instance, the Chief of Staff (in Hebrew rosh ha'mate ha'klali, or ramatkal) is seemingly only equivalent to a lieutenant general in other militaries.

In my case, I was not interested in becoming an officer since I did not foresee the military as being a suitable future profession for me. Since I had graduated from Wingate College and was a physical education teacher, I was assigned to a special location at the Tel Hashomer Hospital Complex and was classified as a non-commissioned officer. I was assigned the rank of “Rav samal rishon”. “Rav samal” translates as "chief sergeant" and is a career NCO rank equivalent to a British or Commonwealth "Staff Sergeant" or "Sergeant Major"/"Warrant Officer". It can also be translated as "chief sergeant first class".

At Tel Hashomer, my assignment was to help rehabilitate injured soldiers through the use of fitness exercises and physical therapy. I had all the physical equipment necessary to work with them and these wounded soldiers improved greatly.

As an Olympian and a bit of a celebrity, I was also assigned the job of fitness training for the top paratroopers, the Special Forces frogmen, as well as, the elite officers in the Army. Every morning from 7 to 8:30 a.m., there would be the somewhat surprising sight of the entire parking lot filled with armed soldiers standing at attention. These soldiers were amassed as a security detail to protect the Generals that I was training for their fitness. Some twenty-five men attended my fitness class.

I paid little or no attention to the names of those officers in this fitness class since my only goal was to ensure that they worked hard and followed my instructions. I was aware that one of them was Moshe Dayan, who was then Chief of Staff. Another officer, now a well-known and recognizable individual, was Ariel Sharon. General Sharon only trained three times a week but since I was not the one to command him to attend, I merely did my job for all of the officers who were there. These men would have to
stretch, run the obstacle courses which I designed, and then train with resistance exercises. We also played indoor soccer, volleyball, and tennis. There were no easy workouts for these men, despite their elevated ranks. It was more important that they be fit and healthy, rather than spoiled and out of shape. Many of these military leaders, Sharon, Dayan and others, were heroes to me and to nearly everyone in Israel for what they had done to save our country in the many wars we had had to fight. Therefore, I felt especially honored and appreciative when they took the time to compliment me on my own tenacity and athletic successes. It made me feel that I truly was on the correct path.

I continued to conduct this officers’ class for nearly two years. In 1990, I happened to visit Tel Aviv, Israel on business and took the time to go to the fitness facility in my hotel. It was a pleasant surprise for me to encounter one of these Generals as he left the gym as I was entering. This former General, who had served Israel for nearly 40 years, assured me that he continued to train according to the same plan which I had instructed him those many years before. The fitness plan which I had devised some 30 years before was the one that he had continued to follow during these intervening years. He explained, with a wink in his eye, that since I had been so insistent when he participated in my Army fitness classes he was afraid of my wrath should he be less diligent now. Despite the expression on his face, I was unsure whether he was serious or joking but since he was working out, I was pleased that my message had resonated.

While I trained the injured soldiers at Tel Hashomer and the officers as my Army duties, I continued to practice throwing the discus and shot. The Army allowed me to compete in events throughout Israel and neighboring countries. I competed in Greece and Turkey and won several competitions. At this point, I had set my sights on the next Olympic Games to be held in Tokyo Japan in 1964. I was preparing for these Olympics and planned to perform better there.

Army life had little appeal to me and it was certainly not a career option. I was then and continue to this day to be a dreamer, an entrepreneur, and an inventor. There is no place in the army where I could synchronize my skills and temperament with the tasks of a soldier. Other than my job of training the officers and helping the wounded, I had no other military obligations. This relatively light work load meant that I could spend time on my own athletic training. However, most of the days were boring, tedious, and uninspiring.

One day, however, my boredom was alleviated by the appearance of a beautiful blonde girl who had come in search of a person she identified as Aluf Geva. In Hebrew, “Aluf” has two meanings, Champion and General. I answered her by saying “Aluf Geva is not here, but Aluf Ariel is.” The beautiful girl had a puzzled expression on her face when she asked, “Who is Aluf Ariel?” I pointed at myself and replied, “There are many Alufs, who are Generals, but there is only one Aluf, who is a Champion. I am that Aluf.”

She laughed and, fortunately for me, was not offended by what some would consider arrogance. Her name was Ilana and soon this girl, who was a nurse and an officer, became my good friend. To this day, she remains one of my best friends. During our Army days, we went to the movies, talked hours into the evening, and I greatly admired her mind, talents, and friendship. She would bring me vitamins from her hospital, since I was as health conscious then as I am now. We enjoyed the beaches, spending...
time with my friends, and the nightlife of Tel Aviv. This wonderful friendship alleviated some of the dullness and boredom of being in the army.

I was afraid to take our relationship beyond friendship. Ilana was a wonderful, kind, and fun person and I have always valued her contribution to my life. I think I was affected, to some extent, by my family experiences. This is the only explanation I have for my preference for women. Of course, life frequently does not follow a logical or reasonable path.

After one competition in the northern part of Tel Aviv, a few of my fellow athletes and I were walking back to our homes. On the way, Ayala Hetzroni, a female Olympic shot putter, was walking with another woman. This woman was extraordinarily beautiful, quite tall, with long blonde hair. “Who is that?” I asked Ayala.

“That’s Yael. She’s a dancer with the Inbal.” The Inbal Dance Theater is Israel’s first and oldest modern dance company. The company was founded in 1949 and acquired international acclaim. I tried talking to Yael, probably boasting about this exploit or that, but with little success. She did not seem to be particularly interested in me or my conversational offerings. She was probably used to men being interested in her wherever she went.

There was another factor which I had to consider. Although I was not close with my father, I knew one thing, he looked down on Sephardic Jews, which most of the Middle Eastern Jews typically were. My father had already met my friend Ilana, a respectable beautiful Ashkenazy nurse, who had been born in Poland. He could not say enough good things about her. Indeed, Ilana remained in close contact with my father long after I had long gone to America. I knew that my father would not have the same positive reaction to Yael, who came from a Sephardic background, and would harbor more than mere resistance to her Middle Eastern heritage.

Yael continued to seem bored with me and we had few common interests. Hollywood movies have generated millions of dollars with stories of attractions based on looks and feelings. Sometimes these obsessions on beauty or behavior become the only things that matter. Perhaps some of Yael’s allure

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was my father would not like her, but mostly, it was her beauty and the pride I felt when other men turned looking at my girl. Unfortunately, youth rarely recognizes the costs that poor decisions eventually garner.

In those days, there were few personal telephones. If you wanted to contact someone, you had to travel to the person’s house. Yael had told me where she lived so I walked half way across the city of Tel Aviv to ask her for a date. To my amazement, she agreed.

For our first date was to see the movie “Psycho”. “Psycho” was a 1960 American psychological horror film directed and produced by Alfred Hitchcock and starred Anthony Perkins and Janet Leigh. It had just been introduced to Israel and was the must-see movie at that moment. Neither Yael nor I knew much about the movie before we went. We only knew from friends that the film centered on the encounter between a secretary, who ended up at a secluded motel after stealing money from her employer, and the motel’s disturbed owner-manager, Norman Bates. The was an exciting thriller and causes the hair to stand up on the neck and your heart to leap into your throat. It was surely an exciting and nerve-racking show.

Although I attempted to be the perfect gentleman and kept a respectable distance because, fundamentally, I was shy. However, throughout the movie, Hitchcock’s dramatic events managed to provoke surprise or shock and Yael would grab my hand or arm! I was surprised but elated as well.

After the movie, we walked back to her home. Just as she turned the key in her door lock, I joking tried to scare her by saying, “Watch out! Tony Perkins is behind your door”. She whirled around and slapped me across the face. Not only had my joke failed miserably, but, unfortunately, I did not recognize this response as less than an auspicious beginning.

At that time, Yael was only 19 and I was 21. We were relatively unsophisticated in our dating practices, but I continued to date her and soon we were a couple. I must admit, I liked how all heads turned when we walked into a room. Here, I was with this woman, whom others could only stare at in admiration. I was not particularly drawn to her personality and she had no interest in academic pursuits for me or herself. She was artistically talented in dancing, painting, and crafting jewelry whereas my artistic talents were mainly restricted to observing these activities. I knew that she had family problems but, since I had a background of personal difficulties, these problems were of little interest to me. She was beautiful that was sufficient to mesmerize me.

Now my life was filled with complications and enjoyment. I was busy with my Army job, my daily exercise routines, the discus and shot put training activities, and with two interesting women. One of them was beautiful and difficult, Yael; while the other one was a beautiful, lovely, smart, and caring friend, Ilana.

While I was enjoying this feminine duality of the heart, Yariv Oren, at one of our training sessions, mentioned to me that they had received a letter from the U.S. Department of the Interior that Israel was qualified to send two athletes to the U.S.A. for training. The U.S. department would pay all the expenses. He told me that I was one of the candidates they were considering.
In Israel, there are two athletic clubs, the Macabi and the Hapoel. There would be one athlete chosen from each club to be sent to the United States for this training. The Macabi had already selected an athlete by the name of Amos Grodjinovsky. Amos was a friend of mine since childhood, a sprinter and long jumper, who had also represented Israel in the Rome Olympics. The other leading candidate was Meir Yaacobi, a hammer thrower, who had just broken the Israeli record in the hammer.

Unfortunately, for me, Meir and Amos were the ones who had been selected for the three-month Exchange Program. I was devastated at losing an opportunity to go to the United States. But my coach, Yariv Oren, was unhappy with the selection and used his influence to replace Meir with me. I was ecstatic. Although Meir was my good friend, these decisions were not ours to make or challenge. Therefore, I joined Amos for the trip to the U.S. in March of 1963.

Forty-five years later, in 2004, I traveled to Israel. As usual, I met with my old friend and mentor, Yariv, and another long-time friend, Gilad Weingarten. We were all invited to Meir Yaacobi’s home near the Sea of Galilee. Meir’s family had originally come to Israel from Iraq so he cooked a delicious Middle Eastern dinner for us. After the meal, when we were sipping our Turkish coffee on the patio, Meir said to Yariv, “Yariv, I have wanted to ask you a question for nearly 45 years and have never asked you.

I interrupted Meir and said, “Meir, I know the question and I know the answer. You’re going to ask, ‘Why was Gideon selected to go to the U.S.A. and what happened to me?’”

Meir was astonished. “Wow! That is my question,” he said. “What is the answer?”

“Well, I guess an injustice was done to you and I have never forgotten it,” I told him.

Yariv was quiet.

“Well, Yariv, what do you have to say?” Gilad asked.

Yariv’s answer was, “No comment.” We all laughed and enjoyed another cup of strong, sweet Turkish coffee.

Amos and I readied ourselves to go the United States for this exchange program. On March 8, 1963, I was ready to leave for the Exchange Program in the United States. However, I needed to receive an early discharge from the Military before I would be allowed to fly to the United States. Luckily, Yariv was there to help me again. He persuaded the Military to discharge me two months earlier than my actual completion date so that I could represent Israel in this Exchange Program. What a dear friend he was and how fortunate I was that Yariv was there to help me in so many ways and for so many years.

When we arrived in NYC, representatives from the U.S. Department of the Interior came to meet all the athletes from approximately 30 countries around the world. When they called my name, it was Mr. Yaacobi, since they still had Meir’s name, rather than mine. I corrected them and explained it had been a last-minute change. They put each of us in a luxury hotel and we attended lectures on how to behave.
Soon, each of us was informed of the name and location of the university we would attend somewhere in the U.S.

Before we flew to our assigned universities, all of the exchange athletes were taken on tours of New York City. We saw the Statue of Liberty, went to the top of the Empire State Building, and appeared on the Ed Sullivan Show. I feel sure that our ratings were lower than those of the ones generated by the Beatles!

New York had seemed like another planet despite my having traveled to Rome, as well as, other large cities outside of Israel. There was nowhere like New York City. This huge, bustling city with its tall buildings and endless concrete seemed like a science fiction movie. The energy on the streets was contagious and it gave life to my fantasies of America being a place where anything was possible.

Amos was assigned to the University of Louisiana and I was assigned to Colorado State University in Fort Collins, Colorado. After I had arrived in Colorado, I was housed in a dorm with regular college students. I began training every afternoon with the Track and Field athletes who represented Colorado State University in their athletic conference.

I asked the coach if I could attend regular college academic classes during the times when we were not training. The school officials readily agreed so I joined the Physiology and Anatomy class in the Pre-Medical program. It was an amazing experience although I had some difficulty with the English and lacked some of the background material for the topics being discussed. However, I was confident that I would do well as a student in an American university if only I had the chance to try.

The coach at the Colorado State University was Mr. McCone. Coach McCone was a dedicated coach who helped me with my technique. During one of the practices, I asked him if he knew any University which could give me the scholarship to continue to study in the U.S.A. I tried to tell him about my encounter with a U.S. coach in Rome, but Mr. McCone had no idea who that might have been. A few days, he called John Walker who was the coach at the University of Wyoming. Since both Colorado State University and the University of Wyoming were in the Western Athletic Conference, the two coaches knew each other well.

I was surprised, when two days later, Mr. John Walker, the coach from the University of Wyoming, appeared at the training stadium. He watched me throw while I was practicing the discus. Then he asked about my shot putting, so I threw some shot puts as well. During this meeting, it became clear that my recent throwing results were better than the current Wyoming record in the discus.

"Gideon," Coach Walker said, "What about a full scholarship to study and represent the University of Wyoming in discus and shotput? You be able to receive your Bachelors of Science there. Do you think this would interest you?"

I was thrilled. "Absolute, you can count on me, "I said excitedly although I did not quite know how I would make this dream into a reality. But, exuding confidence, I said, "When school starts in September, I will be there!"

"Fantastic!" he said, patting me on the shoulder. I will send you a ticket and the required University paperwork for your visa in the mail to your home in Israel. Just give me your home address. I will take care of everything else for your arrival in September.

I was in shock and joy for the remainder of the training session in Fort Collins. I could not believe this fantastic opportunity to study in the United States was practically a reality. I continued to train as hard as possible and to study diligently. My mind, however, continued to swirl about this fantastic opportunity.

As soon as I returned to Israel, I went to see Yariv. By then, Yariv had been appointed as the Minister of Sports. I was extremely nervous. This man had done much for me, but I knew he was a strong Zionist. In Yariv’s mind, all of the young men whom he had trained and supported were to be the future of Israel. Besides, we had been very close friends for quite some time and I also knew that I held a special place in his heart. I knew that he would not want me to leave.
Yariv was in his office with its windows looking out over Allenby Street. The Mediterranean sun was shining and we could see the ocean in the distance as it flickered and glistened in the sunlight. It was a perfectly lovely day in Israel.

“Shalom, Gideon.” Yariv said as he gave me a big hug and a joyful smile. “I am so glad to see you back home.”

“Yariv,” I said, “I am so grateful for everything that you have done for me. I want you to be the first to know that I have been offered a full scholarship to attend the University of Wyoming. I will be on their Track and Field team throwing the discus and shot put. I will be enrolled at the university and will be able to earn my Bachelor’s degree as well as competing for the school. In addition, they will pay all of my expenses including the travel and the airfare to get to Laramie.”

He looked severely at me, “Absolutely not, Gideon. You must now contribute what you have learned to Israel. I did not send you to the United States for you to remain there.”

“I will come back after I finish my studies,” I told him. “Wouldn’t you prefer me to return as a man with a Bachelor’s Degree rather than as a PE teacher? This is the opportunity of a lifetime.”

There was no question in my mind that I was going to the U.S. to study and train. “I will return,” I promised, “after I finish my Bachelor’s degree.”

Yariv listened to my words warily and then stood up, shook my hand, and gave me a great bear hug. This wonderful man hugged me, as my father had never done. Although he was only eight years older than I was, he had been the one who was behind every success that I had achieved to that date. I owed everything to him and his encouragement. It tore at my heart to see his distress at my leaving but I knew he also agreed that this was the correct decision.

“Don’t forget your promise.” he said.

“I won’t.” I replied.

The next person I had to tell was Yael. We arrange to meet and when she arrived she looked beautiful in her dress and had a big smile.

I began telling her my plan to go to America and study. “I have to go,” I said. “The coach in Wyoming is waiting for me. This is essential for my career and life.” She became upset but I continued to explain how important it was for me.

“Oh, if you have to go at least promise me you will come back to Israel,” she said. “You could study here and be a professor.”

“We have enough professors in Israel,” I laughed.

In retrospect, I do not think I ever really expected to return to Israel. I had many good friends in this special country. Yariv had done more than my own father to help me achieve and to excel. I loved him for the special way that he had guided me and had cherished me like a son. Many people knew my name because of my athletic achievements even if they did not know me personally. Realistically, there was nothing that I could do in Israel that would be interesting to me and beneficial to the country. I had joked that Israel did not need more professors, but I also could not imagine leading classes in physical education either. I did not know what my future academic or professional challenge would be but I could not envision that I could pursue it in Israel.

Israel was also the country where my mother lived in an institution. It was the home where my father would read in the papers about his son performing in the Olympics and breaking records for Israel, but could not tell me that he sneaked to the stadiums to watch my performances. At that time, I believed that my father was ashamed of me and thought that I was and would always be a failure. I was unaware that he had saved every newspaper article in a scrapbook or that he was proud of me and of my successes. I did not discover my father’s devotion to me and my activities until many years later after he died.

After explaining to Yariv and Yael my new future ambition to go the United States, I was not sure that I could get a visa to the States. I had a “J” stamp on my passport for my Exchange Program trip to Fort Collins, Colorado. Undaunted, I went to the American Embassy and kept my mouth shut. When I went to the person processing my paperwork, I showed them the invitation and formal documentation
from the University of Wyoming as well as the ticket to fly there. He seemed to give little attention to
my passport and I was issued the student visa to study in Laramie. With a sigh of relief, I packed my
belongings for the trip to America.

At last, I was on my way. I dreamt of a new, bigger, and unforeseen life. I had not bothered to
look at a map to see where Wyoming was in America. I could barely speak English. But I knew in my
heart that the “highest university in America” was going to be the start of what was to be a life of peaks
as high as the Rocky Mountains.

With Coach John Walker 50 years later at my house and the Ritz
In September 1963, I flew from Israel to New York City. Although I had been to New York City before with the Exchange Program, things were different for me on this trip. There were no friendly faces with smiles waiting to assist me. I was a tall, muscular young man surrounded by suitcases, with poor English language skills, in one of the busiest and least friendly airports on the Planet. I had left the old city, the beaches, the ironic laughter, and the ten million opinions in Israel and just landed in the what seemed to be a frenetic, enormous ant colony. No one seemed to notice me let alone stop their own busy activities to ask if I needed help. What a change from my last visit. However, I knew that there would be a solution and I would find it one way or another.

The Israel that I had left was a very small country, roughly the size of the U.S. state of New Jersey. The shortest distance from east to west is nine miles, near Netanya, where I had attended Wingate College. The longest north to south distance, as the crow flies, is 290 miles. At that point, I did not yet know about the shocking size differential. All I knew was the frantic and unfriendly crush of people at this huge airport complex in New York City.

In Israel, people got around the country by riding the bus, walking, or hitchhiking. Naturally, I assumed it was the same thing in the U.S., so I asked an airport worker for directions for the bus to Laramie. Now came the next shock. The fellow told me that Laramie did not exist! He told that it was only a popular American television program and there were no buses going to an imaginary place. Eventually, I found the bus terminal but there were only buses to downtown New York City and none scheduled for Laramie, Wyoming. Now what I wondered?
A man on the plane had told me that many wealthy New Yorkers needed to move their cars from the East Coast to the West Coast. The idea was that these people would fly in comfort and would hire someone to drive their car. He told me that if I could find someone who needed this service, I might even be paid to drive the car. What a fantastic opportunity this would be for me now that I was stuck, 2000 miles from my destination in Wyoming. My driver’s license was for riding motorcycles in Israel, but I trusted myself that with luck and charm this would not be a deterrent. I managed to locate an agency for driving cars to California just as the man on the plane had said. Apparently, the man at the counter was satisfied with my driver’s license but perhaps they assumed that any policeman that I encountered would not read Hebrew any better than he did.

The agency paired me with another young man. This fellow was Chinese and his English was worse than mine which, believe me, is saying something. We were assigned to drive a large, new, fancy Cadillac from NYC to California. I explained that I would be traveling only as far as Laramie, Wyoming, but neither the agency nor the Chinese seemed to understand or care what I was telling them. Of course, I now realize that none of us had a clue where Wyoming was located.

It was not very long before I discovered that the United States was vastly larger than Israel. When I had flown to Colorado, it was just a few hours of flight time covering a huge distance. But driving was a new and eye-opening experience. I had no idea that any place could be so huge! Israel had beautiful landscapes, but my entire country could fit into New Jersey. Here in American, there were roads after roads, hills, green forests, winding rivers, and open lush valley landscapes that seemed to stretch on forever. This America was so much larger than I had ever imagined, when I dreamt my impossible dream, staring at my old map in Hadassim with the elephant in Africa and the family in the Cadillac driving across America. Here I was in a Cadillac but this country was much bigger than the one I had assumed when I stared at the family on my map. This place was bigger than I had ever thought possible.

Unfortunately, the Chinese fellow was quite nervous and easily irritated. He never wanted to make comfort stops and constantly ranted in Chinese. Despite my grumpy companion, I could see the natural beauty of the countryside as we drove from East to West. The green grasses and forests covering the mountain were more lush than any place in Israel. The rivers we crossed seemed enormous compared with the tiny Yarkon River of my childhood. Even the roads were wider and seemed to stretch on forever.

Eventually, the Chinese man left me at a bus station in South Dakota near Mount Rushmore where the presidents’ heads are carved into the mountain. I had never seen such a huge carving and, once again, was impressed by the vastness of America and, seemingly, everything in it. South Dakota, with its mountains and Badlands National Park, could have been the moon for all its unique, but completely unfamiliar, landscape!

I finally boarded a bus for Laramie, Wyoming. At least in South Dakota, the bus station attendant knew that it was a real place and not some television locale. After six hours of riding the bus, I arrived in Cheyenne. I changed to another bus and finally arrived in Laramie. It was an enormous relief to see a friendly face for a change when Coach John Walker was there at the bus station to pick me up.

I stared at the town and the surroundings as we drove in Coach Walker’s car. Once again, I was mesmerized and awed by the nature and the surroundings of the town. I had never experienced beauty or grandeur like this. Until this moment, I had only known the warm Mediterranean sun and small hills which were nearly barren or covered with olive groves. Even the hills of Greece and Rome had been smaller and warmer than these mountains. Everything here was enormous and the Rocky Mountain that seem to surround the town on the horizon were huge, rugged, and snow capped at their summits despite it only being September.

I had left the warm, almost hot, Israeli climate in my shorts and sandals. The temperature this day was quite chilly for an Israeli boy who had rarely experienced temperatures below 60 degrees Fahrenheit. It was a crisp cool autumn day in Laramie which I would look back upon as hot after my first winter in Wyoming. But this first day it was a climatic shock.
Coach Walker’s first stop was at Sears to buy a proper coat for me or I would have frozen to
death. I noticed that all the people around me were also big. In Israel, people were relatively small. I at
6’1”, considered tall by Israeli standards. When I looked around the store in Wyoming, I saw big hats
and blue jeans on big people and felt that I had been transported into one of those Western movies I used
to watch in Israel.
I could not understand one word of any of the conversations that I heard. The people sounded like cats meowing. Although I had trouble understanding the language, I discovered immediately that everyone welcomed me with a friendly smile and big handshake. What a difference than when I landed in New York or rode in the car with the fussy fellow. These people in the store did not even know me but they acted as though I was their best friend. It helped to relieve the tension that I had felt up until now.

Laramie is the home of the University of Wyoming and is nestled between two mountain ranges. Coach Walker pointed out waterfalls and specific mountain peaks as we drove to the University. While he was pointing out the beautiful nature and identifying some of the school buildings, I continued to be amazed, even snuggled in my new warm coat, how cold it was. It was only the beginning of September and I was already cold. But the scenery was truly gorgeous and awe-inspiring.

Coach Walker took me to the Sports Dormitory and introduced me to my roommate who was one of the sprinters. The Sports Dormitory had its own restaurant in the downstairs area since the athletes were fed separately from the other students who lived on campus in other dormitories. Here was another
amazing feature in Wyoming. The food was available in enormous quantities and was delicious. I was rapidly learning that everything in Wyoming was huge.

The next day was the first day of training at the Field House. In September, it was too cold to train outside in Wyoming. The altitude in Laramie is 7200 feet and affected my breathing. Running around the field house was difficult but one of the other athletes explained that this was normal and that I would adjust quickly. The high altitude was a new experience but I rapidly adjusted probably because I was physically fit when I arrived.

I was given several discusses and started throwing in the Field House. How I loved the feeling that elevates your being, when throwing that round, nearly flat sphere. From that point on, my daily life became a regular, predictable routine. The day started with breakfast, followed by the academic classes to which I had been assigned. Initially, I was unable to understand the teachers’ English, but I was confident that eventually I would learn. Classes were followed by lunch, a two-hour rest period, and then back to the field house for training.

All of the Track and Field events as well as the entire football squad trained under one roof. The football players were the most enormous human beings I had ever seen. I could not believe the size of these athletes. I was amazed at the width and bulk of their shoulders and was surprised that their heads were completely out of proportion to the rest of their bodies. Another perplexing problem was why the University could not afford a round ball.

I wrote letters to my friends in Israel since there were no such things as cell phone. I tried to describe the size of these football giants. I had never seen such huge individuals and how grateful I was that they did not throw the discus. Needless to say, my experiences were with soccer, which is known around the world beyond the United States as football. Since I was unfamiliar with the American version of football, I also did not realize the size of the players was enhanced by shoulder pads.

My daily routine continued this way for weeks. One day while throwing the discus at the field house, one of the football coaches started shouting at me. I had no idea what he was yelling nor why. Perhaps my discus had landed too close to the football players’ area, but I was throwing in my designated area. I nodded my head, as though I understood, and continued to throw. The Coach again screamed and ran toward me. Unfortunately, in all of that screaming there was only one thing that I understood which was “Son of a bitch.” The Coach ran up to where I was throwing, waving his arms and ranting, raving, shouting, and cursing the entire time. I wanted to tell him to shut up, but when I went from the Hebrew expression in my head to the English translation that came out of my mouth, I told him to, “Close your hole.” For the Coach, this was the straw that broke the proverbial camel’s back. He lifted his clipboard high overhead and hit me with it. My military training produced an automatic reaction and I punched him hard in the stomach. He crashed the floor holding his midsection. Several athletes and other coaches rushed over to us. I turned and left the fieldhouse and went directly to my dorm.

As soon as I returned to my room in the dormitory, I began packing my clothes and belongings into my suitcase. I was sure this was the end of my college career in Wyoming and probably all of America. There was no doubt that I would be kicked out after this episode. My heart sank and depression rose.

Suddenly, I heard a knock on the door which I assumed meant that the police were there to “take me away.” When I opened the door an older man in his 50s was standing there and started talking to me in Hebrew. Now I was sure I would be returning to Israel, since I was starting to hallucinate that Americans could speak English which converted to Hebrew in my ears. The man introduced himself as Dr. Martin Wolman and explained that he had served in the Israeli military as a volunteer in the 1948 independent war. He asked if he could come into my room and told me that he heard what had happened in the Field House and asked to see my arm. I showed him the large gash on my arm made by the coach’s clipboard.
He told me, “Gideon, don’t worry, you do not have to leave. He explained that in America this aggressive behavior of the Coach toward the athlete was against the rules. The Coach, in this case, was the aggressor and I was the victim. In America, you are allowed to defend yourself when attacked. In fact, the Coach owed me an apology, at the very least. Regardless, I need not worry anymore and I would not going back to Israel.

Dr. Wolman said that he was the head physician of the University. He took me to the school infirmary and treated my wound. Then I was invited to dinner at his house that evening with his wife. He also showed me his Cadillac which impressed me greatly at the time. We remained close friends throughout my college years and he was always available to help for years even after I finished at the University of Wyoming.

The day finally arrived for my first meet as an athlete representing the University of Wyoming. The meet was in Denver at the University of Denver and everyone watched anxiously. My performances were awesome that day and I broke both records for the University in the shot and discus. Coach Walker was ecstatic with my performances as was I.

In addition, my English improved more rapidly than expected and I began to do better in all of my classes. My classes for the second semester would be more intense than those I had taken during the fall semester. They were more academically challenging and included more of the sciences, such as Physiology, Chemistry, and Physics. The professors liked me and were impressed with my intense efforts to understand the material. I would go to each professor when I needed help and then immediately go to the library to get the extra books they had recommended. They were also very approachable when I had questions or needed help with some difficult concept. I think many of my problems were language related but the teachers were always willing to help. I was studying hard in school, training intensely in the weight room, and throwing on the field.

Unfortunately, as much as I was fulfilling my dream of studying in America, I was lonely at school. I believe that some of this loneliness was because I was older than most of the members of the Track Team, since I had served three years in the military in addition to the two years of college at Wingate. I was 24 years old whereas the average Wyoming student was between 18 and 20 years old. Also, I missed Israel, my friends, as well as not having someone to share the academics and athletics. When I went to the track, nobody spoke Hebrew or came from the same background as I. I longed for a companion from Israel.

One day, during training, I told Coach Walker that I thought I should go back to Israel. He asked me why and I told him how lonely I felt and that I missed my friends. He asked me if there was an athlete who was my friend and would be willing to come join me and compete for the University of Wyoming. One of my best friends was Gilad Weingarten who was an excellent long jumper. I told Coach Walker about Gilad and, with no hesitation, he told me to bring Gilad to Wyoming.

I rushed to find a payphone and called Gilad in Israel. I paid no attention to what time it was in either location.

“Hello Gilad, this is Gideon.”

It was turned out to be in the middle of the night in Israel so, of course, I woke him up from a deep sleep. “What? Are you crazy?” he said.

“Listen. Would you like to have a full scholarship, like me, to the University of Wyoming? This would be an unbelievable opportunity for you to achieve all of the goals we talked about all these years while we were on the same team in Israel.” Gilad was in shock or maybe trying to wake up and determine if this was a dream or really a call from me in America.

“What’s the weather like in Laramie?” he blurted out.

I pulled my coat around me in the early snowy chill of October and said, “It’s just like Israel.”

Gilad agreed to come for the semester beginning in January 1964. I was still alone in the dorm, but I had Gilad’s arrival to look forward to for next year.
Despite knowing that Gilad would be arriving in a few months and having my studies and athletic events, I also missed Yael. Finally, after many romantic words and equally creative descriptions of Wyoming, she agreed to join me. She landed in New York on the day that Kennedy was shot, November 22, 1963. She took the bus to Laramie and we spent some happy times together. But she was not able to stay in Laramie since she had nothing to do. I lived in a dorm where she could not stay. She had nowhere to live and could not work since she had entered the US with a visa precluding her from working.

I had met a few Jewish families and they offered to help us. One family, the Brodies, suggested that Yael lives with them in Denver and I could visit on the weekends. She was supposed to help them with their children and housekeeping in exchange for a place to live. Denver was a two-hour drive from Laramie, which was not an insurmountable distance, so we all agreed to this plan.

On weekends when there were no track meets, I would go Denver. Unfortunately, Yael had only been granted a visitor’s visa, when she initially entered the United States which allows the person to stay for only three months. This meant that in January, Yael would have to return to Israel.

When I arrived in Denver one weekend, Mr. Brodie seemed to have solved the dilemma very neatly. He opened the front door, as usual, and said, “Hi, Gideon. Guess what?”

“What?” I answered with a baffled expression.

“You are getting married,” he said.

“When?” I asked, in complete shock.

“Today,” he answered.

His family had arranged the ceremony and even had a suit ready for me. So with the Brodies, the Rabbi, and little else, Yael and I became man and wife. The arrangement was for Yael to continue living with the Brodies since she could not live with me in the dormitory. We would have to find an alternative solution in the future.

I was afraid to tell Coach Walker that I was married since I thought I would lose my scholarship. Yael came to watch one of the competitions shortly after the Christmas season against the University of Denver. I won the shot-put throw and then went over to talk to her. Coach Walker called me and said, “Hey Gideon, leave the girls alone.”
I said “Coach, that isn’t a “girl”, this is my wife. “Your wife?” he exclaimed, “You never told me you are married.”

I said to him, “Coach, you told me Merry Christmas when we left school in December. I always do what my coach tells me, so I married at Christmas.”

I was worried that being married would affect my scholarship at the university so I needed a good explanation for the situation. I hoped my foreign background and less than perfect English skills would help me out of what could be a potential problem. My hope that an Israeli not understanding the meaning of “merry” in the traditional holiday greeting would make some sense.

Coach Walker smiled and shook his head. I guess by that time, he had become accustomed to my humor. I breathed a big sigh of relief and went back to throwing. I do not know if he realizes that he is the one who changed my life in more ways than one. Coach John Walker was and continues to be a wonderful man. Without his help and guidance, I would never have achieved the successes which I have accomplished during my time after the University of Wyoming.

With the Spring semester beginning soon, Coach Walker sent Gilad an airline ticket to come to Laramie. On the day Gilad was due to arrive, I waited with Coach Walker at the bus station just as Coach had for me only a few months earlier. The bus arrived and Gilad was dressed in the same fashion as I had been wearing only a thin shirt with short sleeves, shorts, and sandals. Unfortunately, the day Gilad arrived, the temperature was 50 below zero. When he stepped out of the bus, Gilad gasped for breath in the frigid, mountain air.
Yael at 8th month of pregnancy

Yael and I at Wyoming University

Yael at 8th month of pregnancy
“What do you mean the weather is just like in Israel? How could you lie to me?” he was finally able to stammer as he shivered in the cold.

I replied, “When I was talking to you on the phone, it was 70 degrees.”

He shook his head in exasperation. But to my great joy and relief, Gilad was there and I would not be alone anymore. We had been such good friends, hard-working athletes, and shared many common experiences in Israel, so I knew he would forgive me, eventually, for the climate. Picking up his suitcase, we went to buy some winter clothes for my frozen friend, Gilad.

The temperature in Laramie at times, can reach minus 50 degrees Fahrenheit. One day, Gilad and I went to train in the fieldhouse. I leaned into the trunk to retrieve my shot put with my bare hand since I had forgotten my gloves. At that temperature, the metal shotput stuck to my hand. This had never happened to me before so I had no idea how to remove a shot put which is frozen to the hand. I used a towel to pull the shot out of my hand and the skin of my hand was ripped off with it. It was several days before my hand recovered enough for me to return to shot put practice.

Gilad and I shared a room in the same Sports Dormitory designated for athletes where I had been housed previously. Our room was on the same floor as the one housing the football players. Unfortunately, the Track and Field athletes and the Football team did not share the same competitive seasons. Fall was Football season and Spring was Track and Field’s turn for competitions. Thus, the football players had regulated sleep schedules during the fall months until Christmas. Following the Christmas break, the football players no longer were subjected to rules regarding hours for sleep. During the spring semester, the Track and Field athletes had their more stringent rules regarding curfews and lights off at night. Therefore, during the spring semester, Gilad and I normally had a competition every Saturday.
There was, thus, a mismatch between the competitive schedules for football and Track and Field. The off-season football athletes would stay out late on Friday evening and, when they returned to the dorm, there was loud shouting, screaming, music, and noise until all hours. This tremendous noise interfered with our ability to sleep. One of us would have to get up and go out to the area where the football fellows were having their noisy parties and ask them to please to be quiet.

“Would you mind keeping it down? We have a meet tomorrow.” we would plead.

“Okay, ‘G-Boys.’” “G-Boys” was their affectionate name for us since we each had a name beginning with G. The players were always agreeable but then they would open another beer. Within minutes the noise level would be just as raucously and loud as it had been before we asked. It seemed that no matter how many times we asked them to be quiet, the parties would revive shortly thereafter. They were not mean or vicious but oblivious of their inconsiderate noise

Gilad and I decided that we had to find a solution for our problem. The following Sunday, at 4:30 in the morning while it was still dark outside, Gilad and I wrapped towels around our heads like pictures of Indian swamis. Then we sat crossed legged on our beds, closed our eyes, and began screaming loud, strange, and exotic noises at the top of our lungs. The sounds were deafening and we woke everyone on the hall. As the players were startled awake at this early and unholy hour, they groggily went downstairs to the supervisor on the first floor for help.

The supervisor sleepily came upstairs and knocked on our door. We continued to shout and scream at unbelievable decibel levels. Finally, the supervisor tentatively opened our door and saw us sitting on our beds while we screeched and wailed.

“What are you doing?” the supervisor asked us.

“We are praying,” we answered.

“Can I talk with you guys after you finish your prayers?” he asked.

We only nodded and continued “praying.”

After a reasonable period, we ceased our prayers, and we went to his office. The sun was just coming up on the horizon when we knocked on the supervisor’s door. He was a very nice man who liked both of us. He explained that our prayers were quite loud and woke everyone on the hall and inquired whether we could change the time or the location for our services. We explained that we understood how the other people on the hall felt about the beauty of quiet when sleeping. We explained that if we were able to sleep in undisturbed quiet on Friday nights, we would probably be able to find a different time and place for our own Sunday morning prayers. We would be able to accommodate the sleeping comfort of others on the hall on Sunday morning easily if we could sleep quietly on Friday nights. He quickly understood the situation and assured us that he would explain to the football players that loud noises on Friday night resulted in intensely loud prayers on Sunday morning. Quiet on Friday night meant quiet on Sunday mornings.

Friday nights were quiet after that. Occasionally, we would hear the players coming in late and if anyone made any noise, someone would say. “Shhhh, the “G-Boys” are sleeping. Don’t wake them up or they’ll start praying.”

Gilad and I were continually surprised by America and its many opportunities. For example, when we arrived in the U.S. in 1963 and 1964, we had left a country that did not yet have television available for the masses. During my first visit to New York City as an exchange student, we had all appeared on the Ed Sullivan Show. No one in Israel had known about this event. In Israel, visual entertainment was going to the theater for a movie. One day, Gilad and I ventured downstairs in our dorm and discovered there was a television set available for the athletes to watch. What an amazing magnet for two naive boys from Israel to discover. One evening we were sitting downstairs in the TV room with the other athletes watching a program called “The Fugitive.” We saw a man running with an injured arm and the police chasing him. We were surprised that this man who appeared to be badly injured was able to hide from the police without detections. The following Thursday night, the “Fugitive” was again on the television. We found it incomprehensible that the Police had not caught him yet! America was the
greatest country in the World, but the authorities could not apprehend a man with such a terribly injured arm. When we asked how such a situation could occur the other guys laughed at us. They explained that this was only a story and not an actual news event. We were informed that this chase had been going on for at least a year.

Another revelation for us was the crazy way the Americans danced at parties. We were familiar with the Waltz, Tango, Samba, and, of course, many Israeli folk dances. But at the dance parties we attended, there were bizarre and crazy bodily flailing that looked more like people were being given electric shock treatments than any dance movements, which we had ever seen. Girls attending these parties were not going to let two good-looking guys just sit and watch, however. We were dragged onto the dance floor and were forced us to learn to dance. Soon we looked like active rag dolls, as we twisted and turned.

Another situation which we though only occurred in movies were the bars in the small downtown area. People would ride their horses down the streets, stop in front of a bar, and tie their horses to a post in the front. Then, with guns in holster strapped to their legs, they would saunter into the bar to drink beer and play pool. Before I witnessed this with my own eyes I was sure this only happened in movies depicting times long ago.

One day, some friends invited Gilad and I to go to Cheyenne to see the Rodeo. Cheyenne is a town about 50 miles east of Laramie which we had visited from time to time. However, neither of us had heard of a rodeo so we readily agreed to go see what it was. We soon learned that “Cheyenne Frontier Days” is more than just a rodeo. It is an outdoor rodeo and western celebration held annually since 1897 in Cheyenne, Wyoming. The event, claims to be one of the largest of its kind in the world, drawing nearly 200,000 people every year.

Gilad in our room at the dorm
Prior to the annual kickoff of Cheyenne Frontier Days on a Friday, the annual walking of the steers is held on the preceding Sunday morning. This event, which attracts considerable attention, is based on the running of the bulls in Pamplona, Spain. (In 2013, 447 steers walked a three-mile course in unison into Frontier Park to await the forthcoming events.)

Cheyenne Frontier Days features nightly concerts by popular music and comedy acts, a midway, a fair with rides, games, and food vendors, wild west shows featuring Western riding, an Indian village, and a large internationally sanctioned rodeo. A common moniker for the event is "The Daddy of 'em All", based on its long history and the fact that the rodeo is billed as the largest such event in the world.

After walking around Cheyenne for a while, our friends “steered” us to the rodeo. We soon learned that a rodeo is a competitive sport that arose out of the working practices of cattle herding in Spain, Mexico, and later Central America, the United States, Canada, South America, Australia and New Zealand. It was based on the skills required of the working vaqueros and later, cowboys, in what today is the western United States, western Canada, and northern Mexico. Today’s sporting events involve horses and other livestock, designed to test the skill and speed of the cowboys and cowgirls. American style professional rodeos generally comprise the following events: tie-down roping, team roping, steer wrestling, saddle bronc riding, bareback bronc riding, bull riding, and barrel racing. The events are divided into two basic categories: the rough stock events and the timed events.

American rodeos, particularly popular today within the Canadian province of Alberta and throughout the western United States, is the official state sport of Wyoming, South Dakota, and Texas. The iconic silhouette image of a "Bucking Horse and Rider" is a federal and state-registered trademark of the State of Wyoming. I assume this was the reason for the University of Wyoming mascots and nickname to be the “Cowboys”.

As we watched the events of the rodeo, Gilad and I shared another sense of wondering about these crazy Americans and their seemingly bizarre interests. In Israel, we had dairy cows which are docile and relatively harmless animals. However, in Wyoming, cow-related activities were on an entire different level of activity. For example, these “cows” were not the sweet passive variety but rather they seemed to be massive aggressive males with excessive levels of hormones.

One event was called steer wrestling. In this event, a horse-mounted rider chases a steer, drops from the horse to the steer, then wrestles it to the ground by grabbing its horns and pulling it off-balance so that it falls to the ground. Another event was called calf roping. This event involved riding a horse as fast as possible to catch a small cow, jumping off the horse, and wrestling the calf to the ground. The goal of this timed event is for the rider to catch the calf by throwing a loop of rope from a lariat around its neck, dismount from the horse, run to the calf, and restrain it by tying three legs together, in as short a time as possible. We assumed there must be many good reasons for this event, but nothing in our background prepared us for one.

These cows, horses, and cowboy/cowgirl events continued for several hours. Each one was more fantastic and perplexing than the previous one had been. One of the most astonishing events was watching grown men trying to sit on the biggest, most ferocious bucking bull with long wicked horns and snorting like a dragon. Needless to say, we were flabbergasted. The entire day had been fun but certainly contained many surprises for two Israeli boys who had thought they had seen everything. Now we knew differently.
Gilad and I were older and had experienced much more of life than our friends and colleagues in the sports dorm. We studied and trained with great intensity because this was a one-time chance for our futures and we were going to make it the best opportunity that we could. Eventually, we adjusted to the newnesses of life in the United States. Our participation on the academic and athletic paths became upbeat experiences. Our goals were to graduate and continue to study in a graduate school somewhere in America. We travelled around the country competing for the University and performed well enough to more than justify Coach Walker’s belief in us.

Women chased us for our athletic prowess and good looks. Gilad liked the girls, but I was not someone who liked short relationships. Gilad never lacked for girlfriends. But no matter how much effort we expended in our athletic events nor, in his case, how many girls he dated, we never shirked our studies. We helped each other like brothers in scholastics, training, and life events. We even combined our resources to buy a 1953 Chevy for $150. This car provided us with more mobility and gave us a special sense of belonging in America. Few of our friends in Israel had cars at that time so we were unique in that aspect of life as well.

One of the first Track and Field competitions early in September of 1964 was held at a local university in Elbert, Colorado. I amazed everyone, including myself, by throwing the discus 192 feet 2 and ½ inches. This distance broke both the Wyoming and the Israeli record and was within 13 feet of the discus world record at that time.

I was thrilled because now I had a second chance. A second change to go to the Olympics and a second chance to redeem myself after the poor showing I had in Rome. With a throw of this distance, I immediately qualified to represent Israel in the Tokyo Olympics in October 1964. It was a relief and a burden at the same time. This opportunity happened to only a few people in any country and even fewer Israelis are able to have this chance.

There was only one problem; Yael was pregnant. This would not have been a problem except for the baby’s due date. The baby’s birth was at about the same time as the Tokyo Olympic Games. Needless to say, Yael was furious and resistant to my leaving to go for this completion. What if she had the child while I was away? she argued.

My tickets to Tokyo arrived with the departure date set for October 4, 1964. On that morning of October 4, 1964, Yael, who was living in Denver, went into labor. One of my school friends drove me to the hospital in Denver. Yael was already there and ready to deliver the baby.

What a difficult choice I faced. I was supposed to catch a flight from Denver that night to Tokyo and Yael was delivering our child. I was frantic, anxious, worried and perplexed. This was the most difficult choice I had ever encountered.
Should I cancel my participation in the Olympic Games and stay with Yael? Should I go to Tokyo for my last chance to compete in the Olympic Games, since I would never have another opportunity? Yael insisted that I stay. She begged and pleaded. I told her, “Please, Yael, understand that the discus has been my life. I received a scholarship in America because of this discus. I performed poorly in Rome and was criticized by everyone then. You and I will have long years together, but this is the last Olympics for me to compete. I must show my country that I can do better than I did in the last Olympics. I need to show Yariv and everyone who has supported me and believed in me that they were justified in their beliefs.”

Finally, I realized that my choice had to be the Olympics. I had devoted my life to this activity, it had nurtured me throughout my childhood when only the belief in me by my mentors had given me hope, and it had given me a chance to study in the United States. It was an unfair choice, but one that I had to make. In my heart and mind, I believed that Yael and our daughter would be lovingly cared for without my presence for the first two weeks. It was with these thoughts swirling in my head, I told her that I would have to go to Tokyo, but I would be back soon.

Yael was furious but I felt a greater responsibility to the team and my country. I watched as my daughter’s umbilical cord was cut and left for the airport with tears in my eyes. I also left a message for Yael. “Please give our daughter whatever name you choose, but her middle name must be Olympia since I went to the Olympics on the day she was born.” Yael named our daughter Geffen Olympia Ariel.

The Tokyo Olympic Games in 1964 were the first Olympic Games to be held in Asia. The Olympic torch is ignited at the beginning of the Games, burns for the duration of the competitions, and is then extinguished after the last event has been completed. The Japanese athlete, who carried the Olympic flame, which was used to light the torch, was Yoshinori Sakai. He had been chosen because he was born on August 6, 1945, the day the atomic bomb exploded in Hiroshima, as an homage to the victims and as a call for world peace. It was a fitting choice since the ancient Greeks had also stopped all wars and conflicts for the duration of their games.

But I was not enjoying a peaceful emotion as I marched into the Olympic stadium carrying the Israeli flag. I kept thinking that I had left my wife with our child alone in the hospital and anguished about the decision. Although I knew our friends, the Brodies, would take care of Yael and my daughter, it was not the same thing as having your husband and father around. I was unable to sleep at night and could not concentrate during the discus practice sessions. As in Rome, emotions swirled and churned within me and my throwing attempts fell well short of my previous performances. I felt such tremendous guilt about leaving my family at such a vulnerable stage. During the return trip to the U.S., I
bought some souvenirs for Yael and my daughter. This was where my mind was. At the same time, I carried terrible guilt for failing to perform well. So many of my friends and mentors had cared and placed their trust in me to represent the country well. I felt that I had failed them, as well.

1964 Olympic Gold Medal

Carrying the Israeli Flag in the Olympic in Tokyo 1964

http://arielnet.com/ref/go/1061

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After the Games, I returned to life at the University of Wyoming. Coach Walker helped me move my wife and daughter to student housing on campus. We could put our books and belongings down in one place called home. This was actually my first home.

Now that I lived in student housing with my wife and child, Gilad, was alone in the Dormitory. He came to my house every day and we still studied and trained together. But, at the end of the day, he
always returned to the dorm room alone. I think my own domestic situation made him feel homesick for the close family lives that most Israelis have.

One day Gilad came to me at the end of practice and showed me two photos of girls whom he had dated in Israel prior to coming to Wyoming. He told me, “Gideon, I am going back to Israel, to get married. The problem is that I can’t remember which of these two girls is the one that has accepted my proposal. I have corresponded with Haya, but I can’t remember which picture is of her.”

“Anyway, I am going to Israel to marry Haya,” he said and “I am sure that she is one of the two pictures. I will be happy either way.” During the first school holiday break after this conversation, Gilad flew to Israel and married his beautiful wife, Haya. They are married still today.

When Gilad and Haya returned to Wyoming, we had a great time together at the University and with each other. My life had now expanded to include Gilad and Haya and we were all enthralled with the newness of the States and our success at school. Every day, Gilad and I continued to train and study hard. It was important that we maintain our scholarships and to do well, academically. We were both very dedicated to both issues.

Of course, money was extremely tight for both of our families. The University stipend for student-athletes was small. The money I received as part of my athletic scholarship at the University was $15 per week and was inadequate for a family of three. Gilad and Haya were now the proud parents of a small son nearly the same age as my daughter. Neither of our wives was able to work because of the ongoing problem with their visas. Visitor visas were only for visiting, not for working. Marital status had no effect on the visitor’s ability to work. Therefore, neither Yael nor Haya was allowed to work because of the type of visa each had. Therefore, Gilad and I had to supplement our meager athletic incomes with a
variety of jobs. We moved furniture for a local company, cleaned cars, painted houses, and cleaned the gymnasium after basketball games.

Life for us had ups and downs, as with every married couple. Money was tight and there were enormous language and culture barriers for all of us, but more so for our wives than for Gilad and me. In addition, our wives had young children to care for all day while Gilad and I had our classes, training, and study demands. We were immersed in our jobs at the university and had few spare moments to spend in normal family life. In retrospect, it is easy to account for many of the problems that arose but, at that time, were frequent squabbles and arguments.

During each summer vacation, I worked at a Jewish summer camp in Elbert, Colorado. The Camp’s name was JCC (Jewish Community Center of Denver.) The first year I worked as a Unit Head and was assigned children ranging in age from 10 to 13 years. We had a variety of normal camp activities, as well as, some that reinforced the values and content consistent with a Jewish theme. Of course, I concentrated on athletic events, which the kids loved. This was a beautiful environment in the mountains with nearby lakes. Yael, my wife, was the Arts and Craft director and she taught all kinds of art skills,
such as painting, clay modeling, and Israeli dancing. Thus, this summer work provided an opportunity to supplement our family income and in a beautiful natural setting.

During the school years, Gilad and I were each taking more difficult and specific classes increasingly. Each semester, the courses that I took were increasingly more scientific. One day, as I walked by the computer center, I was struck by the power of the University mainframe. Most projects that university worked on were associated with oil drilling, since Wyoming had vast resources of petroleum. In fact, a large portion of the support for the athletic program was derived from oil royalties to the University. It was here that a small kernel of thought was planted with the nascent realization of the potential power of computers. I had not yet developed an idea for computer assisted training programs, but I could envision the computer analyzing the movement of all sorts.

I continued with ideas to enhance the fitness and strength for athletes. In the weight room, when a lifter wants to perform a bench press with a heavy weight, he needs two spotters. The purpose of the spotters is to assist the lifter with the weight, if he is unable to execute the movement. Otherwise, the weight could crash down onto the athlete’s chest and cause injury. Using spotters allows people to try to increase the amount they lift in a safe manner. I devised a mechanism to help in spotting movements with heavy weights, without having to interrupt two other people during their training, or for those times when no one else was in the weight room. The device I created employed posts on both sides of the bench with holes into which selector pins could be inserted. Then if the person lifting could not complete the exercise, there was no concern about dropping the weight, since the pins projecting out from the posts would stop the weight. This was one of the first selector systems for weights ever created. No one knew about this safety device, other than the athletes and I who worked out in the weight room on a daily basis. I did not think of this invention as a product that
could be bought and sold. All I knew was that it could help the athletes to lift heavy weights, safely, and free them from relying on spotters.

As older athletes who had both served in the Army, Gilad and I were respected mentors to many of the younger team members. Although, in some cases, we were only three or four years older; those age differences can make a difference, if you have also served your country or performed in the Olympics. We were also more focused on our studies, since we had passed the “having fun and dating stage.” We now had eyes beyond graduation and the next step into graduate school.

At the beginning of our senior year, we went to the book distribution center to receive our textbooks for the year. The student-athletes were given their books as part of the scholarship stipend. Most of our Track and Field friends, Gilad, and I arrived early to stand in line so that we could receive the newer books. Those students at the end of the line usually had well-used books with writings in the margins and broken spines. Just when the faculty member arrived to hand out the books, all of the football team members swarmed into the room, pushing everyone out of the way, and stood at the head of the line. This line rearrangement was without resistance. Since Gilad and I were at the front of the line, we refused to move and asked what the football players were doing. The answer shocked us. Football was the top sport, therefore, the players ranked first and received their textbooks first. Needless to say, this was a completely unacceptable answer to us. We refused to move and blocked anyone from receiving any of the textbooks. The irate football team sent a representative to the Athletic Director, Mr. Jacoby, who was at the top of the athletic pyramid. When he came to the room, Gilad and I explained the system and explained that this was inequitable. It should be first come first serve, rather than preferential treatment for football. Mr. Jacoby agreed and established the policy that the books were to be distributed according to the line. The first people in the line were to receive their books first and there was to be no preference by sport. Following the cheers from the track and field athletes and all of the other minor sports members, the books were distributed. Gilad and I made sure that all of the people, who had been in line ahead of us, received their books before we collected ours. The football team members, as the last to arrive, collected the old, broken textbooks.

This was how I spent the three years of my undergraduate studies. I studied intensely, training diligently, and traveled all over the western parts of the U.S. The states, in the western part of America, are much larger in size than those on the Eastern Seaboard. The Western Athletic Conference, at that time, consisted of the University of Arizona, Arizona State, Brigham Young University, University of Utah, University of New Mexico, and the University of Wyoming. Therefore, when the track athletes competed against these schools at their home locations, we would have to spend many long hours driving to and from the competitions. Gilad and I participated in these competitions throughout the Track and Field season, which covered most of the Spring Semester. We were fortunate to see vast stretches of America, as we rode from Wyoming and enjoyed every second of it.

One year, the competition in Las Cruces, New Mexico happened to take place during the Jewish holiday of Passover. This holiday begins with a special meal, called the Seder, and is an extremely important event for Jews. It was not that Gilad and I were primarily religious, but the tradition and joy of the occasion, which is celebrated in a family and home setting, is something very special. As two Israeli fellows in
America, we very much wanted to enjoy this celebratory meal, even if it meant that we were with people that were new to us. There is a special camaraderie among Jews on this day at this event. Of course, we knew no one in Las Cruces, so we decided to look for Ariel, in the telephone directory. There were none. Next we look for Weingarten, and were surprised to find one. We called the number listed in the phone book and explained our situation to the man who answered the phone. Needless to say, the fellow was tentative, about two strange men asking if they could come to his home for the Seder. He agreed to come to the university to meet us. When Mr. Weingarten arrived and discovered our legitimacy, he graciously invited us to enjoy the Seder with his family.

The next evening, scrubbed and happy, we went to Mr. Weingarten’s house. During the Seder meal, the conversation turned to where people had come from and how they got to where they lived then. We related about our arrival at the university in Laramie. There were about a dozen Weingarten family members and suddenly came the shocking discovery that one of the ladies was directly related to Gilad. Gilad’s mother was this woman’s cousin. There were tears of joy and immediate phone calls to Israel. Each of the family members had thought the other one had been killed in the Holocaust. It was a fantastically happy and joyful meal and the families are now reunited.

The next day, Gilad and I were again at the university competition. Then back to Wyoming with the knowledge that he had more family than he had known.

Gilad and I were excellent students and after four years of study, we were finally ready to graduate. Our hard work and diligent efforts had paid off since we earned our degrees with Honors. From a maximum of 4.0, my grade point average was 3.8 and Gilad’s was 3.9. Not only were we to receive our Bachelors of Science with Honors, but also, we were entitled to wear a special blue tassel and to sit on the dais during the presentation of degrees.

Several days before the graduation, we received our caps and gowns. Once again, we faced an American-made dilemma.

What were these dresses that they had given us to wear? I asked Gilad, “What do we wear under this gown?”

Gilad confidently answered, “Underwear, of course.”

On graduation day, we sat proudly on the dais, while the ceremonies and speeches went on around us. Suddenly, I noticed that the other men on the stage beside us, and the ones I could see in the graduating classes, had long pants under their gown. I furtively pointed this out to Gilad who sat next to me on the stage. Here were the only two members of the Track and Field team that were graduating with honors and from beneath our graduation gowns were bare legs above our white socks and black shoes. We struggled to pull the gowns down as far as they would stretch, but I doubt, we fooled anyone who noticed our sartorial faux pas! Still, this clothing malfunction did nothing to deflect our joy, nor the success of our efforts.

At the ceremony, Coach Walker gave a speech about how Gilad and I had performed and how far we had developed during the time since he had first met us. Our fellow teammates applauded us and we were both extremely happy. Our wives in the audience beamed with pride as well. Even Geffen watched
with great interest, as her father fiddled with his gown on the stage.Fortunately, at the age of one and a half years, she was not independently skilled about the dress, either.

Before our actual graduation, Gilad and I had discussed at length about where we would go to continue our education. I mailed at least 25 applications to various Universities requesting an assistantship, so I would be able to continue my studies toward an M.S. Degree. Gilad was accepted at the University of Minnesota, since he had decided that psychology was the most interesting field of study. I was offered an assistantship at the University of Massachusetts, which I accepted since that school appeared to offer the greatest range of scientific options.

So following our June 1966 graduation, Gilad and Haya said goodbye and left for Minnesota. I felt happy after four years of work, study, and athletics. With a new life in front of us, Yael and our daughter, Geffen, began the trip in our 1961 Plymouth from Laramie, Wyoming, to Amherst, Massachusetts.

We left those wonderful Rocky Mountains and drove east to settle in the Berkshires. The size of the mountains may have been different, however we began to encounter new peaks, not only for ourselves, but also, for the whole industry of athletic training.

Fifty years later, I came to the University of Wyoming to receive their College of Health Science Achievement Awards.

Ann, Myself, and Coach John Walker at 2015 in Laramie.

http://arielnet.com/ref/go/1068
http://arielnet.com/ref/go/1069
Amherst, Massachusetts

Amherst, Massachusetts, in the Berkshire Mountains, is an intellectual, bustling, lovely town full of bookstores, winding streets, New England clapboard homes, and lots of trees. We were met with the Splendor of a New England Fall as the leaves turned yellow, red, and orange and it felt as though we had entered a painting. We rented an apartment in the University complex and I began my two jobs. My primary job was as a graduate student working towards a Master’s of Science degree and the second one was my teaching assistantship which supported my family.

The subjects I was assigned to teach were weight training and physical fitness. Since I had experience working in Physical Therapy during my Army service at Tel Hashomer Hospital in Israel, I also was assigned to help in the Physical Training room. Here, the University athletes were treated for injuries or had their joints taped prior to their practice. In addition, I occasionally assisted several professors grading the undergraduate student exams.

Shortly after arriving at the University, I happen to be walking near some sports training fields and saw several athletes throwing the discus. My heart beat a little quicker as I watched the throwers and saw the discus land on the green grassy surface. After studying one of the athlete’s throws, I walked over and commented that he was not holding his arm at the proper height. On his next throw, he raised his arm and the discus went farther. He was quite thrilled with this improvement in his throw.

He asked me, “How did you know that?”
I replied that I was, also, a discus thrower.
This comment seemed to provide more credibility to my coaching comments. “How far can you throw?” he asked me.
“One of my better throws was 192 feet,” was my reply.
“Wow!” he exclaimed. Soon the other discus throwers gathered around and I began demonstrating my throwing technique.
Suddenly, another man joined our discussion. He introduced himself as the University’s Head Track Coach, Ken O’Brien. He had happened to overhear our conversation and was happy to have an opportunity to meet me. “You must be Gideon Ariel, the Olympian from Israel,” he said. “Someone told me that you would be here at the University in the fall and I was looking forward to the opportunity to meet you and pick your brain about various events.”

I was pleased with the recognition and to have the opportunity to meet the Head Coach. I had hoped that there would be an opportunity for me to maintain my discus throwing skills. I responded to Coach O’Brien that I was indeed Gideon Ariel and confirmed that I had competed in the Rome and Tokyo Olympics as a discus thrower. The athletes chatted enthusiastically with this news and immediately plied me with questions. The result was the coach offered me a job as his assistant for the throwing events. I would continue teaching my other subjects for my assistantship but I was more than happy to become involved with the Track Team.

School started in September and my courses were much more stimulating than I had anticipated. I especially enjoyed the classes in Physiology, Anatomy, Kinesiology, and Statistics. My intention was to finish the M.S. degree in one year rather than two. For that I had to register for 24 credit hours in addition to a six-hour research project. At
the time, I did not realize the tremendous demand on my time this academic load would require.

The department of Exercise Science at the University of Massachusetts did not have a Ph.D. program at that time. My plan was to finish the M.S. degree in Exercise Science and apply to another University to work toward a Ph.D. I had not decided where that school would be or exactly what I intended to study. I was confident that by the end of the year both questions would be answered.

Yael was extremely dissatisfied with my plan. She wanted me to go back to Israel after I finished the Master’s degree and start working to support our family. In fact, she had spent most of the cross-country drive from Wyoming to Massachusetts trying to convince me to return to Israel as soon as possible. Yael saw little value in education. Her plan was for us to return to Israel where we could live by our hands rather than by our minds. To be sure, throughout her life, she was, and continues to be, quite successful as a jewelry maker and a clothing designer. Both careers were viable for her since she could combine her creative mind with her highly skilled hands.

My priorities, on the other hand, were education first and family second. Perhaps this is an abnormal choice for some people but it seemed perfectly logical to me then as well as now when I reflect on my decision. “How can you have a comfortable and productive life with a healthy family without a first-class education?” I asked. “For me, the choice is to be a leader or a slave. As a slave, you work all your life for others and you will always have a boss. I would prefer to be the boss. Education will afford me the ability to become the boss whereas the lack of education will doom me to be a slave to others. Therefore, I choose education.”

Clearly, these were extremely contradictory outlooks on life. It was not a situation where one choice was right and the other one was wrong. It was a deeper divide with little or no place for compromise. Yael and I began having serious problems. We had never been particularly compatible. She had traveled to the United States because I had been lonely in Wyoming and I was obsessed with her beauty. Yael had agreed to visit me in Wyoming initially expecting it to be for a short three-month visit. Had the Brody family not pushed for the marriage, she probably would have returned to Israel and that would have been the end of it.

I had lived in America for three years, traveled around the country as an athlete representing the University, successfully graduated with honors, and worked during the summer vacations. I definitely wanted to continue my studies in the U.S. I may have been undecided about what I would do after completing my education but there was nothing that I would allow to interfere with this educational path. I still considered Yael to be the most beautiful woman in the world but I was not willing to sacrifice my education for her.

On the other hand, Yael had not attempted to broaden her horizons of interests or her skills. She was naturally skilled in artistic endeavors but did nothing to enhance those talents nor to broaden her academic knowledge. She maintained the status quo that she had brought from Israel in 1963. We began to argue constantly with many traumatic scenes. We were a young couple with unstable upbringings and childhood experiences. Furthermore, we were uncertain about the future for our daughter or ourselves. Eventually, Yael moved to her own apartment in Amherst taking Geffen with her. We struggled to find some accommodation with each other. We shared a daughter but this connection could not bridge the huge gulf in interests, future plans, or even our daily schedules. It was an awkward situation, which persisted for several years until it ended in divorce.

Meanwhile, my studies at the University were dramatically opening my eyes. Ironically, my course in Kinesiology, with Dr. Robert James, was the same textbook which I had devoured at Wingate College, “The Mechanics of Athletics” by Geoffrey Dyson. Dr. James focused more on the scientific aspects than what we had at Wingate. For the assigned class project to calculate different movement parameters, I selected several of the Track and Field events.

Professor Ricci, renowned in his field, was my professor in physiology. For the first time, I began to more thoroughly understand the basics of muscle action. I realized that regardless of what technique I used to coach my athletes, it still came down to the basics that their arms and legs must be moved by
forces created by the muscles. In the physiology class, we studied the basics of the chemical changes which occur in the muscles, tendons, and ligaments, and other tissues in the body. Physiological changes are not the only cause of success in athletics. There must be a coordination of physiology and biomechanics which creates optimum performance. I wanted to be able to measure these parameters quickly and efficiently.

In addition to the academic classes I took, I also had to execute a scientific project, commonly referred to as a “thesis”. The class work and the scientific project were both required elements for the Master’s degree. Professor Harry Campney was the main advisor for my Master’s thesis. I had some ideas for my thesis project which I presented to Dr. Campney. He agreed with the general idea, but suggested that I try to enlist Dr. Ricci’s interest, particularly, since Dr. Ricci might have some additional funding available.

Professor Ricci had received a substantial grant of money to conduct research projects and he enthusiastically agreed to be a committee member for my Master’s Degree thesis project. I needed to choose a subject and Dr. Ricci would want me to conduct some experiment in physiology since this was his area of expertise. However, my interest was more in the mechanical parts of the analysis of movement. I wanted to know more about quantifying things such as why, raising or lowering the discus throwers arm produced throws of different lengths. Those discus-throwing results could not be due to a physiological reason but must have something to do with the angles of the arms or legs or maybe even more complicated interactions. My dilemma was how to combine both aspects of movement, the physiological and the mechanical to satisfy Professor Ricci.

In one of the physiology courses with Professor Ricci, we had covered a subject that included a famous physiological test of performance efficiency. The Harvard Step Test (HST) was a test of aerobic fitness which had been developed by Johnson, Brouha, and Gallagher in the Harvard Fatigue Laboratories during WWII. The features of the test were it simplicity to conduct and minimal equipment requirements.

The test was presented as a method of judging the general and cardiovascular fitness of the individual. Each test subject was required to step on and off a stool 20 in. high (50.8 cm) at the rate of 30 steps per minute for a total time of five minutes. At the conclusion of the test, the subject sat down and the first heart rate was taken after one minute of rest, then after the second minute, and finally after the third minute. The fitness index was a ratio of the sum of the three pulse counts and the duration of the exercise in seconds according to the formula outlined in the original report.

For my interest, it seemed that this Step Test would fulfill both scientific aspects. The Physiology portion measured the heart’s response to stress and the mechanical portion evaluated the person’s step. One of my specific thesis questions related to the height of the step and how the knee joint angle affected the performance. Obviously, shorter people need to flex their knees more and therefore exert more effort than taller people. I proposed the study to Professor Ricci and he agreed that this would be an excellent topic for my Master’s Degree Thesis.

I conducted the test utilizing two different step heights. One step was set at the fixed distance described by the original Harvard University researchers. I devised an adjustable step which could be changed for each individual. In other words, this step could be adjusted so that the subject would always begin the test with his knee at a right angle. This specialized step is shown in the photo.
I selected 30 volunteer subjects from among my various classes. After analyzing the data, my study revealed that short people must exert much more effort to perform the standard Harvard Step test than the effort required of taller people. In other words, shorter people produced higher heart rates resulting from the increased amount of work required to complete the test. The standard Harvard Step test was only accurate in reflecting fitness levels for people who began the test with their knees positioned at right angles. It was unfair and biased against any individual whose knee joint was not at the right angle at the beginning of the test.

After conducting the test, analyzing the results, and presenting the conclusions, I submitted the study to my Thesis Committee. They were quite impressed with both the Thesis question and the way I addressed the discrepancy in the original Harvard test. They perceived my study as novel work and cheerfully awarded me the Masters of Science Degree in 1967.

Master’s of Science Degree Certificate

Dr. Ricci was proud of me and my accomplishments during the previous year. He asked whether I would be interested in publishing my thesis study in an internationally refereed journal. He assured me that if I published the results of my Thesis, it would be easier to obtain a scholarship to a university to pursue a doctoral degree. My answer was an enthusiastic, “Yes!”

Coincidently, Professor James was leaving for his sabbatical year and he asked if I would run his Therapeutic Center at the University. This position would allow me to earn extra money and to remain at the University of Massachusetts. I would have time to publish my thesis study and take additional courses in engineering and mathematics. Thus, when school resumed in the fall of 1967, I would have a whole new goals and tasks. I could hardly wait.

Although I would be earning more money during the school year, I needed to supplement those funds during the intervening summer months. I obtained a job as a camp director at Camp HES (Hebrew Educational Society) located in upstate New York in the Catskill Mountains. I was hired because I was an Israeli and had camp experiences. Camp HES was the only Jewish camp on a large beautiful lake which was shared by about five other, non-Jewish camps. Every year Camp HES endured a variety of pranks perpetrated by residents from the neighboring camps. The HES Board of Directors in New York City believed that an Israeli would know how to handle this yearly plague of unwarranted practices. In
anticipation of the pranks I had been warned to expect, I hired were some of my Israeli military friends as counselors.

![My Counselors at the HES Camp on my VW Bag](http://arielnet.com/ref/go/1072)

Every year, one of the favorite pranks was to sneak under cover of darkness and cut the underwater connections which held the swimming rafts securely in place. Without the proper tethers, the rafts would float down the lake into the river. Not only was it time-consuming and arduous work to retrieve the rafts but the water activities were disrupted for days.

One of the counselors I hired with this situation in mind was Dany Tal, who had spent his Israeli military service as a frogman. Another counselor was Yaron, who served in the Israeli Army as a paratrooper. In addition to being very popular counselors with the kids attending the camp, they were part of my “counter-terrorism” squad. The day finally arrived when the kids went down to the lake for the water activities only to stare in shocked silence at the empty waters. Our rafts had been cut just as they had been every year before. A few of our counselors now had to find the rafts, somewhere down the lake or into the river, catch them, and tow them back to camp. This task usually took several days which meant our water sports had to be curtailed or eliminated.

![Dani Tal, The Israeli Frog Man at Camp HES](http://arielnet.com/ref/go/1073)
That night, Dany, Yaron and I mobilized our resources and went into action. Under a black sky, Dany, with his frogman’s gear, rode in the boat with Yaron and me. At each dock, Dany slipped into the dark water and severed the ropes holding the dock in place. We quietly circled the lake “liberating” 24 rafts.

As each camp around the lake awoke, the morning’s calm was filled with loud and angry shouts in addition to gesticulating and screaming people. Boats from every camp were on the lake with people trying to locate rafts and shouting at one another through bullhorns. It was a collective disaster and filled the beautiful bucolic area with noise and commotion.

The local police set up a meeting with all the camp directors. I wore my yarmulke and introduced myself to all the other camp directors. After a long discussion about the rafts being cut, I mentioned that our rafts had been cut the day before and I speculated that perhaps it was the same group who had cut the other camps’ rafts. There were no conclusions drawn that day. Likewise, there were no leads on the perpetrators of the vandalism. Therefore, all the camp directors returned to our individual camps and things continued normally until the morning of July 5th.

On July 5th, one of my counselors discovered that a swastika had been painted on the Rabbi’s car. This was another annual event, which the Board had warned us would happen. Although we could not see the faces of the people in the other camps, most assuredly, they were laughing hysterically at this, amusing to them, prank.

That night, about 3 a.m., Dany, Yaron, and I once again went into action. We sneaked into each camp and dismantled the wheels from the cars. The wheels were thrown into the lake and all the bolts were carefully immersed in jars of jelly and left on picnic tables in plain view.

The following morning the police, once again, requested that all the camp directors meet. After a lengthy discussion about who could have been responsible for this crime, I addressed the meeting wearing my customary yarmulke. “Perhaps you are all aware that we are a Jewish camp. First, our rafts were cut and then, miraculously, yours rafts were cut soon afterward. Then someone committed the terrible act of painting a Swastika on the Rabbi’s car. I think removing tires from cars must be an act of retribution from G_d. In fact, G_d came to me at night and warned me about what was to happen. Therefore, I have no reason not to believe that G_d has answered our prayers.” After this short speech, I sat back and waited. Each of the directors and the police chief stared at me as though I had dropped out of the sky. They looked at each other in silence. The meeting was concluded with no other ideas presented regarding the cars losing their wheels to the lake.

The summer progressed without further incidents. Our rafts were never cut again and the Swastika was never again drawn on the Rabbi’s car. The children enjoyed the rest of the summer and I was rehired as Camp Director for the next year.

After my summer camp adventures of 1967, I returned to Amherst for a new and entirely different school experience. This was the first time, since my Army days, that I was less of a student and more of a teacher in several of my new roles. I was responsible for Dr. James’ Therapeutic Center, which was primarily a physical therapy experience. Because of my work at the Tel Hashomer Hospital in Israel, where I had worked with wounded and recuperating soldiers, I was easily able to work with injured and recovery athletes. I was back in the physiology laboratory conducting experiments based on my Master’s Thesis funded by grant monies from Professor Ricci. I also attended engineering and math courses and I continued to work with Coach O’Brien and the Track and Field team. Needless to say, I was quite busy all day including weekends when I worked with the track team.

After a few months, I submitted my experiments to the *Ergonomic Journal* for publication. This is a refereed journal which means that every study is presented and reviewed by a peer group. The scientists who read each anonymously authored publication are selected according to their individual academic and scientific expertise. In this way, each study is examined by a peer professor familiar with the topic as opposed to a professor in Physics trying to make an evaluation of an experiment in Psychology. This allowed better comprehension and decision-making based on the merit of a submitted
study’s content. Also, since the reviewer must judge the article unaware of its author, blatant bias against
the writer is avoided. Fortunately, my publication was approved and published.

My days were full of work and study. I still had time to train with the discus and work out with
the athletes in the exercise room. I filled out and mailed many applications to universities throughout
America in hopes of finding a good school to pursue my doctoral studies. Dr. Ricci was quite helpful
with this effort. With his help and my excellent academic record, I was offered a full scholarship in the
Anatomy and Physiology Department at Indiana University, beginning in the fall of 1968. I was relieved
and excited about this new academic adventure.

Before the semester began in Indiana, I returned to Camp HES for the summer. Fortunately, the annual pranks which had
previously plagued this camp for many years were not repeated. I guess the message from
G_d had carried over the winter into the camp season! There was the usual mixture of Israeli
and American counselors and the summer began with beautiful warm skies.

Every year, I invented some crazy idea to trick and entertain the campers. This year, I
had read that there would be a total solar eclipse. Of course, it was going to occur in the South
Pacific but for my purposes, this was irrelevant. The first order of business was to organize the
 counselors and the sequence of events. We created a completely imaginary injury to
someone who slept with their watch on their arm. Because of this injury, I announced that
everyone must remove their watch before bed and leave it on the small tables next to their
beds. After two weeks of removing their watches before bed, none of the campers gave
this ritual any thought. It became an automatic nighttime routine.

For the next phase of the scheme, I arranged for the local shop to print some
newspapers, filled with the accurate local news but to include an additional article concerning
the solar eclipse. Of course, the staff and I had decided the day that the reported solar eclipse
was to occur. The day that the newspapers were
delivered to the camp all the counselors read the articles as did many of the campers. Imagine my joy
when some of the campers discovered the article about the eclipse that would occur at seven o’clock the
next morning. That evening after dinner and before the evening events, I announced that since tomorrow
morning there would be a total solar eclipse, we would have to begin our day in the dark. However, we
would still have the usual activities although it would be dark for the ones at the beginning of the day.

That night, after the campers had fallen asleep, the counselors quietly crept through the campers’
bedrooms moving the time on the watches forward by four hours. I had enlisted the cooperation of the
cook and other staff members to be part of this eclipse event. They were thrilled to be part of this
potentially hilarious hoax and readily agreed to arrive early and prepare the food.

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**The Effect of Knee-Joint Angle on Harvard Step-Test Performance**

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The purpose of this study was to determine whether the angle of the knee joint has an effect on the Fitness Index Score of the HST. Thirty young Guatemalan male subjects were used in this study. The HST was administered in four different knee-joint angles. A repeated measures one-way classification of variance was used to analyze the data obtained during nine weeks. All tests yielded significant P ratios at the 0.01 level of confidence. Based on these findings, persons who perform the HST in different knee-joint angles have indices which are not measuring cardiopulmonary stress on the examinee. The HST based on standardization of the knee-joint angle promises to increase the evaluating or discriminating power of the test.

1. Introduction

Johnson et al. (1943) formulated a ‘step test,’ known today as the Harvard Step Test (HST), as a method of judging general physical fitness. This test requires the subject to step on and off a stool 20 in. high (50-8 cm) at the rate of 30 steps per minute. The recovery pulse is then counted for periods of 1-1/2, 2-1/2, and 3-3/4 min. The fitness index is a ratio of the sum of the three pulse counts and the duration of the exercise in seconds:

\[
\text{Fitness Index} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{sum of recovery pulse count}}
\]

Since, according to Johnson et al. (op. cit.), the administration of this test is so uncomplicated and the validity so high, the Harvard Step Test has been extensively used in schools, the armed services, and many laboratories. Yet, notwithstanding its popularity, numerous critical evaluations of its validity have appeared.

Miller and Ellert (1946) thought a height of 20 in. for the stool to be too high for the subject to maintain a constant body rhythm. Ellert et al. (1958) considered the length of the leg to be a factor influencing the index score.

Seitz (1940) noted a low correlation between the HST index and the length of the lower limbs. Knox and Hebert (1958) considered stature and leg length as factors which might influence the HST.

Knox (1949) reported as unlikely that a steady state could be reached in five minutes of work. He found that the heart rate in the HST increases steadily until the end of exercise.

Cook and Wherry (1959) published a correlation study between various fitness tests: the correlation between the various fitness tests was low. Ricci et al. (1966) conducted a study of energy cost and efficiency of the HST of male and female subjects using a 20 in. bench (50-89 cm). It was stated that the question of comparable leg length between sexes has not been adequately explored. In addition, Ricci et al. (op. cit.) pointed out that the HST may not be a measure of cardiovascular efficiency, but rather of motivation, unless the subjects complete the full five minutes of...
At the actual time of 3 a.m., the alarms set for 7 a.m. went off all over the camp. The bugler blew the wake-up call and, in the complete blackness that is found in the woods away from city lights, the campers arose. We proceeded with the normal early morning activities including the flag raising ceremony. Everything was done in the darkness of the “total eclipse”.

At breakfast, I asked if any of the campers had been awake to see the moon cross in front of the sun. If so, would they please describe the event for those of us who had missed the eclipse? There were many hands in the air and each of these campers described with graphic details the drama of seeing the moon passing across the face of the sun and the day going into the night. Suddenly, one of the campers shouted that the sun was coming up! Now, as dawn rose around the camp, the total solar eclipse was no more. As the realization of the trick that we had played spread around the dining room, there were cheers of joy and uncontrollable laughter especially from the campers who had seen the eclipse take place before their eyes.

Camp continued for the rest of the summer with the normal fun and games. As usual, our sports teams lost every game they played during the annual “Camps Olympics”. Losing every year was always a low point. But, I tried to overcome these losses with other activities for the kids within Camp HES like the eclipse event.

Following my summer adventures, I set off for Indiana University to pursue a doctorate. The Department of Anatomy and Physiology also provide a path for those who wanted to become medical doctors. I was intrigued with the idea of becoming a physician. Perhaps this was an option that I might seriously pursue. After all, I was a good Jewish boy and, secretly in my heart, I harbored the idea that this would prove my worth to my father. I tried to imagine myself as a doctor as I drove across New York State to Bloomington, Indiana which is the home of the famous Hoosiers.

I began my studies and hoped to become involved with the Track and Field team. Shortly after arriving in Bloomington, I introduced myself to the Head Coach, Mr. Bill Perin. I told him about my two Olympic competitions and that I would be interested in working with him and his throwers. Coach Perin was receptive to my coaching his throwers which was a wonderful opportunity for me to continue my association within the track and field realm.

I very much wanted to go to the Olympics in Mexico City which were to be held in October that year. This would be my third Olympic games but this time I would be a spectator rather than a participant. As luck would have it, Coach Perin and I were able to travel to Mexico City and secure tickets for the Track and Field events. Luckily for me, Coach Perin persuaded the Olympic officials to let me stand on the field so that I could film the events unimpeded by fences, flags, or the spectators’ heads in the cheering crowds in the stands. I had taken a movie camera to record the best performers and hoped I would be in the right place at the right time. This was the first time in Olympic history that a scientist was allowed to collect real-time data at the Olympics. Before my appearance, the only films collected on the field were for television coverage or historical productions like those produced by the great filmmakers, Bud and Cappy Greenspan.

The choice of Mexico City to host the Olympics was controversial because of the city’s high altitude, 7585 feet or 2,300 meters. The high altitude proved an advantage in such explosive events as sprints, jumping, throwing, and weight lifting. But the rarified air had the opposite effect on those competing in endurance events since it was more difficult to breathe.

I was lucky enough to capture Bob Beamon’s World Record breaking performance in the Long Jump. His landing, at a spectacular distance of 29 feet, 2.5 inches, was an amazing world record which stood for 22 years.

It was interesting to watch Bob Beamon as he completed his jump, looked at the scoreboard, and then displayed little emotion. However, after he was told the converted distance from meters into feet for his jump, he was enthusiastic with joy and elation.
The overall experience for me was exhilarating and, as I enjoyed the Games from the spectator’s viewpoint, it was far less stressful than my previous experiences. I also had an opportunity to reunite with many of my old Israeli friends and coaches. I was invigorated by seeing and sharing their Olympic experiences, as well as, chatting about friends and places in Israel. When the Games ended, it was bittersweet to part with old friends but I needed to return to my studies.

I returned to Indiana ready to work and began my second Anatomy course. This class was designed for those students in the pre-med program. I was not aware that the class included a laboratory section in which we had to dissect dogs. The first laboratory session involved slicing into a dog’s chest and removed the beating heart. That was too much for me! I loved dogs too much for that kind of experimentation. In addition, there was more blood and cutting into living beings than I could endure. I immediately realized that I could not seriously consider continuing a medical career. My nascent calling as a physician was immediately terminated that day!

At this point, I had to consider what other options were available for me to pursue. The most logical step seemed to be to return to Amherst and study there while I searched for another program. As I drove east towards Massachusetts, I decided to look at the program possibilities at Kent State University in Ohio.

Kent State had an excellent program of Exercise Physiology under the guidance of Dr. Lawrence A. Golding. Dr. Golding had heard about me from Dr. Ricci and offered me a scholarship. Since I was aware that the University of Massachusetts had not begun a Ph.D. program in Exercise Science, I decided to say at Kent State and continue my studies.

Of course, one of my first destinations was to the Track Coach with offers to assist training the athletes. My offer was readily accepted and I successfully helped some of the team members improve their results. In fact, several of them eventually became members of Olympic teams. Jacques Accambray, the weight thrower, competed for France. American Olympic team members included Al Schoterman, in the hammer throw, and Sammy Walker, as a weight lifter.

Jacques Accambray threw the 35-pound weight and achieved All-American status seven times between the years of 1971 to 1974. He won three in the indoors weight throw and four in the hammer. Al Schoterman was both weight and hammer throws on the collegiate level and represented the United
States in the 1972 Olympic Games in Munich. Sam Walker finished ninth in the weightlifting event in the 1976 Montreal Games.

To supplement my assistantship, I worked at the local Jewish school where I taught Jewish culture. I was quite happy to teach the children about Israel and the culture of my homeland. Since this was a school rather than a summer fun camp, it was unnecessary for me to create eclipses or invent other forms of entertainment.

Shortly after the first quarter ended at Kent State, I received a telephone call from Professor Ricci. He was excited to tell me that the Governing Board of the University had approved the Ph.D. program in the Exercise Science at the University of Massachusetts. The first doctoral candidates would be admitted beginning in the fall semester of 1969. His question was whether I would like to be a member of that first doctoral study program. Also, he assured me that there would be assistantships available for those students who needed them. This was wonderful news and I responded with great enthusiasm that I was more than interested. I would complete the necessary paperwork for the fall semester and send them to him. I told him that I would plan to return to Amherst at the end of the second quarter classes at Kent State. I also told him of my intention of working at a camp in the summer before the classes began in September.

That summer, I was once again the Director at Camp HES. The weather that year was particularly rainy. Needless to say, it is not as much fun to go to summer camp and have torrential rain forcing everyone indoors. The counselors and I were continually stretching our creative minds to invent active and fun things to do inside rather than in the great outdoors which everyone had looked forward to enjoying.

Finally, after nearly two weeks of rain, I decided to contact the local weather bureau regarding the forecast for the near future. I hoped to gain some insight so that we could try to find indoor things for the campers to do. I listened with increasing relief to the description of the weakening low-pressure center which would be moving eastward during the night and would clear to partially cloudy skies by noon. Then the extended forecast was for a period of warm and sunny summer weather for a few weeks.

I could not let this opportunity pass without capitalizing on the weather. The counselors and I put our heads together to find an appropriate end of this seeming endless monsoon of rain. Finally, we decided to have a “Flood” to rival the one experienced by the biblical Noah.

The next morning the rain continued to fall. After breakfast had been eaten and the dishes cleaned up, I announced with great sadness that the entire World was flooded and our camp was the last place
still on dry ground. This was a repeat of Noah’s flood and we should prepare for the worst. The children began to cry and ask what were we going to do. The counselors moved around the room with paper, pens, and bottles complete with stoppers. We told them to write their thoughts and dreams, their names and address, and any final wishes. We assured them that someday in the distant future those bottles would be opened by archeologists and they would discover what had happened to our camp.

After the children had written their messages to the future archeologists and stuffed them into the bottles, we arranged for each group of campers to drag the canoes from the lake up into the basketball court. Then the campers, with their paper-filled bottles, climbed into canoes to await the rising waters. The counselors and I would walk around among the canoes and murmur words of encouragement.

Suddenly, the sun began to peak out from behind one cloud with a hint of blue sky nearby. As the sky became brighter and the sun shone through the remaining clouds, the counselors and I made a circle the canoes and began to sing and dance. The song and dance are a famous Israeli melody called, “Mayhem, Mayhem” which means, “Water, Water.” As we cheerfully sang and danced, the campers slowly realized that the whole “Flood” was another one of my creative events. They climbed out of their canoes, wiped away tears, and joyfully joined the circle of dancers.

That evening after dinner, any campers who wanted to share their messages could read them aloud to the group. Some of the messages were hilarious and the whole dining hall rocked with laughter. To this day, I am sure that none of those kids will ever hear that specific song and not smile while they explain how they survived the “Flood”!

Soon thereafter, a new problem developed. On the signup sheet for the dance and drama activities, too few campers had registered to act in the annual camp play which was performed near the end of the camp season. How, I pondered, could I solve this problem? Inspiration led me to announced at dinner that Camp HES was privileged to have been one of the camps selected for the Hollywood directors and producers’ tour. A group of Hollywood representatives would watch our play and would most likely select one or more of our talented actors or actresses for future roles in Hollywood. Currently, all the roles were filled but, perhaps because of this fantastic opportunity, the dance and drama counselors would be able to expand the number of positions if anyone else was interested. The play that had been selected for that summer was “Fiddler on the Roof”. Miraculously, by the next morning, the signup sheet was filled with willing campers.

As the summer drew to a close, I arranged with six of my friends to arrive in large, expensive cars to judge our talented players. They arrived on the appointed day wearing dark sunglasses, scarfs tied around their necks, and clipboards for note taking. They were quite serious as they sat at the front of the audience which was comprised of the campers and most of their parents. We watched with enjoyment as “Fiddler on the Roof” was performed. Afterward, the producers interviewed the performers and made many notes. Following declaration of encouragement, these Hollywood directors drove away leaving many pleased and happy campers. As the camp director, I was one of the most pleased at the success of the dance and drama portion of Camp HES.

Following the summer at Camp HES, I drove to Amherst to begin the Ph.D. program at the University. My job that year, 1969, was to be a graduate assistant for physical education classes. Also, on my own, I created an “Exercise for Your Life” class which was open during the lunch hour for everyone in the university. I usually had 30 to 40 men and women of all ages attending this class. I was quite pleased that few people dropped out and, in fact, the roster swelled slightly as the semester continued. In addition, I worked with Ken O’Brien and his Track and Field Team. I focused primarily on the field events including discus, shot put, hammer, and the jumping events.

In addition to my assistantship work, I had a full academic load of classes. One was a Statistics course with a wonderful Canadian professor, Dr. Gail Oakland. His background studies in Canada had involved wheat and other grains which were surprisingly not that different from human beings when you examine them statistically. In class one day, Dr. Oakland asked a question that hung in the air unanswered for an elongated pause. Finally, one girl raised her hand and answered the question perfectly as Dr.
Oakland proudly noted. Since I had absolutely no idea what the answer was when posed by Dr. Oakland, I approached the girl after class. I inquired how she had known the answer since I had studied and not found anything like that. She stared at me without smiling, calmly asked if I knew where to find the library, turned on her heels, and walked away. I was shocked and dumbfounded and, worse, I still did not know where to find those kinds of statistical answers.

Another course I took that first semester was Motor Integration with Dr. Walter Kroll. His field of interest involved understanding how the nervous and the muscular systems worked together. My personal interests were inclined to the mechanical portion of the human performance but it was important to understand how the nervous system controlled functioned. The nervous system controlled when the muscles pulled on the bone levers to produce movement. I wanted to ask Dr. Kroll a question that had been discussed in class the preceding day.

Dr. Kroll was the only man who had an office in the Women’s Physical Education Building. He had a large office downstairs and an even larger laboratory for his research. Apparently, he was the only male faculty member who could get along with the teachers in this building. My walk across the campus began at Boyden Building where my office was located. It was a long walk since the powers that be had put Boyden, the men’s gymnasium, as far away as possible from the women’s building, where Dr. Kroll worked.

Dr. Kroll’s office door was slightly ajar. I knocked on the door but there was no answer. I peeked inside to make sure he was not there and pondered my next step. His laboratory was just down the hall so I decided to check there. I knocked loudly on the door and nothing happened. After a brief pause, I knocked again much harder this time in case Dr. Kroll was at the back of the laboratory. Suddenly, the door was flung open to reveal the same girl that I had seen in Dr. Oakland’s statistic course. I asked if Dr. Kroll was there. The girl scowled and nearly sliced me into pieces with her fierce, “I don’t know. I am not his secretary. Can’t you read?” and slammed the door in my face! Now that the door was in front of my face, I read the large, colorful, poster-sized, sign on the door, which read, “TESTING, DO NOT DISTURB”. “Oops” came to my mind and I still had not located Dr. Kroll to ask my question.

One of my independent projects was to analyze the Olympic athletes I had filmed in Mexico City. I was particularly interested in Bob Beaman’s jump since it was a World record and one that was probably not going to be broken for a long time. I had a close friend, George Dales, who was the Head Track and Field Coach at Western Michigan University in Kalamazoo. George was a very intense person and devoted to the athletes and coaches in track and field events. In addition, he was the head of the [128]
International Track and Field Coaches Association and published a Quarterly Journal for this organization. His goal was totally focused on how to help coaches train their athletes and how athletes could better understand their events. This meant the articles which he published were to help his target audience not for the aggrandizement of the scientist writing the article. George has worked tirelessly with this goal for as long as I have known him and he has not slowed down although he is now in his nineties. He is almost as strong now as he was then and he continues to practice what he preaches with daily exercises. George published my article about Bob Beamon’s record jump. This was one of my first, of many, articles published in the Track and Field Quarterly Review.

During the spring semester of 1969, I happened to be in the hall outside of the weight lifting room in the Boyden Building. Just as I had my hand on the doorknob, I heard a shout from a friend of mine, Jim Selidas. He was waving at me and there was a girl walking just behind him in his shadow. Jim said that he wanted me to meet his friend, Ann Penny, who had heard so many stories about “Crazy Gideon”, but insisted she did not know who that was. I was stunned to see the same girl who had refused to answer my statistics question and had slammed the lab door in my face. Based on her facial expression, I could tell that she did not remember these encounters. We politely shook hands, chatted for a few moments, and then I had to begin my class. Little did I know that we would meet again.

Classes concluded at the end of May, so I set off again for Camp HES for the summer. Each year there was a kind of “Olympics” among the camps around the lake. All the camps competed in different sports such as basketball, swimming, and various running events. Our Jewish camp always had terrible results. The other camps beat us mercilessly in every event. I had decided that this year things would be different.

Applications to attend the camp arrived at the beginning of the summer. I took the opportunity to meet and select the 100 kids whom I wished to be campers for that summer. Only kids who excelled in basketball or soccer, or ran fast, or swam like fishes were accepted. My goal was to choose 100 “Spartans” for a camp that summer. I separated them, not by age, but by sport. I only hired counselors who could coach sports. I did not hire counselors for art, drama, for Jewish activities. This year, Camp HES was going to be an “Olympic” training center.

We trained every day for hours in preparation for the last week of camp when the Camp Olympics would take place. I minimized the other normal camp activities in order that there would be more time to train. For example, instead of studying Jewish prayers, the Rabbi coached the soccer team.

About a month before the Camp Olympics, I organized the annual “Maccabiah Games” for Camp HES. The actual Maccabiah Games are quadrennial Jewish Olympics held in Israel the year following the Olympic Games. Every four years, the best Jewish athletes from throughout the world compete in Open, Masters, Juniors, and Disabled competitions.

The concept of the Maccabiah Games was the brainchild of 15-year old Russian-born Yosef Yekutiel. The teenager had been so energized by news of the 1912 Olympic Games that he conceived the fanciful notion of a worldwide Olympics for Jewish athletes in Palestine. With little encouragement, and not a small amount of ridicule, Yekutiel spent the next ten years developing details of his unique idea.

The first Maccabiah was held March 28 to April 6, 1932. Its overwhelming success guaranteed its permanent future. Originally conceived as a quadrennial event, Maccabiah II was moved up a year to 1935 because of the rising tide of Nazism in Europe. The rumblings of World War II forced postponement of the third Maccabiah. The delay was 15 years. The Games were reborn in 1950 in the new State of Israel, and Maccabiah #4 was held in 1953. Thereafter, the Maccabiah established its current quadrennial formula, held the year following the Summer Olympic Games.

The Games today are organized by an International Maccabiah Committee and are sanctioned by the International Olympic Committee and World Federation of Sports. The Maccabiah Games, ranking among the five largest sports gatherings in the world (in number of participants), are considered Regional Games by the International Olympic Committee.
This year I wanted the Camp HES event to be especially meaningful so that the campers would be even more inspired to continue to train for the Camp Olympics. A few mornings before the big event, I announced I had arranged for the Prime Minister of Israel to come to our camp and officially preside over the opening Ceremonies. The campers were ecstatic with pride and joy. They prepared songs to sing and flags to wave for him. We purchased a large floral arrangement to present to him when he arrived.

The day dawned with beautiful sunny weather. The campers were dressed in their sporting clothes and eagerly awaited the arrival of our important visitor. About ten o’clock, a large black limousine drove around the corner of the administration building and the campers burst into song and enthusiastically waved their flags. When the door opened, the Prime Minister stepped out of the limousine in formal wear with dark glasses protecting his eyes from the sunlight and a black hat on his head. He graciously accepted the flowers and waved at the campers and counselors. He was escorted to the place of honor and in halting English read the proclamation opening the Camp HES Maccabiah Games of 1969.

Shortly after the first events began, I announced that the Prime Minister had to leave to conduct some important official duties. The campers waved and cheered as his limousine disappeared around the building. The Prime Minister then returned to his real job as the owner and director of the local funeral home.

In 1969, there were no cell phones. People did not spend their lives calling and texting everyone all day and night as is common practice now. In fact, the campers were not allowed to call their parents unless there was an emergency. Apparently, one of the counselors went into town after the Games, had a meal at a local diner with friends, and from there the tale spread. The only phone in camp was located in the administrative office, so I was quite surprised to receive a call from the Chairman of the Board of the Camp in distress over my failure to tell him that the Prime Minister of Israel had been at Camp HES. As I described what had happened and who the Prime Minister was, we both had quite a laugh about the whole episode.

Finally, the biggest event of the summer was about to take place. The campers from the surrounding camps congregated at one of the camps for the annual Camp Olympics. As usual, our kids overheard snide comments and saw smirks from other campers in anticipation of their forthcoming victories. I confess to being quite nervous because of our history of failures. Just because we had trained for the whole summer did not mean that we would be successful. As the day progressed, each event ended with Camp HES campers proudly standing on the victory stand in first place. There was first place in basketball, then soccer, then track, events. Finally, we took first place in each of the swimming events. I was so proud that we had won every event. The kids and the counselors were crying and I had tears in my eyes. All of us enjoyed these victories which had eluded the Camp HES campers for so many years before.

After camp ended, I was fired. Why? The committee in New York discovered that although the campers may have become excellent athletes, they had not become particularly great Jewish scholars. It seemed that skipping the Jewish education part and the early morning prayers to train for sports was unacceptable to the parents and the Board. My career as Camp Director at HES ended.

Despite the end of my career as a camp director, there was a silver lining. During the summer, I shared the camp director’s house with several of the counselors including Dany, the Frogman, who had returned every year since the infamous raft-cutting events. Dany had met a stunningly beautiful Israeli girl, Esti, who was a counselor at another camp. As the summer progressed, I watched their relationship evolve. Although I did not discuss the situation with Dany, it appeared that he did not seriously care for Esti and, in fact, seemed not to respect her. I was much more of a gentleman with women.

One hot day late in the afternoon when we had a few hours free before dinner, I offered to drive down to the local ice cream parlor to buy milkshakes for the group of counselors lounging in the living room of my house. This offer was met with enthusiasm and I made a list of everyone’s favorite flavor. When I returned with a box filled with milkshakes, I neatly wrote a message on Esti’s cup, “You are so beautiful.” I carefully handed her the milkshake so that she would immediately see the message before
she had the first sip. At first, she had a puzzled look and then smiled. As the summer progressed, Esti parted ways with Dany and became my girlfriend. When the summer ended, she came to live with me in Amherst.

This residency was short-lived, however. Although Yael and I had lived separately for three or four years, Yael was not willing to let go of me. During that same summer, Yael and Geffen had gone to Israel. She learned about Esti and me since gossip mill runs across miles of land and oceans. Yael was outraged and paid a visit to Esti’s family in Israel informing them that she would never divorce me. She made it very clear that Esti could never be my wife.

Esti’s family was extremely distressed by this news and soon thereafter an uncle was dispatched to Amherst to discuss the situation. Esti was persuaded to return to Israel and wait to see what happened between Yael and me. It is difficult to maintain a long-distance relationship, so Esti and I gradually drifted into our separate lives.

Esti and I have remained good friends for many years, however. In fact, once when I was visiting Israel, Esti wanted me to meet her fiancé. I was surprising to find that he was one of the injured soldiers that I had rehabilitated during my Army time at Tel Hashomer Hospital. We continue to meet whenever I travel to Israel or she is in the United States. Esti is a wonderful person and still beautiful.

Academic life, working as an assistant, training in the weight room, and working with the Track and Field team filled my days. I focused on these things and pushed Esti into the back of my mind. Fortunately, I was extremely busy and, over time, obsession with my work overtook thoughts of Esti. I discovered more academic areas of interest and began to intensely focus on many new things. I had another surprise, about this time, when I discovered a new and fantastic friend.
Chapter 7: Love and Work

The doctoral program curriculum was similar to the one I had pursued for the Master’s degree. There were academic requirements within and outside the focus of the individual’s interest and there was a mandatory research project. I registered for fall classes in Statistics and for several new courses which sounded intriguing. One was Cellular Physiology with a new professor Dr. Eddington and the course description described how students would become proficient with the electron microscope. I was surprised to learn that in the one year I had been away, the University had acquired such a sophisticated tool for the study of human movement. Another new course which set my heart ablaze was Biomechanics of Performance to be taught by Dr. Stanley Plagenhoef. He was a new professor and the class had a promising title. I eagerly anticipated the Biomechanics class since it sounded more promising to my way of thinking than even Kinesiology had. I had my fingers crossed when I went to the first class.

When I stepped into the classroom for the first day, I was in for another surprise. There was my nemesis from before. The tough pretty girl, who had stood up to me after Statistics and slammed the door in my face outside of Dr. Kroll lab, was sitting in the front row. I considered my options. Then, selecting bravery over cowardice, I sat down next to her.

We had a few minutes to chat before the professor arrived to begin the class so I reminded her that we had been previously introduced by Jim Salidades. She told me her name was Ann Penny. She explained that she was half way through the Master’s program and then would continue towards the doctorate. Following graduation from the University of North Carolina, she had taught Physical Education in a private school in Princeton, New Jersey for two years. Suddenly, the lights flashed in my brain! Now I understood why I had not met her during my Master’s program. As we chatted, I learned of her disinclination to teach children in elementary or high school. Apparently, it had taken less than one full day of teaching for her to realize that she had made a huge mistake in her college career path. Now she was in graduate school at the University of Massachusetts with the goal of following a more scientific program of study.

Jim Salitas, a friend I had first met during my Master’s program, soon joined us. It transpired that Jim and Ann had become very close friends during the previous year. They had studied together in several classes and shared many discussions over coffee. At that time, there were few women in this field of study so, as it turned out, Ann was the only girl in class. Fortunately for her, she was intelligent, direct, and capable. Jim sat down and we began discussing our class schedules, what we had done during the summer, and people that at least two of us happened to know. It was one of those conversations where everyone was talking at the same time but somehow all was understood.

We also caught up on the details of our private lives. Jim was originally from New Hampshire and was married with two children. His wife was a wonderful person who supported Jim completely in his academic quest. But they struggled financially since she could only work as a babysitter and his assistantship was too small to support a family of four.

I reminded Jim of how he had helped me during my Master’s program to overcome my all-thumbs approach to loading the movie projector. We remembered how I tried to thread the film through the maze of pressure plates and make the loops form properly and eventually laughed until tears poured because of my ineptitude. Now we could share those hilarious moments again. Once again, my old characteristic of persistence and effort had rescued me. I never give up when I undertake a task. Sometimes it takes extra time and effort, but I never quit and eventually I could operate the projector. Jim agreed with my description of the times and my personality assessment.

Dr. Plagenhoef came into the class room and commenced to amaze us with the abilities to quantify motion using biomechanical analyses. The biomechanics class was an eye-opener for all three of us. We left the class bubbling with ideas and went directly to the closest coffee shop to expand on what we had learned. Everything that the new professor, Dr. Plagenhoef, had discussed was especially exciting to me.
since I saw an academic path towards understanding movement from a mechanical point of view which had been my quest for decades.

Over endless cups of coffee, Jim and I learned more about Ann. She had been born in Raleigh, North Carolina, but spent most of her childhood in Chapel Hill, North Carolina. “Go Heels” was a phrase we heard often. To an Israeli, this made no sense and to a New England Yankee like Jim, this was nearly a declaration of war. In addition, we were further informed that the sky was Carolina blue because _G_ d was a Tarheel.

Despite this seeming craziness, it turned out that Ann was also obsessed with understanding the anatomy and the mechanisms of controlling the human body. I was more intrigued by the mechanical aspects while Ann was more interested in the nervous system’s impact on the functions of movement. Jim was interested in both aspects and hoped to find a path to a career perhaps in physical education or coaching. Jim’s financial stresses pushed his plans to find a teaching position in a college in New England since this was close to home for both Jim and his wife.

Our friendship flourished and soon we were the “Three Musketeers”. Jim, Ann and I would meet in class, in the laboratories, and over coffee. Frequently, we drove to the local ice cream shop, where Jim and I would consume enormous hamburgers, milkshakes, followed by four-scope banana splits. Ann would drink her coffee and shake her head at the amount of food two men could eat and remain trim. Our shared common interests seemed endless and were lucky to be able to help each other with difficult class work. If one of us could not solve a problem, eventually we would collectively discover the answer.

As the semester progressed, I became convinced that biomechanics provided the way for me to understand and produce answers to my many questions about movements and activities. Clearly, biomechanics was my field and gave me a focus to achieve the answers I sought. But there were new aspects, which intrigued me continually. Early in his career, Dr. Plagenhoef, had developed a biomechanical program written in one of the early computer languages called FORTRAN.

<table>
<thead>
<tr>
<th>Table B-3 Computer Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) COMPUTE THE N + 1 VALUES OF XBAR (I), WHERE N IS THE DEGREE</td>
</tr>
<tr>
<td>(2) INITIALIZE THE VALUES OF Y(I) TO THE INTERVAL (-1,1)</td>
</tr>
<tr>
<td>(3) PERFORM THE LAGRANGIAN INTERPOLATION TO OBTAIN N + 1 VALUES OF YBAR(I) WHICH CORRESPOND TO THE N + 1 VALUES OF THE XBAR(I)</td>
</tr>
<tr>
<td>(4) COMPUTE THE COEFFICIENTS C(I)</td>
</tr>
<tr>
<td>(5) CONVERSE THE CHEBYSHEV SERIES FOR Y(I) TO ITS EQUIVALENT POWER SERIES</td>
</tr>
<tr>
<td>(6) CONVERSE THE POWER SERIES FROM THE INTERVAL (-1,1) TO THE INTERVAL (A,B)</td>
</tr>
<tr>
<td>(7) PUNCH THE COEFFICIENTS OF THE FINAL SERIES EXPANSION</td>
</tr>
<tr>
<td>M = DEGREE OF THE POLYNOMIAL Y(I) DESIRED</td>
</tr>
<tr>
<td>XMIN = FIRST VALUE OF X (SMALLEST VALUE OF ORIGINAL X-COORDINATES)</td>
</tr>
<tr>
<td>DELTX = INCREMENT BETWEEN VALUES OF X, THAT IS, X(I) = X(I-1) + DELTX</td>
</tr>
<tr>
<td>YU(I) = VALUE OF THE ORIGINAL Y CORRESPONDING THE JTH VALUE OF X</td>
</tr>
<tr>
<td>R(I) = THE ITH ROOT, OR XBAR(I)</td>
</tr>
<tr>
<td>V(I) = THE ITH VALUE OF X(I), OR NORMALIZED X(I)</td>
</tr>
<tr>
<td>C(I) = THE ITH COEFFICIENT OF THE CHEBYSHEV SERIES IN (-1,1)</td>
</tr>
<tr>
<td>F(I) = THE INTERMEDIATE STORAGE USED IN COMPUTING INTERPOLATED YBAR(I) IN COMPUTING C(I)</td>
</tr>
<tr>
<td>AND IN CONVERTING C(E) TO FINAL POWER-SERIES COEFFICIENTS IN (A,B) THE FINAL COEFFICIENTS ARE</td>
</tr>
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[Section of one of the first ever program for Biomechanics]
Unfortunately, the process required to process a biomechanical analysis was excessively tedious. The sequence began with filming the subject at a right angle to the motion. After the film was developed, the next step was to project the 16mm film of the movement one frame at a time. The film sequence was projected through a series of angled mirrors onto a glass-topped table. As each frame appeared, the location of the body’s joints was traced by marking points on a large piece of paper which had been taped onto the glass top. This process was known as “digitizing”.

The next step required measuring the various angles and distances on the large paper with a ruler and protractor carefully recording them in a table. The data in the numerical table had to be hand-punched into computer cards necessitating sitting for hours in the computer center to complete this task. These punched cards were then submitted to the computer center for processing by the biomechanical program. If all the point information had been correctly transmitted to the computer punch cards, a long, thick stack of paper was the happy result. But if even one card was wrong, upside down, or missing, there was only a thin computer printout of failure as the result. There were many times, after hours of waiting, the result was a disappointment. However, if all went according to plan, the program could correctly calculate the kinematic characteristic of moving bodies.

![Projection System for tracing films, frame by frame](image)

The program produced kinematic parameters which included the positions, velocities and accelerations of each of the selected joints. The information for any one of these joints and for any of the selected kinematic parameters could be plotted on paper. The plotted data yielded diagrams such as the following examples of stepping from a table, jumping into the air, and hitting a tennis serve.
During the semesters that Dr. Plagenhoef taught our class, he was in the process of writing a book: *Pattern of Human Motion*. All of the biomechanics class members, including Ann and me, contributed most of the figures to his book. The tables and diagrams were ours as well, although no royalties resulted from our work. We were typical graduate school slaves, but the learning and experience more than made up for any financial rewards or lack thereof. After all, the students were there to learn not to earn a living.

That was my first introduction to using a computer to measure or quantify human movement. I became obsessed with using this tracing procedure and Dr. Plagenhoef’s biomechanical program. I wanted to analyze as many Track and Field events as possible with this technique.

Fortunately, at that time, I was the assistant track coach and shared an office with the head coach, Ken O’Brien. He was the same coach who had invited me to work with the Field events during the year that I pursued my Master’s degree. He had enthusiastically welcomed me back after my stint in Indiana and Ohio and gave me the job of working with the Field athletes as I had previously.

Soon after the semester began, I made a fantastic discovery. During the previous year, Ken had acquired loop films for each Track and Field event. Each event was individually presented for one full cycle of that specific activity in a 16 mm movie films. The event cycled continuously in a repetitive loop. In other words, the activity would continue to repeat over and over as many times as desired. The first event I examined showed a javelin thrower running down the runway, employing the complicated cross-step running approach pattern, planting the front leg, and throwing the javelin. Coach O’Brien had loop films for the discus throw, shot put, hurdles, and the other track and field events.
The most important part of the technique for throwing the javelin was from the moment of foot plant until the javelin was released. Therefore, I cut that section out of the loop since the only section of the throw that I needed for my biomechanical analysis was from the moment of the foot plant until the release of the javelin. After I had cut that section out, I connected the remaining film into a loop. After I had connected the remaining film, anyone watching the film of the javelin throw would see the athlete ran down the runway with the complicated crossover footwork followed by the javelin flying in the air. Everything in between the run and the javelin flight was missing.

This was the era of films rather than the digital technology currently available. During the first century of photography and moviemaking, everything was recorded on film. Film was a celluloid material whose light-sensitive surface could record lasting images. At that time, film was the only option for recording. Film could be easily cut and spliced so I could remove the parts I needed and connect the rest of the film into a loop.

Using this splicing technique, I removed the most important segment of each event, such as the takeoff in the high jump, the release of the discus, the step and stretch over the hurdle, and all of the other films that Ken had purchased to teach Track and Field events. I carefully returned the abreviated films, neatly connected, to their original containers and replaced them in the film drawer in Coach O’Brien’s office. I planned to return those sections to their proper places in the loop but before that happened, the loss was discovered.

A day or two after I had surgically altered the loop films, Ann was working on her studies at my desk in the office I shared with Coach O’Brien. Suddenly, Ken burst into the office. He slammed his books down on his desk and began pulling open each of the drawers in his two metal file cabinets all the while shouting about films. He would yank out a metal drawer, rummaged about in the files, throw things up into the air, and then slam the drawer back into place. The entire time of opening and slamming drawers, he maintained a thunderous monologue about missing films and shouted about Gideon cutting the movies. Ann silently observed this cacophonous and loud racket generated by the metal file drawers as they were pulled open and slammed shut. The tumultous file drawer sounds were amplified with Coach O’Brien’s shouts accompanying the pandemonium. Ann described this tumult to me later when the proverbial dust settled.

This berserk behaviour was so completely out of character for the normally mild and gentle Ken O’Brien that Ann slowly and silently oozed under the desk in hopes that she would go unnoticed. After a few minutes of this tirade, Ken breathlessly sat down in his office chair and noticed Ann who by then was peeking warily from beneath the desk. Despite his enormous frustration, Ken smiled sheepishly and suggested that she warn me if the films were not repaired quickly to their proper sequences. Imagine a slapstick comedy act with drawers flying and the ravings of a mad man while an innocent bystander hides watching in fear. This is a glimpse of what that day looked like. Needless to say, I returned the missing film sections as quickly as possible.
In my defense, I spent long hours analyzing these athletic movement sequences which had been temporarily removed from the films. One of my first studies was to examine the style and technique of the then world record holder in the javelin throw. The athlete was Janis Lusis, a Latvian and Soviet athlete, who won a bronze medal at the Tokyo Olympics, a gold medal in the 1968 Olympics in Mexico City, and a silver medal in Munich in 1972. His performances were amazing and he demonstrated a tremendous accomplishment to perform at such an elevated level across three Olympiads.

My goal was to understand his technique from a quantifiable rather than merely visual perspective. I traced the film, frame by frame, measured the coordinates, punched the computer cards, and ran the biomechanical program on the University’s mainframe computer. The results were fascinating and I immediately began work on a presentation to the athletes and coaches at the Olympic Training Camp in Dartmouth College and for the International Track and Field Coaches Convention to be held in Eugene, Oregon. I also planned for the article to be published in the Track and Field Quarterly Review.

In both my presentations and the publication about Lusis’ javelin throw, there were diagrams of the movement path followed by each joint. In addition, I demonstrated how the athlete was able to coordinate the acceleration and deceleration of the various segments. I explained quantitatively that the lower, heavier parts of the body, such as the legs and torso, had to rapidly slow down close to the release of the javelin, thus transferring the momentum to the arms and javelin. The analogy I employed was a speeding car crashing into a wall and sending the driver flying through the windshield. My speech and this article described many details about how Lusis performed and how his style could be utilized by other athletes.
I was very optimistic about the usefulness of biomechanics in understanding the activities in which many people had spent their entire working careers. My experiences, until then, were that some coaches were as stubborn as donkeys and resistant to change. Their attitudes were if it had not been done before, there was no reason to do it now. Because I was aware of this ingrained resistance, I was somewhat apprehensive before my presentation and the response that it might receive. I took a deep breath and decided to try my best to explain the beauty and usefulness of biomechanical analysis to these coaches. Then, let the chips fall where they may, as the saying goes.

I was pleased and felt justified after my talk when many of the coaches attending my presentations were enthusiastic about this new biomechanical information. Anything that could help their athletes perform better and make them better coaches was welcome. This was a refreshing attitude and one I hoped to spread throughout the coaching community.

The editor of the *Track and Field Quarterly Review*, George Dales, was extremely enthusiastic about the potential of biomechanical analysis for athletes. It was at the Eugene convention when I met George in person for the first time. Previously, we had communicated only by mail. George was the head coach at the University of Western Michigan in Kalamazoo and was obsessed with Track and Field from both the athlete’s and coach’s perspective. He wanted to help this population in meaningful ways and sought to publish articles that would accomplish this goal. George enthusiastically embraced my method of performance analysis and published many of
my research papers throughout the nearly 50 years since that first article. He has been a great supporter and friend of mine and Ann and both of us cherish this long and enduring friendship.

I returned to Amherst after the Oregon convention elated by the response which I and the presented material had received. Now, it was back to work on publications, academic class studies, teaching, and coaching.

While I was engaged in these daily tasks, however, I pondered about a good Ph.D. dissertation topic. The thinking process was similar to the dilemma about a suitable topic for my Master’s thesis. How could I combine the mechanical part of the movement with the physiological portion? I knew that Dr. Ricci, my dissertation advisor, would want a concentration in the physiological part but that had less appeal to me. I needed a subject that would interest both of us. I reflected on my discus and shot putting background from the perspective of the new Olympic attitudes concerning supplements and performance enhancing substances. I had attended a few conferences dealing with the Olympians as well as chatted with athletes throughout the Yankee Conference during track meets when I coached the Field events. It became increasingly apparent that pharmaceuticals were becoming as much a part of sports as training and equipment were. Nearly all of the college athletes I met were convinced that “the other guy” was taking drugs, such as anabolic steroids, to enhance their performances.

In addition to the assumption that “the other guy” is taking steroids was a growing controversy whether anabolic steroids produced enhanced musculature and, therefore, improved performances or was there only a placebo effect. I had heard from my Israeli friends that the undercurrent murmured in the competitive locker rooms in Europe and Asia was that the Russians and East Germanys were consuming a variety of drugs. This belief fueled the gossip mill among athletes from college age through the Olympic ranks. Since I had coached Olympic athletes previously and was currently working with the college team members, I thought that this would be an excellent opportunity to determine the precise effects of anabolic steroids on strength and performance. I could evaluate both mechanical and neuromuscular factors and determine what, if any, effects the anabolic steroids had.

Another important consideration was that all dissertation research had to be unique. It was well known in the scientific medical literature that physicians routinely prescribed anabolic steroids to hospital patients. However, the patients were frequently elderly and/or had been bedridden for extended periods of time and their muscles had begun to atrophy. However, no one knew the effects of anabolic steroids on healthy, well-trained athletes since that group had never been studied. I was convinced that this research topic would be both timely and unique and should be suitable as a dissertation topic. I discussed the idea with Professor Ricci and he agreed that the idea had merit.

The next task was to devise a scientific strategy to determine if anabolic steroids had any effects and, if so, what were they. Since I taught weight training classes and coached Track and Field athletes, I optimistically placed a “Volunteers Wanted” sign-up sheet on the wall next to the weight room door. When I went to class the next afternoon, I was shocked to discover that the page overflowed with names. The list of volunteers was more numerous than the 30 subjects that the study needed.

After careful screening, thirty men were chosen and divided into three normal and homogeneously representative sample groups. Each potential subject was sent to the infirmary for thorough physical exams by the doctors to ensure that the subject was healthy and physically able to participate in the research proposed. After being medically cleared, the doctors assigned each of them to one of the three groups. The subjects were unaware that there were any differences among the groups. The infirmary physicians placed one-third of the men in a placebo group, a second third were in the anabolic steroid group, and the remaining men were in the control group. Then, the roster of participants was sent to me.

The three groups participated in identical training and testing events. The only differences among the groups was whether they received the steroid. The control group followed the same exercise protocol as the other groups but were given “dummy” pills. Their performances on the exercises constituted the extent of their participation in the study. The individuals in the other groups were given pills that looked like everyone else’s.
Each week, the other subjects would report to the infirmary for an assessment of their health and then they would be given a container with that week’s “prescription”. At the midpoint of the experiment, the infirmary reversed the ingredients in the pills. The group which had initially received the placebo would be administered the anabolic steroid and vice versa. The pills for all groups looked identical including the control group which continued to receive only “dummy” ones. This information was not shared with the subjects who all thought they were receiving anabolic steroids throughout the study.

Every participant reported weekly to the testing laboratory for specialized strength evaluations which I conducted. I measured their strength with a device which I had designed for testing isometric strength. The apparatus was constructed to obtain accurate and consistent isometric strength measurements for all subjects. Isometric strength is defined as the maximum force the muscle can produce in a fixed position. The test position was for a seated subject with the upper right arm supported on a table, the elbow fixed at a right angle, and a cuff around the wrist. The subject was instructed to pull the wrist cuff as forcefully as possible and the strength was recorded on the computer. The apparatus with a test subject is shown in the following photograph:

![Isometric Strength Apparatus](image)

Another weekly test was to measure the Patella Tendon Reflex. A “reflex” is a response to a stimulus without conscious thought and involves the reactions of nerves, ligaments, tendons, and muscles. Simply put, the patella tendon reflex is what the leg does when the doctor hits the knee with that little hammer. For my dissertation study, a special procedure involved placing electrodes on the right leg so that, in addition to the reflex itself, I could evaluate some of the neurological components.

The third aspect of the study was a prescribed Weight Lifting Program. Every day, all the men had to follow a specialized training program and record the amount of weight they lifted each day for each exercise. I collected these results every day for processing.

The experimental subjects reported to the infirmary every Monday morning for their battery of physical tests and then received their weekly dose of pills. The study progressed nicely for about three weeks and I was amazed to watch the progress of the people on the various tests. At that point, it was
merely my personal observation but all of them seemed to be increasing in strength. I was excited about
the study and convinced that it would yield fascinating results and garner worldwide interest especially
among coaches and athletes.

On Monday of the fourth week, I was working with some of the subjects in my one o’clock weight
training class when Dr. Ricci rushed into the weight room. His hair was disheveled and windblown, his
face red, and he was gasping to catch his breath. Between gasps, he told me that we had to hurry to the
infirmary because the chief physician had called for an urgent meeting with both of us.

Once we were out of earshot of the test subjects and rushing across the campus to the infirmary,
Dr. Ricci explained the urgency. There was a medical problem with one of the students. One of the
weekly medical tests for that subject had revealed a potentially disastrous problem which the doctor
would explain once we were privately secluded in his office. My heart sank as I envisioned not only
about the terrible news that I might have to present to my subjects, who were my friends, but also about
the vast amount of work already invested in this dissertation study. I would have to start from scratch
with a new idea. I felt gloomier and more worried with each step we took towards the infirmary.

As I sat facing the head physician across his desk, his expression said it all. My research project
was doomed and I would have to begin again. The doctor explained that prior to my study, there was no
scientific literature about the effects of anabolic steroids on healthy human males. Therefore, his medical
staff had included, as one of the batteries of tests for each subject, a test for sperm count. Unfortunately,
he explained, Subject JP’s test that morning showed a sperm count of zero. They wanted me to find him
immediately and have him come to the infirmary for a retest. Hopefully, it was merely a lab error.

I jumped up and ran from the room. Since this was long before cell phones, I had to depend on
his friends to know where I might find JP. Soon, he was located and we ran as fast as possible to see the
doctor. Once again, as JP and I sat across the table from the chief of the infirmary, the doctor explained
the reason we were there. As he listened, JP became flushed and stared sheepishly at the doctor.

“I know the rules included sexual abstinence for the duration of the study,” he stammered. “But
Saturday night my friends and I were eating pizza and drinking beers at one of the local student hangouts.
Two of the most beautiful girls were there, sitting on my lap, kissing me, and they insisted that I go with
them to their room. I knew that this was against the study rules but I couldn’t resist. I couldn’t believe
this was actually happening to me and it was impossible to say ‘No’ to them. They were so beautiful and
insatiable. I am so sorry. I hope I haven’t ruined your study, Gideon” he said greatly chagrined.

The doctor and I looked at each other and burst into laughter. What a relief to hear this tale of
fun and college behavior. With our collective fingers crossed, we hoped this would be the explanation
for the zero-test count. The doctor told JP that he would have to drop out of the study and report to the
infirmary for follow-up tests until they were confident that he was completely healthy. Then, shifting his
gaze towards me, the doctor told me to continue the study following the protocol in place. Without a
doubt, I floated, rather than walked out of his office.

The data collection was completed in 16 weeks. I statistically processed the results and discovered
several interesting results. One finding indicated a significant improvement in force and other
neuromuscular patterns due to the use of anabolic steroids. Another result indicated that the increase in
strength was not due only to training or psychological factors. In studies previously reported in the
scientific literature, test subjects consisted of weak or untrained subjects. In those studies, strength
increases could be explained that they had been lifting weights for the first time rather than to any steroid
use. The subjects in my study were very strong and athletic prior to the study. In other words, they have
already skilled in the activities themselves and improvement in strength at their level of achievement was
quite difficult to obtain merely by lifting weights.

For this reason, I had three groups in my study. The control group had received only “dummy”
pills and the other two groups had received either placebo or anabolic steroid pills. I had included
administration of the placebo to detect whether merely ingesting a pill was a contributing factor to the
resulting responses. The administration of the placebos and the actual anabolic steroids were reversed at
the halfway point in the study. This meant that the subjects in two of the groups received both placebo and anabolic steroids but in different segments of the study. The results revealed that athletes given the placebo during the first half showed little strength gain until they were switched to the anabolic steroids in the second portion. Those subjects who began with the anabolic steroids had sharp strength gains in the first half and demonstrated little change during the second part when they were administered the placebo. The control group which had received nothing demonstrated little or no improvement in their overall strength levels. These responses were consistent with expectation.

After processing and analyzing the data, I had to write the dissertation according to the rigidly prescribed format that everyone was required to follow. Ann was enormously helpful since her English was superior to mine. Although, I had been living in America for nearly ten years, I maintained a noticeable accent when I talked and my writing skills apparently had some kind of accent as well. She and I worked for many long hours until the document was finally finished.

Every doctoral student had to present their research to a committee and, if successfully received, is awarded the degree. My committee was extremely pleased with my work, especially because of the sophisticated statistical tools which I had used to evaluate the results. I passed with flying colors and submitted the final, printed version to the University. My Ph.D. was officially awarded in 1972.

After completing my dissertation and receiving my Ph.D., I began to prepare the information for publication. In those days, as now, the need to publish or perish was a necessity especially if a student planned for a University position following graduation. At that point in my career, I was unsure of what avenue I would take but I knew that publications would be essential on my resume.

I persuaded another graduate student to help me with the articles in exchange for including his name on the publication. I would provide the data and interpretations and he would write the article in the exquisite English that he possessed. My friend readily agreed and we spent many hours writing and rewriting the material. We prepared and mailed different manuscripts to four journals in anticipation of their being accepted for publication. Unfortunately, we were less precise about the details regarding which journal received which article. We mailed different articles to several publications since each article, as well as the journals themselves, targeted a variety of subject matters. As luck and lack of attention would have it, we sent the same article to two different journals. That would not have been so terrible except that each journal accepted the publications. Even as we rejoiced over the acceptance letters, we paid no attention to one small detail. Each letter referred to the same title but we failed to notice that the letters were from different journals. We cheerfully congratulated ourselves on two articles in two journals.
Imagine the dismay and consternation we experienced the day our mailboxes contained two separate journals, but with the identical article in each publication. The good news was that each of the organizations which had accepted our publications was at the top of the academic ladder. They were the Journal of Applied Physiology and Medicine and Science in Sports. The bad news was that we had committed the ultimate sin in academia! We had double published. This is a fancy term for having the same article in two different journals.

The scandal soared into the stratosphere of condemnation and blame. Eventually when the academic dust settled, we had to write letters of apology to each organization explaining our oversight. We threw ourselves on the mercy of the editors and asked for understanding. The letters were published in the next publication cycle in the Letter-to-Editor section complete with the editors’ chastising condemnations. Students and professors scolded us as well. Eventually we were forgiven and have continued to enjoy successful careers.
During the time I was working with my dissertation activities, I continued to take classes and was involved with the Track and Field team. The teamwork included daily sessions in the weight lifting room, coaching the Field events, and traveling with the athletes to competitions. The competitions were held indoors during the winter session and outside during the spring period. One day in 1971, returning to Amherst from a track meet with one of the javelin thrower, Rocco Petitto, we noticed a beautiful, quiet lake along the left side of the road. The lake with the surrounding trees looked tranquil and welcoming.

“Hey, let’s go look at that lake,” I said to Rocco. I had always loved nature and especially water. The lake appeared even more serene and beautiful as we drove closer. Eventually we found a placard with the name identifying the lake as Metacomet Lake. Shortly thereafter was another road, Poole St., which appeared to border the lake as we turned onto it. We drove along this small road and enjoyed the beauty as it curled around one side of the lake under a canopy of tall oak, pine, and maple trees. I saw a “For Sale by Owner” sign in front of a small, reddish-colored waterfront house with a phone number printed at the bottom. I copied the phone number onto a small slip of paper and put it on the car’s dashboard. The next day I called the owner who told me the asking price for the house was $15,000.

At that time, I was separated from Yael and lived in a small apartment in Northampton. The town of Northampton is about ten miles west of Amherst across the Connecticut River and is the Home of Smith College which is one of the Sister Colleges of the Ivy League schools. My small apartment was adequate for my needs but there was no lake for my soul. “How could I get $15,000!” bounced around in my head? I discussed it with Ann, who had become a close, trusted, good friend in addition to a collaborator in our shared academic classes. Her suggestion was to see what terms I could negotiate at the local bank. Neither one of us had ever borrowed money nor applied for a mortgage from a bank so this was a completely new experience and a little unnerving.

Under a cloak of apprehension which we each felt but valiantly covered, we were escorted into the bank manager’s office. The banker was surprisingly friendly even as he asked questions from a huge list on his loan application questionnaire. The questions were straightforward and I was easily able to answer them. Because I was teaching at the University, had some cash in their bank, and was beginning to generate money from biomechanical projects, he offered me a loan at a 3.0 percent interest.

I called the seller, received the bank loan, and became the proud owner of that cute red house on Metacomet Lake. I was so happy to have a home of my own and on a lake as well. I knew, in addition to a home, I could use it for my scientific and business activities.
About the same time that all the classes and dissertation data collection were proceeding, I was also traveling nearly every weekend to track meets throughout the Yankee Conference. There were competitions in Boston, Providence, New London, and Hanover. I met coaches from the schools and shared information. It was at one of the meets that my head coach, Ken O’Brien, introduced me to the coaches from Dartmouth College. The Head Coach was Ken Weinbel and his assistant was Carl Wyland. It transpired that Dartmouth College would be hosting a special Olympic Throwers Camp during the summer and Coach Weinbel asked me if I would be interested in participating as one of the coaches in this Camp. He was especially interested in the biomechanical analysis that Ken O’Brien had described. I was very excited by this opportunity and enthusiastically agreed to join the coaching staff for the Camp.

When the summer arrived, I had many decisions to make. The first one was what to do about money? I had to find a summer job which would not conflict with the time needed to attend the Olympic Throwing Camp at Dartmouth College in Hanover, New Hampshire. Luckily, the director of the University’s Intramural program would be traveling most of the summer and needed someone to fill his
position for that time. I applied and got the job with the understanding that I would have to travel to Hanover periodically.

The next task was to find someone to assist me in the data collection and processing at the Olympic camp. Although Ann would have been invaluable, she was quite busy with classes so she could only help in a limited capacity. Luckily, one of my student athletes, Rocco, needed to raise his grade point average with high extra credit grades during the summer class period. Since Rocco was a javelin thrower for the school, he was familiar with the biomechanical work I had been performing for the team members. In addition, he was an undergraduate physics major so he brought his own knowledge to this new and developing area of biomechanics.

The Throwing Camp was three long and intense weeks. Rocco and I would drive the four hours from Amherst to Hanover, work with the throwers, and film the various performances. After a few days of filming, we would drive the four hours back to Amherst to process the data. Rocco did most of the tracing of the films and transferring the numbers onto the computer punch cards. I had to execute the biomechanical programs and interpret the resulting outputs. These processes were arduous and time-consuming. Rocco, Ann, and I discussed at length about finding or creating better techniques for data collection and processing.

Ann was involved in much of the work when we brought the work back from New Hampshire. She used my office for much of the summer, since it was convenient for her classes, my intramural job, and for the biomechanical analysis we were doing for the throwing camp athletes. Summers in Amherst were relatively quiet and tranquil. There were few academic classes available in the summer, so most the students and faculty left town. The campus population consisted mostly of University employees or graduate students working on projects. Our dear friend, Jim Salidas, had taken his family to a well-paying summer job which left Ann, Rocco, and I to work and study together.

Another thing I did while I was working with the Olympic athletes in Hanover was to take some courses in the computer science department at Dartmouth College. Coach Weinbel had helped to arrange this unique experience for me. Dartmouth College had a faster, newer computer than we had at the University of Massachusetts and, in addition, there was around-the-clock access. We could send our data over a coupler to the mainframe and pick up the printouts even at 2:30 a.m. in the morning. This was a marvelous advantage over the Massachusetts system, so I tried to capitalize on it as much as possible.

One of the computer courses fascinated me since the two professors, John G. Kemeny and Thomas E. Kurtz, had invented a new language called BASIC (Beginners’ All Purpose Symbolic Instruction Code). It was simpler, more straightforward computer language than FORTRAN and allowed the user to communicate with the computer via time-sharing. This meant that a user could directly connect to the computer through an acoustic coupler and share the computer’s processing time with other users. It was also possible to work at a remote site rather than having to be directly connected via hard wires to the computer. The main-frame computers were larger and could perform faster than any individual human and, therefore, a computer system could host many users working simultaneously. Even with many
simultaneous users, the computer had more capacity that went untapped. In today’s world, most people have their own computers and only connect to some type of remote access through a server or cable provider. In 1971, nothing like today’s PC or even our modern powerful cellphones existed. Bill Gates and Steve Jobs had not yet worked their magic.

In one of the coaching sessions with the Olympic throwers, I explained the step-by-step procedure from the throwing performance, processing the data collected, computer calculations, and finally explaining the results to the athlete. The biomechanical analysis was a fantastic solution for quantifying the sports performances despite the drawback that it was a slow tedious process.

Following the coaching session, I was explaining to Coach Weinbel that an improved tracing system would accelerate the process by many hours and should be less labor intensive. In fact, an automated digitizer would enable the films to be more easily and quickly processed. Since I had become familiar with the ability to time-share with the computer, I recognized that this would be a perfect marriage of technologies. I began to envision an automated tracing system linked directly to the main computer system through the telephone couplers we utilized at Dartmouth. Ken Weinbel listened to me with the same skepticism that the kids at Hadassim had, when I told them about going to the Olympics.

Since I never give up on solving a problem, I continued to ponder a solution to this laborious bottleneck. One sunny day in Hanover shortly after that biomechanics discussion with Coach Weinbel, he suggested that I go to a specific laboratory in the Medical School to see some of the equipment they used. He had heard about a medical application using lasers and though there might be a potential application for my biomechanics need.

I hurried over to the Dartmouth College Medical Center and located the lab he had mentioned. I discovered a surgical center employing equipment to outline brain tumors on X-rays using a specialized pen. The patient would have four to six X-rays taken of the tumor each from different angles and orientations. The technician employed a type of specialized light pen to trace the outline of the tumor on each X-ray. Then the exact location of the tumor in the brain in three dimensions would be determined using a program that the physicians and researchers had developed. The location had to be determined very precisely since the tumor in the patient’s brain was to be annihilated by intersecting laser beams. Any error in the exact location of the tumor would result in damaging healthy tissue.

I wondered whether I could use something like this for the film sequence of a movement. Perhaps a pen could touch each joint center and a sound could replace the light used to outline the tumor. The biomechanical technique needed to determine the “x” and “y” coordinates for each joint center for each frame of the film. I asked the researchers at the tumor laser lab if their system was accurate. Their response was that it was life or death for the patient so the system had better be accurate. Next I asked for the name of the manufacturer which they readily provided.

The light tracing equipment was manufactured in Connecticut in a small town not too far from Amherst. Shortly after I saw the equipment in the Dartmouth Medical Department, Ann and I drove to the factory. We explained our needs and I asked whether they could build a prototype using sound. I had an idea that the bottom and side of a frame would have built-in microphones. A “pen” or stylus would create a sound that would be detected by the microphones. The pen would create a spark with a certain frequency which would propagate the instant that the glass surface was touched. The first microphone that detected the arrival of the sound would be the one located at the shortest distance from the pen in

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both the horizontal and vertical directions. These perpendicular microphone locations represented the x and y coordinates.

The “tracing” or “digitizing” equipment would transmit the X and Y values to be punched onto a paper tape. After the film had been “digitized” for the entire motion, the paper tape could be submitted manually to the computer. An acoustic coupler could also be connected so that the data could be sent directly to the computer. In this fashion, there would be a computer connection and a backup paper punched tape. After the “X” and “Y” coordinate data was saved in a computer file, the biomechanical analysis program could be executed.

By inventing the Sonar Digitizer, I had developed a unique device which would increase the digitizing process rapidly. Increasing the identification and stored information of the body’s joint locations would greatly enhance the biomechanical quantification process. The company enthusiastically embraced the sound modification and said they would let me know as soon as it was available for us to see. As we drove back to Amherst, Ann and I could not stop talking about this fantastic device which we were using before it actually existed.

During one of our biomechanics classes in the previous spring semester with Dr. Plagenhoef, Ann had leaned over and whispered that this would be a great technique for analyzing racehorses. After class, we continued the conversation and amplified the possibilities that could be used with horses. It could be employed to predict the best horse to win a specific race, detect an injury, or even play a part in which yearlings showed the most promise.

I told her, “Let’s start a company.”
She responded, “Okay. Let’s do it.”

Now, several months later, we were driving through Connecticut towards Amherst and she reminded me about that earlier discussion. Since neither of us had ever started a company, we did not know how or where or how much money was needed for such an idea. As I was returning to Hanover the next day, we decided the next step would be to see if anyone at the Throwing Camp could give us any suggestions.

The next day, between training sessions, I told Coach Ken Weinbel about our idea to form a company and asked if he had any suggestions about creating one. He said one of his friends worked in the Business School and he would ask him.

The following day Ken had the information. The professor said that it was very inexpensive to establish a corporation in New Hampshire costing a mere five hundred dollars. The fee in Massachusetts for forming a corporation was five thousand dollars and the yearly filing fees were higher as well. I was astonished that states sharing a border could have such disparate costs. Once again, I learned that America could be a baffling place.

In addition to finding the information I had requested, Coach Weinbel expressed an interest in being an investor of our company if we decided to proceed with a company. I told him that I would discuss it with Ann and let him know when I came back to Camp in a few days.

Ann and I discussed the situation and decided it would be an advantage to have someone with known credit and a professor at a prestigious school as a member of our company. Therefore, Ken Weinbel invested the money we needed to incorporate in NH and provide some initial costs for running the business. For example, we needed an office and the new Sonic Digitizer which was being developed in Connecticut. In exchange for this cash investment, he would receive 50% of the company while Ann and I would own the other 50%. The company was named Computer Biomechanical Analysis, Inc. (CBA). It was the World’s first research company established for analyzing motion regardless of whether it was human, animal, or fish. Our motto was, “If it moves, we can measure it”. CBA Inc. still exists and continues to do well.

Our new partner, Ken, found a large, spacious second-floor office for the company. It was located above the fire department and next door to the most delicious ice cream store in town. We had room for desks, the new digitizer, and started work on the remaining film from the Throwing Camp.
It was probably during this long summer filled with work but with less pressure than during the normal schoolwork and classes that things began to change. Ann and I studied in the same office and worked on the biomechanical projects for the Thowers. When we were in Amherst, she invited me to her apartment for steak and salad dinners so that we could continue working. Somehow, without either of us noticing, we developed a unique and special relationship. As Ann tells it, one day she blinked her eyes wide open with the realization that she loved me! I am certain, to this day, she was more shocked than I was. All our time together had been filled with shared ideas, interests, and dreams but without holding hands, kissing, or anything else. Our friendship had grown, strengthened, and now blossomed into love. Each of us was surprised at this discovered love but happy with the realization.

School began again in the fall with a flood of students and faculty returning to Amherst. Life was busy now with so many things occurring at the same time. Ann and I had full academic course loads to occupy our minds and now we had a company as well. In addition, I had classes to teach and the team to coach, while Ann continued with her research assistantship collecting data for her professor. I lived in my new house by the lake while Ann continued to live in her apartment as we cautiously tiptoed into our newly enchanted life.

We quickly realized that for our company to succeed, we needed to let the World know that it existed and what it could do. Communication about this innovative service seemed obvious to two graduate student researchers. We assumed this information could be provided through scientific presentations and publications especially in international publications. Needless to say, we were incredibly naïve at that time about the world of business and commerce.

For several months, we worked on an article, which described the system in a step-by-step fashion so that academicians and lay people could understand it. I chose the journal, Mechanics and Sports, in hopes that they would publish the article which included my digitizing innovation. The article was titled “Computerized Biomechanical Analysis of Human Performance” and I was overjoyed when it was accepted for publication.

Immediately after the article’s publication, Dr. Plagenhoef called me to his office. I had been very busy during the summer and Dr. Plagenhoef had been in Maine for the vacation. Since I had completed his classes the previous year, I was a little surprised to receive this summons from him. I was completely unprepared for his aggressive tone once I was in his office.

“Why would you publish an article in Biomechanics without consulting me?” he asked.

I told him that during the summer while he was away, I had started a company dedicated to Biomechanics.

“You started a company?” he shouted.

“Yes, sir,” I answered him.

He was clearly upset and I was confused and stunned about his furious reaction. I had understood that one of the most important achievements for academicians was to publish their work and I had no idea what had provoked the angry response about starting a company. Dr. Plagenhoef continued his tirade and then I was dismissed.
I left his office with a sense that my relations with him might make things a little awkward around the department. Despite Dr. Plagenhoef negative reaction, I kept busy preparing publications, working on things within the company, studying, managing the weight room at the University, and working with Coach O’Brien and the Track and Field Team. As Assistant Coach, my responsibilities were to coach the Shot Put, Hammer, Discus and Javelin events.

A publication describing the services of C.B.A. Inc. (Published in “Mechanics and Sports”, 1972)

http://arielnet.com/ref/go/1086

My expectation was that both professionals and amateur athletes would come to CBA for help. Our analyses of the way they ran, swung a bat, or kicked a ball would assist them to perform better or to avoid an injury. Now all we needed were paying customers. Since I had begun to attend academic conferences and present my research, these venues seemed like potential sources. One downside to this idea was the jealousy that academicians have when someone else is more successful than they are. The other problem is that people attending these kinds of conferences are usually seeking sponsors for their own research rather than hiring other people. Since I continued to travel with the Track and Field athletes to competitions during the Indoor season, we considered the possibility that there might be people who want our services among that population.

My system was spread around the world. One day I received a phone call from Gerald Astor, one of the editors of the Esquire Magazine. He heard about our system and asked me if I can determine the ultimate performances in different Track and Field events. I told him that I will try and this resulted after one year of work with the article: “How to Know A Perfect Performance When you See One”. The publication came out just before the Montreal Olympics in 1976. It spread our system around the World.
In fact, this book was started with Gerald Astor after the Olympics in Montreal in 1976.

Esquire Magazine
http://arielnet.com/ref/go/1088
Travelling to track meets and trying to spread the word about CBA’s services had not stimulated the expected projects. The article I had written about analyzing human performance had created interest among academicians but no jobs yet. Ken, Ann and I decided that CBA needed a brochure to advertise our services. We would be able to hand them to prospective companies or mail them if requested. We designed a brochure with a creative design on the front and slots inside which allowed us to insert letters or publications.

Our new endeavor was born long before the era of e-mail, websites, or even fax machines. We had a prototype fax machine which was connected to our landline phone system as it was the only way to connect to the telephone at that time. In addition, the machine needed about 2 hours to send one short letter because the technology was so slow and the recipient had to have the same slow device to receive the fax. Needless to say, these early fax machines were not going to be of much help for our fledgling business.

Another feature in our new enterprise was our determination early in 1973 that we needed a company car for us to use for travel between Amherst and Hanover since we had cameras, tripods, and other biomechanical paraphernalia to transport. We purchased a hearse from a local funeral home in Hanover which served our needs well. It was a perfect vehicle for us at that time as well as provoking many smiles of disbelief among our colleagues.

Unfortunately, the 1973 oil crisis began in October 1973 when the members of the Organization of Arab Petroleum Exporting Countries (OPEC) proclaimed an oil embargo. By the end of the embargo in March 1974, the price of oil had risen from $3.00 per barrel to nearly $12.00 globally. Prices in the US were significantly higher.
Our problems by October were twofold: (1) the hearse was a gas-guzzler operating on 7 miles per gallon and (2) gas stations were restricted on the number of gallons they were permitted to sell to each customer. Since we normally departed our Hanover office after midnight for the drive back to Amherst, we were frequently alone on the road for most of the 100-mile trip. We would have to stop at least 3 or 4 times to buy the limited amount of gas permitted at each station. It took longer than necessary to make the trip, the weather was becoming bitterly cold, and we risked being stranded on the highway.

Ann and I discussed the idea of creating a biomechanical laboratory in my new lake house in Belchertown. Although CBA had a wonderful office in Hanover, it was still a long drive back and forth to Amherst. During the summer months, our schedules had been less hectic. Now with all of us working full time and the problem with gas, Ken, Ann, and I felt the need to re-evaluate the situation.

I invited Ken to my new home and convinced him that with the time-sharing connections, we could eliminate the expenses in the Hanover office and move the headquarters to Belchertown. He agreed since it saved both time and money.

In no time, the laboratory was working perfectly in the lake house. We projected the film onto the newly invented digitizer which was mounted in the division between the living room and the kitchen. The digitizer was connected to a Teletype for recording the coordinates on paper tape and directly to the mainframe computer through the acoustic coupler. This arrangement allowed the data to be transmitted directly to the computer eliminating hours of work previously needed for punching cards. In addition, the paper tape provided backup in case anything happened during the direct transmission.

It was fortunate that we had developed a backup system. As every scientist and engineer knows, things can go wrong and soon after we moved the laboratory to Belchertown, it happened to us. During a digitizing session, the computer connection began transmitting scrambled data. This was a monumental disaster since we depended on flawless interaction with the computer. It was a dreadful discovery that the data transmission was garbled but of greater importance was to determine what could have caused things to go wrong? What could be the source of the noisy interaction?

Each connection between equipment was checked. We restarted the projector and the digitizer but nothing corrected the noise problem. Finally, I lifted the phone from the acoustic coupler and listened. There was a strange buzzing noise which I had never heard before. I shouted into the phone to see what would happen. After about two minutes of shouting, someone answered me.

“Who are you,” I inquired?
“Who are you,” a man replied.

After several minutes of discussion, we discovered we were neighbors across the street from each other. This was during a bygone era when people had to share phone lines on what were known as “party lines”. There could be two, three, or more homes connected to the same phone line and you had to share it with each other. What had transpired was that every time our neighbor had tried to use his phone, he heard the screeching sound the coupler made. Since he had no idea what the noise was and the noise seemed to always be there, he was never able to use his phone. Finally, in desperation, he put his electric razor next to the phone and just let it run. Here, then, were two families baffled by crazy phone noises.

We needed to convince the phone company to give each of us a single-family phone line although the homes around the lake were more rural and remote than in a big city. At that time, there was only one phone company and this monopoly was notoriously stubborn and insensitive when dealing with little, powerless people. Imagine having two or three people sharing the same modern cell phone of 2016. Imagine if I-phones or Androids were not stand-alone devices but rather were shared by several people at the same time. Imagine having to wait to take pictures or read text messages until another person sharing the phone had completed their own task. That was our situation. I guess the uniqueness of our problem must have played into the decision since we were given a direct, unshared line to our kitchen laboratory.
Shortly after the phone situation, we expanded our staff. During one of my trips to Dartmouth, I was chatting with Ken Weinbel’s assistant coach, Carl Wyland. Carl was a good shot putter who had thrown the shot more than 60 feet. This day, he showed me his female dog and her six puppies. The mother was a pedigreed Siberian husky but the father was the Newfoundland “milkman” who had sneaked into the backyard. Carl gave me one of the furry little guys whom I named “Ringo” after one of the Beatles in the British musical group. Ringo became CBA’s first employee.

Our second employee arrived shortly thereafter. On a chilly September evening after a late dinner, we returned to the office to work a few more hours. Somehow, crickets always found a way into our office and then had to be relocated outside by Ann since she would not allow them to be killed. That evening, when she was providing a new home for a wayward cricket, there was a loud meow. When she looked down, a large gray cat was rubbing against her leg. The cat followed her into the office, enjoyed a hearty meal, and drank quite a lot of water. Apparently, he had wandered away from his home and found us. This was at the beginning of the school year when the town of Amherst was inundated with new students, graduate students, and faculty members returning home. We tried for several days to locate his owners but to no avail. The cat had lived in the office without creating any problems. After a week, we decided to hire him as our second employee. We named our new staff member “Melich” which is “king” in ebrew.

We took Melich with us to Belchertown to meet Ringo. The first few minutes when Ringo and Melich were formally introduced to each other, there was a little tension. However, I explained to them...
that now they were our family members and employees and, therefore, had to be friends. I guess they understood my accent because they lived happily together for the next twelve years.

Now that school was back in session for the normal school year, I had to drive from Belchertown to my office at the University in Amherst every day. Regular classes, dissertation work, and coaching responsibilities were back in the forefront of my workday.

My Track and Field athletes trained four hours each day including weekends. This was the commitment I insisted on if they wanted to be on the team. Without this devotion to their personal fitness, they would be wasting my time and theirs. The strength and fitness program in the Weight Room, thus, became well known on campus and new athletes continued to join the training sessions.

Unexpectedly, I received a call from one of the editors of the magazine, Strength and Health. Mr. Bob Hoffman was the founder of the magazine as well as of the York Barbell Company. Mr. Hoffman was instrumental in arranging for Arnold Schwarzenegger to come to the United States from Austria. Bob Hoffman’s picture, taken during his bodybuilding days, had graced my wall when I just a young boy in Hadassim.

Publication in “Strength and Health” – (I am on the right wearing shorts)  
[http://arielnet.com/ref/go/1092](http://arielnet.com/ref/go/1092)

It was a pleasant surprise to learn that the editor of this magazine wanted to do a story on the training methods I used. I had no illusion that some of the professors, including Dr. Plagenhoef, would be annoyed with me when they learned about this development. I continued to experience a nascent, but growing, impression that these kinds of opportunities were going to have a negative effect on me in the future. Students were encouraged to publish and achieve success but independent publications, private companies, publicity, and other types of success were not supposed to happen to graduate students. I was the first and only graduate student in the department of Exercise Science who had inventions and had begun a private company. There were no official rules or pronouncements that commercial independence was not allowed, but I continued to sense an undercurrent of displeasure and negativity.

During this same time frame, Ann continued to pursue her doctoral programs in the Exercise Science department. Ann’s interest was in Motor Integration, which belonged to the field of Neurosciences, while I concentrated on the field of Biomechanics and began to focus on post-doctoral studies particularly in computer science and computational neurosciences.

My publications also advanced my reputation in the field and I began presenting various studies at national and international meetings around the World. One of my presentations was given to the
American College of Sports Medicine in Baltimore. The title of my presentation was the same as my publication in the Mechanics and Sports Journal, “Computerized Biomechanical Analysis of Human Performance”. For my presentation, I utilized the typical format employed at that time. This meant that I projected 35mm slides onto a screen and discussed what each slide represented. The ability to connect your own PC and use PowerPoint or animated graphics were far into the future. However, at this conference, I presented my computer programs and demonstrated how it was now possible to biomechanically analyze human performance.

After my presentation, many of the scientists and attendees chatted with me about the subject matter. One of them was Ed Burke, the American Hammer Throwing record holder. Ed asked me whether my system could analyze people performing an exercise skill such as the bench press. I assured him that it was quite possible to measure such a performance. We had a lengthy discussion over dinner about his hammer throwing, my discus background, the recent article in Strength and Health, and the exercise machine company where he worked.
Ed told me about his boss, Harold Zinkin, who lived in Fresno, California. Harold had developed a line of exercise machines which were marketed under the brand name of Universal Gyms. Ed worked for Harold traveling around the country promoting Universal Gyms.
Ed shared some of the interesting facts about his boss, Harold. At one point in his youth, Harold Zinkin had been Mr. California. One of Harold’s best friends was Jack LaLane who was possibly the most famous fitness guru in the 1950’s and later. For years during their youth, these two friends had worked out on the sunny beaches of Venice, California. Venice was called “Muscle Beach” because of the large number of devoted weightlifters who trained and flexed their muscles for the public to admire.

There were also many competitive challenges among these weight lifters and body builders. However, there was one stunt that none had successfully accomplished despite repeated efforts. The stunt, nicknamed “Pyramid”, was to have the first person arch his back into a backbend or wrestler’s bridge. The second man could stand upright on the stomach of the first person. Then in a stacked formation, the third and fourth men stood on each other’s shoulders balanced on the shoulders of the second man. In other words, three men stood on each other shoulders while the man at the bottom of the Pyramid supported them in a back arch position. Success was only achieved if they could maintain the configuration for three seconds. Everyone struggled to achieve this feat, but only Harold Zinkin, Jack LaLane, and their two friends, “Moe” DeForest and Gene Miller, were ever able to successfully create and hold this human structure.

I was pleased and hopeful that Harold might provide an opportunity for me to meet Jack LaLane. They were both fascinating men who loved life and were willing to share their joy with others.

At some point during the dinner, Ed asked if I could fly to Fresno to talk with Harold. I readily agreed and we discussed some potential dates. After I had returned to Amherst, Ed and I communicated and found a date that did not conflict with my very full schedule. Although I was stretched in many directions at that time, Universal Gyms seemed like a natural potential customer for CBA and so I flew to California.

Ed introduced us in Harold’s office. What I noticed immediately about Harold was his incredibly muscular build despite his age. I was in my 30s and trained every day but Harold, twenty years older than I, was still a powerful, muscular man. He came around his desk and shook my hand. His grip was firm and his smile was infectious.

Harold gave me a tour of the amazing pictures on his wall which included photos of famous people he knew. Prominently placed was the infamous Pyramid of him, Jack LaLane and their friends. There were also some marvelous oil paintings that his wife, Betty, had painted.

When we sat down, he said, “I heard that in one of your presentations, you called dumbbells and exercise machines dumb. You said there is a need to develop an intelligent machine. Okay. How would you do it?”

I explained that the human body is made of levers and muscles in configurations such that, when you lift a weight, there is a mismatch between the resistance and the position of the limb at that point.

“And?” he asked.

“A better design would be to vary the resistance based on the limb angles and levers.” I thought for a moment. “What is needed is a mechanism on the equipment that can vary the resistance. In other words, it is necessary to devise a machine or mechanism that can compensate for the changing lever systems of the human,” I explained.

“How would you do that?” he asked.

I told him that most exercise machines are designed merely from personal observations and ideas. They lack scientific data relating to individual athletes or specific performances. That is to say, a device might purport to exercise a specific muscle or group of muscles. Without proper mechanical calculations and testing, it is impossible to know whether the claims were correct. Whether or not someone exercises efficiently cannot be determined merely with visual observations. Leonardo da Vinci studied birds but none of his brilliant designs, impressive though they were, allowed men to fly. It is possible to have a
good concept, but the idea must be quantitively tested and a machine created with those specifications before the desired results can be produced.

“An exercise machine needs to be built,” I explained, “that takes into consideration the natural changes that occur in the human lever system while performing any movements that necessitate different levels of muscular involvement. With traditional weight training equipment, much of the effort is wasted because the muscle-leverage system changes throughout the movement.”

I saw a stack of weights in the corner of Harold’s office. I told him “Pick up this twenty-pound weight and hold it at your side. Then lift it slowly upward keeping your elbow locked until your arm is straight out at shoulder level. You can feel how much more your muscle must work as you lift the weight. Now try the same movement with this 100-pound weight. Most people would not be able to lift the 100-pound weight very far. What this means is that all weight lifting with barbells and dumbbells is restricted to the amount you can lift at your weakest point.”

“Imagine performing that same lifting exercise again. Begin by holding a heavier weight and, as you raise it, a magic genie removes some of the weight as the exercise became more and more difficult. In other words, the weight would vary as you raised your arm. You could start with a heavier weight and as the movement progressed, the amount of the weight would change. We need to find a mechanical solution to provide the magic genie in my example,” I concluded.

He nodded as he replaced the weights in the rack at the back of his office. Then he sat in his desk chair. Although Harold remained silent he was obviously concentrating.
I continued, “To develop maximum conditioning effectiveness, we need to accurately vary the resistance. The variations in resistance should occur only when there are biomechanical advantages or disadvantages which decrease or increase the required muscular efforts. By varying the resistance accurately, it is possible to maintain the same degree of muscular involvement or effort throughout the entire range of movement.”

“Give me an example of how you would do that,” Harold replied.

“Each exercise is different,” I replied. “For example, when you execute a Biceps Curl, your arm is strong at the beginning, weak when the elbow reaches the 90-degree angle, and strong again when your hand reaches the shoulder area. However, there is an entirely different force profile for the Leg Extension and yet a third force profile for the Bench Press. The only way to accurately determine what the force profile should be for each exercise is to perform a biomechanical analysis of them,” I continued.

Harold said, “Gideon, do you think that you could redesign our existing equipment using your biomechanical evaluation? If you think that it is possible, I want you to proceed immediately and send me the bill. By the way, I want the results as soon as possible.” He smiled broadly at the last comment.

I told him that I would need to have some of the machines he currently manufactured to begin data collection on them. Since I had a large basement in my house, he could ship the machines to me and I could make the measurements there.

I soon realized how serious Harold was about wanting the information quickly because three days later, a large truck arrived at my house with some Universal gym equipment. The main unit was a large, square with 16 different exercises that could be performed on it. In addition to the equipment, Harold arranged for one of his mechanical engineers, Ken, to spend time with us to collect and process the data. Ann, Ken, and I filmed the equipment and traced the movements using our new Sonic Digitizer. Then Ken calculated some of the mechanical changes based on the quantified results that would have to be made to have the resistance vary for each different exercise.

Eventually, our calculations and biomechanical analysis led us to devise a Cam and Lever System. The Cam System we developed was the first one ever used for modern exercise equipment. We could use a Cam directly for most of the single joint movements, such as the Biceps Curl. For the multi-joint exercises, we had to develop a modified system.

The Biceps Curl station on the equipment was modified to utilize a carefully calculated Cam which provided resistance throughout the entire movement. The Biceps Curl station cable went around the specially designed Cam and attached to the weight stack. Thus, when the person pulled on the cable, the Cam provided changes to the moment arm on the cable. The cam caused the weight to vary appropriately as the individual flexed the arm.

http://arielnet.com/ref/go/3020
For the multi-joint exercises, such as the Bench Press, we had to devise a modified Cam to accomplish the task. This device consisted of a Sleeve which rolled on the bar. The bar was attached to a section of the frame opposite to the weight stack with the handles at the exercise station. A specially designed Sleeve was connected to the weight stack, which rolled as the bar moved up and down. When the person pushed up on the handles, the bar moved up. The Sleeve rolled on the bar as it was pushed up. As the bar moved up, the selected weight moved with it, so that the moment arm changed throughout the range of the movement. In other words, the rolling or sliding Sleeve on the bar altered the amount of resistance the person had to lift. This change in the location of the weight on the bar relative to the person exercising provided the variable resistance.

Ken took the calculations with him and returned to Fresno. Shortly thereafter, I flew to California to check the prototypes that Harold had built based on our calculations. For several months, we performed
additional biomechanical analysis and finally perfected the variable resistance mechanisms for each of the 16 stations.

Harold appointed me as the Head of Research for Universal Gym. We named the new exercise machine line as the “Dynamic Variable Resistance” mechanism, or DVR. All the Universal Machines incorporated these mechanisms of cams or levers that adjusted the resistance to the movement of the athlete or the person who trained on the machine. This new concept machine was an immediate success among schools and athletic teams. The introduction and growth in sales of the DVR helped the company expand and their revenues grew exponentially.

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Universal created a new brochure which introduced the variable resistance concept as well as me personally. I was proud that I was so prominently included in their advertising brochure. For CBA, this was a fantastic development since we received publicity as well as payment for the scientific analysis.

Our relationship with Universal progressed nicely as well. Both Ann and Ken Weinbel were pleased about the success we had with this project and with the continuing involvement with Universal. It was also helpful that I was asked to attend many of the fitness trade shows to describe the DVR concept. This publicity helped CBA since the more well-known I was, the greater the chances that we would attract projects from other companies.

In one of my trips to Fresno, Harold said, “Gideon, we would like to pay you royalties for each machine we sell. How much do you think would be fair?”

I told him that I had no experience with this situation. Since he had been fair with us in all the projects to date, I told him that I trusted him to decide on a fair amount.
Computerized Biomechanical Analysis

Human movement analyzed with total precision. The first unveiling of man's precise resistive needs as required in true dynamic movement.

ANALYSIS PROCEDURE

Sophisticated slow motion cinematography is used to capture highly complicated body movements. A camera with speeds ranging up to thousands of frames per second, becomes a recording observer of each segment of movement. Through careful use of this film, research scientists are able to get a full perspective on the complete movement cycle.

Complex tracing equipment is then used to digitize each segment movement and organize the data with all varying details. This digitized data is processed directly into a high speed computer.

As film has aided the human power of observation, increasing the amount of available facts, computers are required to remember and collate the facts. These modern technological “wonders” are fed vast amounts of film-bred information which they instantly decipher and edit into usable form.

Independent modern computer center used by Universal.

The Universal Gym Project
http://arielnet.com/ref/go/1102
“How about $350.00 per machine?” he asked.

“That sounds great,” I replied. After that meeting, we received royalties on each machine that Universal sold. At one point, they sold more than five thousand machines per year so the effort which we had previously expended was nicely compensated.
INTRODUCTION

In order to accurately assess man's biomechanical system, it is necessary to resort to scientific methods of research which are capable of accurately determining the various human mechanical changes. This requires a systematic application of the laws of mechanics and biological concepts, both anatomical, physiological and biomechanical, to the problems of human motion.

In order to understand some of these complexities, consider the following illustration. A man performs a squat exercise using the same weight but assuming two different trunk positions. The traditional kinesiological approach utilizing conventional methods of determination of origins and insertions of various muscles may conclude that the knee extensors are the dominant muscles. However, by utilizing computerized biomechanical analysis to assess the intricate relationships among the body's link system, it was determined that with an erect trunk the knee extensors are the dominant muscular force, but when leaning forward the knee flexors are dominant.
Not long after my meeting with Harold and the initiation of the royalty payments, Ann accompanied me to Fresno to work on the current project. Harold called us into his office and his first question was, “Gideon, what do you do with the royalty checks we send you?”

I shrugged and said that I put them into the bank. Harold asked whether I kept a bankbook with deposits and withdrawals. I told him that normally I had a general idea in my head as to how much money was in the bank account. Nodding his head, Harold called for his secretary to come into his office.

“How many checks have we sent to Gideon and how many has he cashed?” he asked her.

“We have sent twenty checks and he has cashed fourteen of them,” was her answer.

At this point, Harold turned to Ann and inquired whether he could hire her, with Gideon’s agreement, to act as his accountant regarding the deposits of the checks from Universal and maintenance of his bank account. I laughed and readily agreed that Ann would be perfect for this task. Ann agreed as well and was shocked when Harold said he would pay her fifty dollars a month to perform this task. At that time, fifty dollars went much farther than it does in today’s world so she was more than thrilled to accept this job.

Harold also told me that I should apply for a patent for the DVR, since I had invented the system. He said that Universal would do the paperwork and legal processes at their expense. However, the patent had to be issued to a person not a company. Subsequently, the patent was issued and, for the first time, a cam or a mechanism to vary the resistance based on anatomical and biomechanical conditions were incorporated into Exercise Machines. Today, any gym utilizing a cam-based machine is a copy or an application of my idea and this patent. This method of varying the resistance revolutionized the resistive training methods for many exercise machine companies and many publications resulted from it.

Needless to say, that those patents generated Millions of Dollars for us to expend.
As luck and hard work would have it, we now had an office with equipment, a computer connection, and some money from Universal. We had real biomechanical power and hoped that soon there would be additional moneymaking projects.

One day a man from the Spalding Corporation called. He introduced himself on the phone as Egon Romacker and said that he was the Director of Research at Spalding Sporting Goods in Chicopee, Massachusetts. Mr. Romacker had read my article in Mechanics and Sports and wondered if we could meet to discuss some ideas that he had. We arranged a time and date for lunch at a restaurant in Holyoke called the Yankee Peddler. I dared not invite him to our laboratory in my kitchen. Ann and I dressed nicely for the meeting. “Nicely” for us meant we changed out of the blue jeans and T-shirts, which were our normal attire into “dress up clothes” and drove the 20 miles for the meeting.

At the restaurant and, following the round robin of introductions, Mr. Romacker told us how impressed he was with our technique of analyzing athletes. His questions involved whether we could also trace and analyze other objects. I asked him what objects and he answered, “The flight of a basketball.”

“Of course,” I replied without hesitation, although I had no idea whether we could do it or not. However, to secure our first real project, I confidently believed we could analyze anything. Egon explained that Spalding was the leading basketball manufacturer in the world. However, some of their competitors claimed that Spalding basketballs wobbled in the air. In other words, they had been accused
of producing basketballs like the crazy distorted ones that the comedic basketball team, the Harlem Globetrotters, used. The Globetrotters included in one of their less-than-serious routines giving their opponent a ball that wobbled and swayed all over the court following unpredictable and irregular paths. This accusation against Spalding’s basketball production could have serious repercussions in their market and, thus, negatively affect their profitability.

Mr. Romancer asked whether we could ascertain the actual flight of their basketballs and, if there was a problem, could we provide a solution to solve it. The question was “did their basketballs follow a parabolic flight, which gravity dictated, or did they wobble during flight.”

Obviously, the ball would have to be perfectly balanced as it revolved around its center of mass. If one part of the ball were heavier or lighter than the other parts, it would wobble. Throughout the lunch, we discussed the various factors associated with ball flight and briefly created a proposed testing protocol. We would have to determine whether the center of mass was located at the center of the ball. Egon agreed with my assessment but told me that they had measured it numerous times with engineering firms and spent hundreds of thousands of dollars to show that the center of mass was exactly in the center of the ball.

“Well,” I suggested to him, “we should set up the test area in a location in a gym where we can launch the ball from a machine. With a machine to launch the balls, there would be no human interactions which might contaminate the movements and the test could be repeated with the same motion for as many trials as necessary. The test results would be completely objective. Also, it would be a dynamic test rather than a static one which is what most engineering firms perform. We are the only company which can evaluate dynamic as well as static conditions. We will utilize our high-speed cameras, film the flight of the ball, and calculate both the center of gravity and the center of the ball. These films and calculations will determine whether the balls follow a parabolic path or not.”

Mr. Romaker asked me how much the project would cost. I told him that I would let him know the next day. Spalding would provide the ball-throwing machine and find a local gymnasium for testing that would be conveniently close for both of our organizations. We would provide the biomechanical equipment. He told us to call him with a proposal as soon as we were ready.

When we drove back to Amherst, Ann and I were very excited about having our first project. I called Ken Weinbel and shouted, “Ken, we have a project!”

Ken was excited, too. He asked, “How much are you going to charge for this project?”

I asked him how much money he had spent so far on the company as of today. He told me that it was about $12,000 including the corporation registration with the State of New Hampshire, the digitizer, purchasing the two projectors and the two Kodak Special 64 frames per second spring-loaded cameras. I said that I would call him the next day after we spoke with Spalding.

Now Ann and I began our calculations. The project would require a full day of travel for filming the basketball flights and then there would be at least a week to complete the digitizing. We would have some paperwork calculations and reporting printing. When we considered the overhead expenses accrued to date we had quite a list. As of this time, we included the $15,000 for the cost of the house, $12,000 for Ken’s expenses, $2000 out of pocket costs for paper, gas, and meals. In addition, we needed another Teletype, which would cost $1500.00. We concluded that $50,000 would sufficiently cover our costs and whatever was left over would be used for future expenditures. Since this was our first project, we wanted to make sure we covered our costs and executed the job so well that perhaps we would, hopefully, generate some repeat business.

I called Ken and explained how we had calculated the cost for the project.

“You’re crazy,” he said.

“They have already spent more than a hundred thousand dollars and found nothing,” I replied.

“Go ahead,” he replied. “But I think you have priced us out of the competition and we will lose this opportunity.”
The following day we arranged to meet Mr. Romaker at the Yankee Peddler for lunch where we would explain our proposed experimental protocol. We described the procedure of measuring at least 50 ball flights using different speeds and angles of trajectories. We would then digitize four points on the edge of the ball. The intersection of these points would be the location of the center of the ball. Then I would write a computer program to calculate the flight path of this calculated center and determine whether it followed a parabolic pattern. I described the equipment we would need, the biomechanical processing of the films, and the computations which would be required.

“So what is the cost of the project you are proposing?” he asked.
“I estimate the cost at $50,000.00 dollars,” was my confident reply.
“Is that for the entire project?” he asked.
“Yes,” I answered, with my fingers crossed under the table for good luck. Ann sat beside me and I knew she was as nervous as I was. We collectively held our breaths as we watched Egon thinking quietly to himself.

“Gideon,” he said, after a few minutes, and extended his hand. “I accept your proposal and want you to start immediately.”

We were elated on the drive back to our home where our laboratory was set up in the kitchen. I asked Ann, “What will happen if Mr. Romaker wants to see our laboratory?” and we both exploded with laughter. She answered that we had better produce an excellent report based on credible findings. If we do a good job on this project, perhaps there will be other ones to follow. Then we could consider a more proper laboratory setting in the future. First, we had to do our job and do it well.

The ball-throwing machine was delivered to the test location at a local school gymnasium. We met Mr. Romaker early one morning with our photographic equipment and prepared to film the basketball flight paths. It took nearly the entire day to film all the balls that Egon brought to the test session.

The next day we delivered the film to the local camera store so they could send it to a lab for processing. At that time, cameras only used film and development usually required two days for processing. This was long before the advent of digital technology which can store the pictures on the disk and then immediately access them.

Once we received the developed film, digitizing of the balls commenced using our digitizer screen. The data was transmitted to the computer at Dartmouth through the phone line. Ann did the digitizing which took nearly two weeks to complete despite the long hours Ann devoted to the job. While she did the tracing work, I wrote a simple BASIC program to calculate the center of the ball and trace this point throughout its flight.

After we had processed the data, we began to examine the results. For every ball that we tested, we calculated that the center of the ball followed a perfect parabolic pattern. There were no distortions in any of the flights.

There were a few differences, however. We had requested that Spalding prepare three special balls for the test. One had a heavier weighted panel on the same side of the ball as the valve. Another ball had smaller seams and the third ball was a solid color without the usual black seams.

I called Egon to let him know that we had one additional test to perform before we presented our findings. We returned to the gymnasium where we had collected the original data. This time, we collected additional data using a strobe light rather than the normal gymnasium lighting system. We had...
rented a light strobe generator from one of the photographic stores. The light at the gym was turned off and Ann activated the ball-throwing equipment. Then we filmed the ball flights using only the strobe light to illuminate the throws.

We processed this film and analyzed our results following the same testing protocols. What we discovered was that, once again, the balls demonstrated no wobbling at all when biomechanically evaluated. However, the visual comparison of the film taken under the strobe condition showed that the ball appeared to the eye that it was wobbling. Clearly, the brain’s interpretation of the information provided by the visual centers indicated that the balls were wobbling. The brain was being deceived because of the nature of the visual input. Although the scientific data decisively calculated perfect parabolic flight paths, the brain thought that something else was happening. Now, we had to explain these apparently inconsistent findings to Mr. Romacker. We would have to explain what happens when people watch actions under strobe light conditions.

We met Mr. Romaker to present our results. We showed that the normal Spalding basketballs were perfect in their parabolic flight patterns. The special balls that we had asked Spalding to construct for us showed some variations. As expected, the weighted balls showed definite looping patterns. There was no difference in the smaller seamed and the solid colored balls.

After this portion of the results, we described our second data collection session using the strobe equipment. A strobe light flashing off and on produces the same effect as do fluorescent lights. A fluorescent light is a strobe light that flashes on and off at a fixed 60 cycles per second. However, anyone who has seen the apparently jerky movements of dancers in a nightclub that uses overhead strobe lights, knows that the movements do not seem to flow in the normal manner that we have come to expect from human activities. Dancing beneath a strobe light produces crazy exaggerated movements. The actions are distorted and almost seem to be disconnected.

Thus, the wobbling attributed to the Spalding balls was due to the same optical illusion as found in a strobe-lighted disco. Their normal production run basketball had very dark seams and appeared to move up and down during flight with the same jerky appearing movements as the disco dancers. The interaction of the dark seams and the strobing fluorescent light produced an illusion of wobbling. Anyone
watching the balls in the normal gymnasium setting, under fluorescent lights, could be visually tricked by this strobe effect. The basketball, which we had asked Egon to prepare with no seams, had not introduced this illusion. Likewise, the balls with the smaller seams seemed to wobble less than the normal wide-seam ones.

We demonstrated this strobing effect with both the strobe and the fluorescent lights in the gym. Our analysis had determined the source of their problem and now they could design their basketballs to prevent this situation.

Egon was very pleased and excited to be able to explain the source of their problem to his boss. Now, they could brainstorm within the manufacturing department to solve the seam problem. The following week, we received the balance due and a thank you note from Spalding for a job well done.

Ann and I continued to maintain an incredible work pace. We had more than enough work with our class loads, but now we had compounded it with the development and growth of CBA. In addition, we had our other commitments at the university so we were very busy indeed. Fortunately, we had many common interests and complementary talents. I could easily conceive of wild creative ideas and she could work out the details to bring them into proportions that were more realistic. Our life was good together and we seemed to be working towards a productive future.

Many projects at CBA Inc.
Chapter 8: Munich Olympics 1972

The United States Olympic Trials are held every four years approximately two to three months prior to the beginning date of the Games. The purpose of the trials is to select, based on the best performances of the athletes, the team members who will represent America in the Olympics. All of the summer sports have these team selection events but I am most familiar with the Track and Field Trials. Without a doubt, the U.S. Olympic Trials is the best national track meet in the world. There is no other athletic meeting quite like them as far as performance level and the enthusiasm of the participants and spectators. The Olympic Games and the World Championships may have higher overall standards of performance, but no other national track championships can compare with the quality of the U.S. It is not just the statistical performances, but also rather the intense competitive process of the sudden-death form of selection that heightens the excitement. Make the top three in your event and you are on the team. Have an off day and you become an observer.

My first participation at the U.S. Trials was in 1972 in Eugene, Oregon. The city of Eugene has a fantastic history of sports and especially for track and field. For example, jogging was introduced to the U.S. through Eugene. It was brought from New Zealand by Bill Bowerman, who wrote the best-selling book “Jogging”, and who coached the champion University of Oregon track and cross country teams. During Bowerman's tenure, his "Men of Oregon" won 24 individual NCAA titles including titles in 15 out of the 19 events contested. During Bowerman's 24 years at Oregon, his track teams finished in the top ten at the NCAA championships 16 times, including four team titles. Bill Bowerman also invented the waffle sole for running shoes and, with Oregon alumnus Phil Knight, founded the giant shoe company, Nike, Inc.
The environment of the Eugene area is rich with knowledgeable fans and supporters of Track and Field events. There is an excitement in the air that seems to vibrate and communicates to the athletes and coaches almost as soon as they step onto the field. Eugene is home to the University of Oregon's Hayward Field Track. I was lucky enough to be at Hayward Field when the stands were alive with the crowd shouting, “Pre! Pre! Pre!” for their hometown hero, Steve Prefontaine. Prefontaine was a middle and long distance runner who had both amazing good looks and an exciting style of running. For many members of the Track and Field world, Prefontaine is one of those legends who gave a magnificent performance every time he stepped onto the track and whose spirit continues to hover over Hayward Field. He was a joy to watch and it is one of my special memories of that time.
It was to this amazing track-crazy town, filled with some of the best athletes, that I arrived in the summer of 1972. My friend, George Dales, had invited me to attend the trials and perform our biomechanical analysis on as many events as possible. He would then publish the results in the Track and Field Quarterly Review where he had printed other articles which I had submitted. One of my most recent articles was about the “Training Camp for Throwers”
Ken Weinbel, one of my CBA partners and the Head Coach of the Dartmouth College Track and Field team, and I flew to Eugene with our photographic gear. In addition to the two movie cameras, we also had to take the scale factor, extra film cartridges, and other photographic paraphernalia. At that time, movie cameras used 16 mm film since there were no digital cameras available. The current digital movie cameras were not available in the consumer-level market until 1994. Therefore, in 1972, the entire filming process was quite lengthy and tedious during those early years of biomechanical analysis.

The Olympic Trials follow the same schedule that the Games use so Ken and I were able to film most of the events. We usually had to wait two or three days for the film to be developed, but, at least, we could check the films to verify that we were capturing the events correctly. We would film the entire activity as well as the scale factor for converting the athlete to full size. We also kept precise logs of the names, dates, and sequences for identification of each athlete.

We had to arrange different filming positions for each activity. For the 100-meter sprint, we focused the cameras on the start. For the run-up in the javelin, our filming requirements were more complicated. The pole vault was challenging because the pit obscured some of the event. We had to be creative for each event in order to obtain the data while staying out of the way of other events. Track and field meets are like a three-ring circus so attention had to be given to many activities occurring at the same time.

We spent all day, every day, filming each of the Olympic Trial events, so we collected an enormous amount of data. In fact, we had so many reels of film that I had to buy an extra suitcase to take all of them back to the Amherst office. George had requested several specific events that he wanted me to analyze quickly so he could include them in the next issue of the Track and Field Quarterly Review. The next issue would be published prior to the start of the Munich Olympic Games.

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Early computer Digitizing results. (First in the World from real performances)

http://arielnet.com/ref/go/3022
One study I conducted was on the pole vault. The question that we needed to resolve with our technological process was what does the fiberglass pole contribute to the jump? The most important characteristics of the pole are strength and flexibility since it must support the athlete, as well as, providing a whip to propel the vaulter over the bar. The pole must have the capability to store energy and release it at the proper phase of the jump. Originally, poles had been made of ash and later bamboo but the modern ones contained different materials, such as aluminum and fiberglass. The poles of the 21st Century employ even more sophisticated composites including carbon fiber as well as E-glass and S-glass materials to create poles which are lighter.

In the past, when the poles were made of bamboo, they functioned like the subsequent fiberglass models. As pole materials, both fiberglass and bamboo possess similar characteristics for storing energy during the beginning phase of the jump and then, like a catapult, the energy is returned to the athlete to pass over the bar. Cornelius Warmerdam used the bamboo pole and held the pole vault world record for seventeen years, from 1940 to 1957. During the 1972 trials, the vaulters used only aluminum and fiberglass for their poles.

Because of these different pole materials, George Dales’ question was, “Is there an advantage or difference between pole materials?” If there were differences, George wanted to know what they were. The biomechanical analysis revealed that fiberglass was similar to bamboo. Both materials exhibited better energy storage during the beginning phase and subsequently whipped or threw the vaulter over the bar. Aluminum was too stiff and lacked the flexibility necessary for reaching extraordinary heights.

Coach Dales published the results of that study in the Track and Field Quarterly Review. Additionally, he suggested I submit the same paper to the International Scientific Olympic Congress for presentation in Munich. The Scientific Congress was held every four years shortly before the beginning of the Games. This scheduling allows many people to attend both the Congress as well as, the Games. I submitted “The Contribution of the Pole to the Vault,” as well as another paper, “Biomechanical Analysis
of Javelin Throwing.” Both papers were accepted for presentation and would be included in the publication of the Scientific Congress for that year.

In his position as the president of the International Track and Field Association and the editor of Track and Field Quarterly Review, George asked if I could collect data on the field at the Olympics in Munich for later publication in his journal. Since he had already published my article about Bob Beamon’s legendary Gold Medal Long Jump in the Mexico City Olympics in 1968, as well as, the studies from the Olympic Trials of 1972, I eagerly agreed. Now was a time of intense planning for the equipment that would be needed for this first major overseas event for me and for CBA. George also arranged for housing, participation in the Scientific Congress, and a special pass to get onto the field in the Olympic stadium for filming.

On August 23, 1972, I left Amherst and drove to JFK airport in New York City. By this point in my life, JFK did not seem nearly as daunting as it had in 1963 when I had first arrived in America. With several suitcases packed with cameras and film, I boarded the plane for Munich filled with the excitement which accompanies each Olympic Games. In addition to the thrill of attending the Olympics, I was also excited about the anticipated reunion with my friends on the Israeli team.

Most of the Israeli athletes who were participating as well as their coaches in Track and Field and Weight Lifting were friends of mine from the past. After all, I had trained with many of these people in Israel, such as with track coach, Amizure Shapira, and Weight Lifting coach, Yakov Springer. Many of the athletes from my era were now coaches but old friends nonetheless. Many of us had been together in the 1960 and 1964 Olympic Games in Rome and in Tokyo.

Israelis are extremely gregarious and friendly by nature and these old friends and colleagues were no exceptions. They insisted that I stay with them in the Olympic Village. What a grand beginning with everyone talking at once, smiles and backslapping. The early stages of every Olympic Games are always filled with anticipation and joy, companionship with other athletes, and hoped-for success with performances. Every athlete dreams of standing on the top of the podium and receiving the Gold medal. Even if that dream is beyond what, in your heart you know is unrealistic and unattainable, it is still a dream that everyone has. I was happy for the opportunity to stay with my friends in the Village for the first two days. Everyone in the Olympic Village bubbled with excitement amidst the tension and thrill of the upcoming competitions.

My presentation at the Scientific Congress was scheduled for September 6. Although I lived with my Israeli friends in the Olympic Village, George Dales suggested that I spend the few nights before the presentation in his hotel in town. From the hotel, we would be able to maneuver about the city more easily and we would be closer to the Conference location. The Scientific Congress was held in one of the main convention centers in Munich. The Germans had constructed an elaborate, modern subway system to move athletes, coaches, and fans around the city. However, it would be more convenient and practical for George and me to stay in his hotel, rather than in the Village, during the Congress. I agreed that this was a more logical arrangement for the Congress since I had much work to do there. It had been a happy reunion with my old friends and I will always cherish those days I was able to spend with them.

As it transpired, had I not been scheduled to give that presentation on pole-vaulting, I would not be alive today. George’s idea of moving to the hotel was a life-saving suggestion for me. The very night that I moved was the night the Arab terrorists broke into the complex where the Israeli athletes were sleeping and took them hostage.
The German Olympic organizers had planned meticulously for every aspect except security. Their goal had been to create a friendly image in an atmosphere of harmony among the participants of so many different countries. They hoped and planned to dispel the old, historical image of Prussian aggression and the militaristic image of the 1936 Berlin Games exploited by Adolf Hitler. History now knows better that such an idea was a beautiful dream but failed to anticipate the evil which exists in the world.

Much has been written about that time and Steven Spielberg produced a movie that also accurately showed what happened. But to briefly recap the events, five Palestinian terrorists, calling themselves Black September, wore track sweat suits and climbed the 6-foot 6-inch fence surrounding the Olympic Village. Several people saw them but no one paid particular attention since athletes had been routinely hopping over the fence. Three more men who are presumed to have obtained credentials to enter the village and joined these five.

The terrorists used stolen keys to enter the two apartments, one of which was the room where I had stayed only the day before. The Israeli wrestling referee, Yossef Gutfreund, was awakened by a noise at the door and, when he saw the masked men, yelled, “Hevre Tistalku! Guys, get out of here!” He threw his considerable weight against the door to stop the terrorists from coming into the room but was overpowered. In the meantime, many of the other athletes hid, tried to escape, or looked around for something to use as a defensive weapon. The wrestling coach, Moshe Weinberg, also attacked the terrorists and was shot in the face. Moshe was then forced by the intruders to help them find more hostages. He lied to them about the residents of Apartment 2 saying they were not Israelis and instead led them to Apartment 3 where the larger, stronger wrestlers and weightlifters were sleeping. Unfortunately, the athletes from Apartment 3 were surprised in their sleep and were marched back to the coaches’ room. Again, Moshe Weinberg attacked the terrorists and this act of bravery allowed one of his wrestlers, Gad Tsobari, to escape. Moshe was knocked unconscious by one of the terrorists then slashed with a knife and shot to death. Another weightlifter, Yossef Romano, attacked and wounded one of the intruders before he was shot and killed. The Arab terrorists then succeeded in rounding up nine Israelis to hold as hostages.

At 9:30 in the morning, the terrorists announced that they were Palestinians and demanded that Israel release 200 Arab prisoners and that they be given safe passage out of Germany. Golda Meir, the Prime Minister of Israel, refused to negotiate with the terrorists and told the German authorities that they should handle the situation.

After a grueling day of tense negotiations, the Palestinians agreed to a plan the Germans offered. The terrorists and hostages were to be taken by helicopter to the NATO air base at Firsstenfeldbruck. From the air base, they and their hostages would fly to Cairo. The world’s press and television coverage had shown in extensive and repetitive details where the hostage takers and German sharpshooters were positioned. Unfortunately, the terrorists in the Israeli’s rooms watched the coverage on the television sets. The perpetrators were aware of everything that was happening outside of the buildings in addition to the future plans expected to be used against them.

The Israelis hostages and their Palestinians captors were taken by bus to the helicopters and flown to the airfield. During the transfer, in what was to be a day full of ineptness, the Germans discovered that there were eight terrorists instead of only the five they expected. Suddenly, the Germans realized that they had not assigned enough marksmen to carry out the plan to shoot the terrorists at the airport. In addition, there were no means of communication among their snipers so the mess became increasingly worse each moment.

When the helicopters landed at the airbase around 10:30 p.m., the German sharpshooters attempted to kill the terrorists and a bloody firefight ensued. At eleven o’clock in the evening, the media was mistakenly informed that the hostages had been saved and the news was announced to a relieved but anxious Israeli public. However, nearly an hour later, new fighting erupted and a terrorist grenade blew up one of the helicopters holding the Israelis. The remaining nine hostages, restrained in the second helicopter, were shot to death by one of the surviving terrorists.
At three o’clock in the morning, a drawn and teary-eyed Jim McKay, who had been reporting throughout the day as part of ABC’s Olympic coverage, announced: “They’re all gone.” It was a devastating announcement and broke the heart of many of those who had watched the whole episode as it had unfolded.

The terrorists had killed eleven Israeli athletes and coaches and one West German police officer. Five of the eight members of the Black September were killed by German police officers during the failed rescue attempt. The three surviving terrorists were captured but later released by West Germany following a Black September hijacking of a Lufthansa airliner. Israel allegedly responded to the massacre with Operation Spring of Youth and Operation Wrath of God as well as a series of airstrikes and killing of those suspected of planning the kidnapping. There have been highly placed sources within the government who deny these programs of retaliation but that remains for future historians to unearth.

Fortunately, or unfortunately, on that day, I awoke completely oblivious to the events underway at the Olympic Village. George Dales and I joined a tour to visit Saltsburg, Austria. It was only when we returned to the hotel that evening that we learned about the terrorist activities which were ongoing.

I was shocked and dismayed about these events. In Israel, we had learned how to cope with such terrorist activities by providing security within the country and for groups or teams when they traveled abroad. For the Olympic Games, Israel had relied on the German security at the athletes’ venue and had not provided their own protective measures. This false sense of security had backfired badly for the Israeli athletes and the host country Germany.

As events unfolded during the remaining few hours of the tragedy, all of us, within and outside of Israel, crossed our collective fingers, prayed, and clustered in groups for emotional support. Our collective hopes were dashed as the news of the violent, tragic results were transmitted across the airwaves. My own sense of despair deepened as I realized the scope of the massacre. In what seemed like the blink of my eyes, I had gone from the joy of again sharing the Olympic experiences to the loss of many of my good friends and coaches. Perhaps it is a type of survivor’s guilt but I wished that I could have been with them and done something to help. I do not think I would have surrendered; I think I would have fought. After all, I was big, strong, and very fit. But who knows? Those who tried to fight were shot and the ones who initially fought back were as big and strong as I was.

One of the men who was able to escape was my friend Avraham Melamed. Avaham was the Israeli 200-meter butterfly champion for Israel. When the initial shouting began to lock the doors, Avaham did just that and then he escaped by climbing out of the window, walking along a small ledge, and jumping to the ground. Many months later, we learned that after Avraham jumped out the window and was creeping along the window ledge, he remembered his new camera was in the room. He hurried back, scrambled into his room to retrieve his camera, and then exited the window for the second time. Despite this seemingly reckless behavior, his escape was successful. Avraham later became my student at the University of Massachusetts where he received his Master’s Degree.

Other developments from this tragedy surfaced in odd and unrelated ways. One of my friends in the class below me at Hadassim worked for Mossad. One of his assignments involved finding and disposing of the remaining living terrorists. Unfortunately, his directors sent him to Norway. The information provided to him was incorrect and he killed the wrong person. He became distraught and, at one time, came to stay with Ann and me. Another Hadassim connection was Gila Almagor, a famous actress who was in the class above me at Hadassim. She played one of the main characters, the mother of one of the Israelis, in Steven Spielberg’s film, Munich.

After the murders, decisions were made for the Olympic Games and the other conferences to proceed with the scheduled activities. The idea underlying this decision was that violent behavior should not be encouraged by allowing it to interfere with life activities and events. The decision should be to proceed legally against the terrorists through the courts of law rather than to give media attention to senseless murders.
From my perspective, I do not know if this was a correct idea or only a pacifier for the times, but it was extremely difficult to go forward with such a heavy weight on the heart. However, there was nothing to do but continue so I presented my talk at the Congress with tears in my eyes. I was hardly able to talk. When I finished giving my paper, however, I looked up and all the attending members of the Hall were giving me a standing ovation. I am sure it was because I was an Israeli and the participants wanted to show their respect for our athletes and for what I was suffering.

In 2004 at the Greek Olympics, George Dales and I were interviewed by a television station regarding the events that we had experienced in Munich. The interview about these days in Munich are presented below:

The Murdered Israeli Athletes and Coaches at the Munich Olympics
http://arielnet.com/ref/go/1107
After the Congress, as is common at scientific meetings, there were many gatherings and invitations to continue discussions about the topics presented. Not surprisingly, many of the conversations continued with ample lubrication from pitchers of delicious German beer where friends and foes joined with respect, camaraderie, and shared interests. One meeting I was invited to attend was with the East German and Russian coaches. Some of them I knew through the literature having read their published studies and others I had known when I was an Olympic competitor. At that time, the East Germans and the Russians were the most well-known sports scientists. This opinion of excellence was based on the athletic results they produced on the playing field, in the gym, and in the swimming pool.

The tiny country of East Germany and the massive Soviet Union controlled their athletic training by having specific locations for the athletes to live, especially prescribed diets, unique training techniques, and, reportedly, specialized pharmaceutical enhancements. These systems and applications were hidden from public view since they were behind what was known as “the iron curtain”. It was rumored that children were removed from their parents at very young ages and raised at these special training camps. Once in these training facilities, their entire day focused on training and practicing their sport, physical fitness, and, presumably, some academic instruction. There was little, or no, media coverage and few visitors from the outside were ever allowed to see what and how their athletes were trained. In this way, the myths grew exponentially among those on the outside.
Unable to see what was actually occurring on the other side of the opaque wall, the mystery deepened. I was pleasantly surprised to learn how impressed these coaches and scientists were with my method of using high-speed cameras and the computer to analyze events. During our conversations, I learned that they had neither mainframe computers nor the programming ability that I could access. They were very curious and our discussions lasted for hours.

The conversations and scientific dialog were fascinating, but I struggled to concentrate since I was unable to forget about my murdered friends. One of the very famous East German coaches, Hochmouth, asked if I would be willing to go with him to Leipzig, the East German city where their Sports labs were located. I liked the idea of leaving Munich and all the heartbreak. Everyone knew that the East Germans currently dominated world sports, but no one knew how they were able to accomplish
it. What were their secrets? It was such a tiny country and yet such a major athletic power. What were they doing that the rest of the world was not?

One consideration was whether I could enter East Germany on my passport. At that time, I was still an Israeli citizen although I had an American Green Card. I was informed there would be no problem, since I had the Participant card. For the Olympics, the East German and West German border was open to Germans with the correct papers which meant that I could travel to the GDR. George Dales was invited to travel with me. Unfortunately, because he was an American, the U.S. authorities forbade his entry into East Germany. I could go only because I would travel on my Israeli passport.

Although George had to remain in Munich, his time was well spent. It took him two days of persistent dialing to the U.S., before he finally made a connection to his wife in Kalamazoo, Michigan. George brought her up to date with all of the events that had transpired in Germany. Of course, she had been watching the news coverage from Munich and had suffered through the agonizing events along with the rest of the world. She was quite relieved to learn that I was safe since she had been aware of my plans to stay with the Israeli team. George asked her to call Ann in Amherst and let her know that I was safe. Ann also knew of my plans to stay with my Israeli friends in the Village. Also, during some of our trips to Israel, she had been acquainted with a few of the athletes who had been killed. Needless to say, Ann was a nervous wreck with worry, so it was a tremendous relief to hear that I was safe and sound. After hearing the news from George, she could finally breathe.

Ann had been shouldering an additional emotional burden during this time. While I was in Germany, she had been caring for my daughter, Geffen, who was eight years old at that time. It was quite a daily task to ensure that Geffen remained unaware of the activities occurring in Munich. Fortunately, for all concerned, there was a great sense of relief with the news that George and I were safe. Of course, traveling to East Germany may have been an incredible opportunity for me but now Ann had something to worry about.

While George remained in Munich, off I went with Coach Hochmouth to East Germany. We drove for many hours at night in Coach Hochmouth’s old Mercedes sedan. I must have fallen asleep in the car since I have no recollection of crossing the border from West to East Germany.

After we had arrived in Leipzig in the morning, I was given a tiny room in a small hotel. Everyone was exhausted so the first order of business was a long afternoon nap. We met later for a quiet dinner in the hotel. Of course, the conversations lasted late into the night but we were inspired by the subject matter. In the morning, one of the scientists picked me up at the hotel and we went to the Sports Center complex for breakfast. The food was delicious, well prepared, and beautifully presented.

The athletes ate in a dorm-like restaurant similar to what I remembered from my Wyoming days. The food was plentiful and very carefully orchestrated to be rich with specific vitamins, as well as, appropriately balanced for proteins and carbohydrates. The athletes were seated according to their events and the girls were separated from the boys. I asked the scientist why they were separated and he explained that the diet of the females was different from the males. He also said that each sport has its specific diet composition which was specially designed by health and nutritionist scientists. Not only was the nutrition specific for each sport, but also, it was further tailored for each athlete within that activity. For example, if one of the swimmers needed more protein, his or her portions were adjusted accordingly. This was
completely different than my Olympic training table in Israel! In my time, our food had been rationed and we only received protein once a week rather than daily as did these East German athletes.

After breakfast, I met one of the scientists, Dr. Schmidt. He told me that he would not be able to reveal all of the secrets involved in the German Democratic Republic’s (GDR) athletic system. Obviously, he was unwilling to disclose the secrets that had allowed the GDR to excel during the previous ten to fifteen years of athletic competitions. The record number of victories in World Championships and the Olympic games reflected their successful selection and training of athletes. These successes indicated that they were doing something that the other countries were not.

“Well, what can you tell me?” I asked.

“Okay,” he smiled. “First of all, we start training the children at very young ages. All children have physical education in kindergarten. The physical education teachers in elementary and secondary schools have been thoroughly trained in our State Institution for Physical Education in Leipzig. These teachers know how to evaluate young children as well as how to encourage these young, talented athletes. There is also a tremendous emphasis in school sports clubs and athletic associations. It is in these sporting groups that we can identify young adolescents who are particularly suited for sprinting, jumping, flexibility, and other basic skills. From the 9th and 10th class onwards, the training becomes more focused and intense for their event. Once individual children are selected for training, they are placed in one of our sports centers to live, study, and train. The financial support for these sport training facilities is from the government.”

I nodded. So far, I had not heard anything that was different from my experience as a discus and shot put thrower. No magic bullet had been revealed yet!

Dr. Schmidt continued, “By 12 or 13, a child is familiar with the whole range of exercises. The exercise routines are harmonized, of course, with the biological development. As they get older, we add resistive training with weights, squats, presses, and so on. These talented, athletic kids attend school classes until two o’clock in the afternoon. Then they spend the next four or five hours working with a fitness trainer and practice the sport itself with a coach. Success usually results from the enthusiasm with which the trainer can attract these young promising athletes and their dedication to their activity.”

“But this was my story in Israel. I worked every day to increase my strength and I threw the shot and discus every day. I practiced between classes, after classes, and every other moment that I could find,” I told Dr. Schmidt.

He responded to my comment by providing additional insight into the rationale of the system. “But I generated the idea for the GDR’s sporting program based on our Marxist philosophy for children and young people. There is a paragraph from Friedrich Engels’ book which describes ‘the role of work in the humanization of monkeys’ and this is a factor in the implementation of our sports system. In other words, at a young and tender age, we can develop a young person through very specific training methods which are designed to shape and train the body in that particular direction.”

I recall thinking that this was an unusual attitude about children which compared them to monkeys and trying to humanize them. I have often wondered what he felt in his heart about the individual children and their welfare. It certainly diverged from my sensitivities of loving and caring for children. As I reflect on this meeting, these many years later, I wonder what his true feelings were about young people.

Dr. Schmidt believed that training was the key. Thus, enormous attention was focused at every athletic training camp on exercise and fitness. So far, I had not seen anything that was different from my experience of focus and training that was making the GDR athletes so successful. Perhaps there would be some new revelations as the day proceeded.
Dr. Schmidt and I went to the main conference room and, to my surprise, I saw all my published studies in Biomechanics and Anabolic Steroids on the table. Each study had a German translation next to it. This was quite a shock. One of my studies, which was of particular interest to Dr. Schmidt, was the “Analysis of the East German Shot Putters” published in the Track and Field Quarterly Review. East Germany held the world record in this event and I had tried to understand how and why they were so accomplished.

What perplexed these East German scientists was that I had calculated exactly what their throwers were doing which resulted in Gold Medals. They had developed a technique with no deceleration of the front leg before its initial hitting the toe board. In other words, the front leg continued to accelerate until hitting the toe board stopped it. After the front leg had contacted the toe board, the back leg touched down. This was like driving a car into a wall without applying the brakes. In this case, the driver would be propelled through the windshield. For the shot put, the front leg block was the car hitting the wall and the shot put was the driver. The technique had produced many world records and Olympic medals.

The scientists were impressed with the technique I utilized, since it was so much more advanced than the accurate, but elementary, procedures they employed. Their calculations were accomplished with the use of slide rules, paper and pencil, and hand calculators, but they applied the same basic Newtonian equations which I used. The scientists were amazed that I had discovered what the East German throwers were doing without being there. My technological tools surpassed the more primitive methods that they used. Although we both employed the same Newtonian equations but I could execute them faster, more accurately, and with greater detail. They were extremely impressed by the computerized system.

The tour proceeded to the resistive training facility. As I entered the weight training room, I received another surprise. There, in the center of the room, was the Universal machine with the cam technology which I had developed.

“Wow!” I said. “Where did you purchase this and how did you get it here?” I asked.

The weight coach smiled and answered, “It was made in East Germany.”

They had copied the machine precisely in every detail including the proper cam. It was an exact duplicate with every one of the details described in my patent.

“I see there are no secrets anywhere,” I laughed. They laughed too and asked, “What about the secret machine you are working on with Universal which has a computer on it? The Intelligent Exercise Machine.”

I replied, “You’ll have to wait for that.” In 1995, one of their scientists, Dr. Zinner, purchased my intelligent computerized machine. By then, there was no longer a division between East and West Germany since they had reunited after the destruction of the Berlin Wall. Until today, they continue to use the computerized exercise machine for research and to train some of their athletes. In 1995, I was invited to the Olympiastutzpunkt (OSP) Berlin for a two-day working visit. They published a description
of my visit in their newsletter praising my accomplishment, as well as, my contributions to their own work at their Center. This report, “Simply the Best”, can be found in its entirety by scanning the QR Code below.

After they had shown me the duplicate of my Universal weight machine, the tour of the 1972 facility continued. From the weight room, we walked down the hall and I was introduced to one scientist whose name I do quite clearly remember since it was Dr. Israeli.

“Are you Israeli?” I immediately asked.

“No.” he answered.
Dr. Zinner Partial Evaluation

Full text at:

http://arielnet.com/ref/go/1111

Dr. Zinner Partial Evaluation

Full text at:

http://arielnet.com/ref/go/1111

Are you a Jew?"
Again, the answer was “No.”
I have always wondered how he happened to have this Hebrew name. Shortly after meeting with Dr. Israeli, I learned he was the head of the pharmaceutical system for all of the training centers. This, I was to learn later, was of significance.

Following the tour of the facility we returned to the room where my articles, in English and German, lay on the table. The discussions with the various scientists, as well as Dr. Israeli, continued for hours. They were particularly interested in discussing my studies on Anabolic Steroids which had been published in the Journal of Applied Physiology. Their specific interest was whether Anabolic Steroids
caused augmentation in performance because of the muscular system or because of the nervous system. My research had shown the effect on muscular strength and the effect on motor integration. The neural muscular interaction was a function of the nervous system’s effect on increasing the speed of the stimulation of the motor units of the muscles. This finding indicated that the nervous system was able to activate and/or stimulate more of the motor units at the muscle and caused the subsequent contraction of the muscle fibers to be quickened. Thus, the time of muscular contraction following the arrival of the nervous system signals from the spinal cord, or “Motor Time,” was much faster under the influence of the steroid drug. Strength is important but speed was a more important factor. To generate power, force and velocity are essential but velocity is the most critical.

In 1972, Anabolic Steroids were legal for athletic usage. The East Germans had been using them in what they believed were scientific methods. The GDR conducted a decades-long program of coercive administration and distribution of performance-enhancing drugs, such as testosterone and other anabolic steroids to its elite athletes for the purpose of bolstering the communist state’s image and prestige by winning medals in international championships (such as the Olympics), known officially as State Plan 14.25. Drug regimens, given either with or without the knowledge of the athletes, resulted in victories in international competitions, including the Olympic Games. East Germany had been a pioneering state in doping so much that it was considered to be the inventor of doping.

In the seventies, the Berlin wall was part of a fortified border that split Germany in two. Officially, it kept the West out. But in reality, it kept East German citizens in while their government sought ways to demonstrate communist superiority to the rest of the world. Rare glimpses of life behind the Wall suggested a sporting revolution. Talented children were handpicked for special sports schools. Coaches and doctors were employed full-time to train them. Sports festivals became highly anticipated national events. Successful athletes enjoyed freedoms not available to their fellow citizens. This was the communist equivalent of fame and fortune – they became the public face of the German Democratic Republic. In the 1976 Montreal Summer Olympics, the world took notice as East Germany, a relatively small country with few previous Olympic wins, triumphed with an impressive 40 gold medals. The women’s swim team alone won 11 of 13 swim events, an unprecedented feat. U.S. swimmer Wendy Boglioli describes her opponents performance at the Montreal Olympics, “They were very strong women; they were very fast; we thought they were machines. Here (we) were, four of America’s best athletes ever put together on a team, and every single day the East German women were winning every, every event. “The secret to their success would not come to light for decades: a state-sponsored doping program. Under the auspices of East Germany’s elite sports federation, headed by Manfred Ewald and monitored by the Ministry of State Security (known as Stasi), the government used doping as part of a deceptive master plan to secure international prestige through success in sports. Girls as young as 12 were recruited from across the country, and without their knowledge, were regularly administered untested steroids and male hormones as part of their training. Ultimately, Olympic gold came at a disturbing price for many of the German athletes, specifically side effects ranging from male-type hair growth and deepened voices to liver and heart disease, depression, infertility, miscarriages, and even death. The systematic doping began in 1974 when Party leaders met with the East German Sports Performance Committee to decide how best to guarantee gold medals and international glory. What they came up with was “state plan theme 14-25.” The protocol was based on the work of chemists and pharmacologists at a secret lab in Leipzig. A pill, known as Oral Turinabol, was given to the athletes to bolster their hormones. Oral-Turinabol, or O-T, was an anabolic steroid derived from testosterone. More than 3,000 Stasi moles within the sport system monitored scientists, coaches, and even athletes who secretly reported every move they and their colleagues made. The web of informers meant the athletes had to be wary of what they said – probing questions or dissent were immediately and harshly punished. Produced by the state-run pharmaceutical company, Jenapharm, it was given to the most promising athletes. O-T and other anabolic steroids increase muscle mass and hasten recovery time, allowing athletes to train harder and build up more strength. And because they are similar to testosterone, they have a greater impact on women, who have less real
testosterone in their bodies to begin with. Many of the girls had barely reached puberty when they began receiving the hormone pills. Their parents, too, were kept in the dark. East German swimmer Katharina Bullin describes the before and after of the drug use, “Drips, injections, pills, it was all normal (during training). Nothing strange about it and I wouldn’t have known what to ask because I wasn’t skeptical at all. I didn’t start to look like a man overnight, it happened gradually. I wasn’t really aware of it myself but it was obvious to everyone else. And whether I wore a dress or a skirt, make up or jewelry, it got worse and worse. They called me a transvestite or gay, and it shocked me.”

By the 1980s, steroid use was widespread throughout the sports world, and scientists were fighting a constant battle to catch up with ever-more-sophisticated doping techniques. At the Pan American games in 1983, organizers asked West German scientists to set up a lab to test for illegal drug use. It was the first time a large number of positive tests became public. Steroids were becoming pervasive, and all athletes were affected. But while the opportunity to use performance-enhancing drugs was present, there were differences between the East German methods and everybody else’s. Doping in the GDR was different from the doping in the West of the world but it was also different from the doping in other parts of the East.

This desire to promote left wing ideologies mixed with advancements in medicine also led the GDR to use their athletes as propaganda tool. The politicization of sport became a central theme for world powers following the end of the Second World War. International competitions like the Olympics, World Cups, and such began to lose its athletic reputation. Incredible media attention, financial support and national reputations are all at stake. The origin for sports culture in the GDR can be found following the war when its people were poor, malnourished, unhealthy, and in need of guidance. With most fitness centers destroyed in the air bombing campaigns and any remaining equipment taken by the Soviets during their invasion of Germany, the government of the GDR decided to create the DSA (Deutscher Sportausschuss) which translates to the German sports committee. The Left-wing policies of East Germany meant that every citizen was equal and expected to give back to the state. The results of the GDR were an immense success. In 1964, at the Tokyo Olympics, East German participants won more medals than their Western team colleagues. In the Mexico Games of 1968, the GDR, entering for the first time as a separate team, surpassed the Federal Republic of Germany (FRG) medal count. This was repeated on “enemy territory” at the 1972 Munich Games. Subsequently, the GDR never fell below third in the unofficial rankings. The total medal count of GDR participants at the Winter and Summer Olympics from 1956 to 1988 amounted to 203 gold, 192 silver and 177 bronze. Most East German children would compete in youth sport centers and be scouted by the government which resulted in the best prospects being taken for intense Olympic training. These children were expected to deliver great victories and the state was willing to use anything at its disposal to ensure that. Advances in medicine and science meant that use of steroids, amphetamines, human growth hormones, and blood boosting were common practice behind the scenes in training centers for the athletes. The results were fantastic for the country of East Germany but absolutely devastating for the athletes involved. While figures cannot be precise, the state-inspired doping program affected perhaps as many as 10,000 athletes. Not only was cheating at the center of the program but the abuse of the athletes’ health was too. Female athletes, including adolescents, experienced virilisation symptoms. “Virilization or masculinization” is the biological development of sex differences that is to say changes that make a male body different from a female body. Most of the changes of virilisation are produced by androgens and possibly as many as 1,000 sportsmen and women suffered serious and lasting physical and psychological damage. While the doping worked in achieving victories for the state and advancing a small nation to prominence on the world stage many concerns remain. All victories by East German athletes are tainted due to the widespread use of drugs and many former doctors and former athletes struggling with the side effects are bringing sports directors to court. The legacy of East German sport outlasted the country. In 1977, the shot-putter Ilona Slupianek, who weighed 93 kg (205 lb.), tested positive for anabolic steroids at the European Cup meeting in Helsinki. At the same time, the Kreischa testing laboratory near Dresden passed
into government control. The Kreischa lab was reputed to perform approximately 12,000 tests a year on East German athletes but without being penalized. On August 26, 1993, the former GDR disbanded itself to accede to the Federal Republic of Germany. In 1990, the records had been opened and evidence was found that the Stasi, the GDR state secret police, had supervised systematic doping of East German athletes from 1971 until reunification in 1990. Doping existed in other countries, both communist and capitalist, but the difference with East Germany was that it was a state policy. Often, doping had been carried out without the knowledge of the athletes some as young as ten years of age. It is estimated that around 10,000 former athletes bear the physical and mental scars of years of drug abuse. It was revealed at a much later date that the East Germans were manufacturing a steroid, artificial epitestosterone, and administering it to 14-year-old athletes. These young people were unaware of the contents of the many pills which they ingested daily. They were given vitamins and supplements in addition to the anabolic steroids but they lived in a controlled environment in which they trusted everyone who worked with them. They had no reason to distrust, neither the individuals, nor the contents of the pills they were given. Unfortunately, the side effects of the anabolic steroids had lifelong damaging consequences. When the doctors were finally taken to court, their defense was that they had been forced to give the athletes these drugs by the secret police (STASI). However, my impressions during my visit to Leipzig were that these scientists knew exactly what they were doing. In their defense, they may have been unaware of the long-term consequences of these steroids but there is no doubt that they recognized the advantage of the short-term effects. Unfortunately, females were particularly vulnerable to the adverse side effects of these anabolic steroids. On the one hand, their performances may have been spectacular. In fact, the women produced greater results than those by the men. Unfortunately, the risks to these women were substantially higher. Using drugs to enhance performance was nothing new in Germany. During World War II, Hitler issued vast quantities of steroids to the SS and the Wehrmacht so that his troops would better resist combat fatigue and were more ruthless in following any order. As early as 1941, Soviet Red Army observers had noted an unusually passionate fighting spirit among German soldiers who often seemed eager to die for the glory of the Third Reich. Now these girls would be physically maimed for the glory of the country of the German Democratic Republic (GDR). The doctors had taken the scientific knowledge gleaned in the Nazi era to carry this human engineering experiment a giant step forward. Their program had a single goal: to transform the GDR from a lackluster Soviet satellite into a giant in the global arena of competitive sport. Within this context, the quadrennial Olympic Games were the summit of ambition. Maximum efforts, financial resources, everyone, and everything were dedicated toward amassing Olympic medals regardless of the costs to any individual. Sadly, the researchers also discovered that the drugs affected the mind as well as the body. Sometimes after taking these drugs, the athletes – like the shock troops of Hitler’s elite SS units – reported a sense of invincibility, unlimited energy, and an uncontrollable libido. Early in the program, female athletes as young as fourteen embarked on sexual rampages in the sports complexes that their trainers, coaches, and physicians ignored as long as the girls performed well in the pool or on the track. So, as it transpired, the key to East German dominance and Gold Medal successes was the doping control laboratory in Kreischa. The laboratory was built in 1977 and this brain trust served to secure and to conceal the use of all performance enhancing medications. I did not visit that particular laboratory facility and, like everyone else, learned about it only after it was finally closed and outlawed. Ignoring their drug program, I had observed that the East German program was systematized, scientific, and efficient. One thing was abundantly clear and irrefutable that neither the United States, nor any other free country, would be unable to successfully perform against the GDR’s highly regulated, efficient, dedicated system with the sports structure that currently existed in the U.S. The U.S. relied on DNA and talent but had no organized program to augment or increase performance skills or raise the levels of achievement. No athlete in the U.S. could improve or enhance their physical abilities to their optimal capacity compared with the East German’s successful achievement with their athletes. I returned from the visit to East Germany and joined my Israelis friends and the other athletes of the World to mourn the losses of our friends and colleagues who had been senselessly
murdered. We stood in the sun, in an open field with the participants from around the globe, and everyone wept. My old friend Gilad, from Wyoming days, was on one side of me, and Yariv, my first coach and mentor, stood on the other. The grief among all of us was intense and palpable. This one moment in time with all the countries joined to mourn was very moving. We were all athletes rather than countries competing against each other. Each man and woman knew what our Israeli athletes had endured on the training fields and the fitness rooms to participate and how they had been senselessly murdered in their prime. The Arab countries and the Soviet Union were the only countries that refused to lower their flags. An additional insult was that the dead terrorists were welcomed as heroes when their coffins arrived in Libya. It was a disgusting display of insensitivity, as well as, an unfortunate form of victory. Rather than relentlessly pursuing peaceful solutions, murder had become the ultimate trophy for victory. The remaining days of the Olympics were difficult for the other Israelis and me. I would have preferred that they cancel the remaining competitions. I listened to the argument that cancelling the competitive schedule would prove to the terrorists that they had won their victory. Perhaps, from one perspective, it was the correct decision to continue with the Games. However, for my friends and me, it was extremely difficult to be in the Olympic venues surrounded by ordinary daily events while over-shadowed with an umbrella of grief. I remember that Jim Murray of the Los Angeles Times wrote, “Incredibly, they’re going on with it. It’s almost like having a dance at Dachau.“ When the Games ended, George Dales and I returned to the United States. After I returned, I knew I had to do something after what I had learned in East Germany. Our training system had to change if we wanted the American athletes to win future Olympic medals. At that time, the U.S. had no training centers. Athletes were trained at Universities, clubs, or at camps, such as we had conducted at Dartmouth College. I was convinced that the United States could do better than that. We may have had superior athletes at that time because we had such a large population pool from which to select the best performers. But these athletes were severely hampered by the lack of a system to help them achieve their optimum performance level. America had the best technologies and the best equipment but now we needed a system to amalgamate technology with DNA. Also, there was the disadvantage of financial support. In the East German and the Soviet Union, athletes were in the Army or some other government department so they were paid to do their job. By holding these government jobs, they were not paid to play and could retain their amateur status as defined by the Olympic rules. Because no such system existed in the U.S., athletes had to find jobs to support their own athletic endeavors while continuing to be recognized as amateurs. The discrepancy was difficult and inherently unfair but it meant that the Americans had to find a clever way to overcome this imbalance. We needed to develop our own unique system so our athletes could excel to their maximum and defeat the Eastern Bloc countries at the next Olympics. This was my mission. Now I had to find connections to make my case to the authorities that actually controlled Olympic Sports in the U.S. Unfortunately, I was not able to work fast enough. At the next summer games in Montreal in 1976, East Germans dominated the gold medal count, especially in swimming, sweeping eleven out of a possible thirteen first place finishes. But, tenacity is one of my most dominant characteristics so I continued searching and working on the goal of improving the training system for U.S. Olympic athletes. My first order of business after returning to Amherst was to take care of things there. I had classes to teach at the University and I had to help Ann with our CBA projects. We had several important projects to complete which she had been working on while I had been in Munich. Our company was working well and we needed to continue our business progress. Things had been more successful than we had dreamt they could be and now we needed to maintain the initiative. After Ann and I brought CBA up to date on our projects and my University duties were being satisfactorily addressed, I would track down the heads of the Olympic sports. I was confident that we could improve the situation. Although this was a burning issue for me, it would have to be on a back burner for the immediate future.
CBA was inundated with projects. One of our projects was to examine the progression of movement changes in muscular dystrophy. Muscular Dystrophy (MS) refers to a group of hereditary muscle diseases that weakens the muscles that move the human body. Muscular dystrophies are characterized by progressive skeletal muscle weakness, defects in muscle proteins, and the death of...
muscle cells and tissue. Nine diseases including Duchenne, Becker, limb-girdle, congenital, facioscapulohumeral, myotonic, oculopharyngeal, distal, and Emery-Dreifuss are always classified as muscular dystrophy, but there are more than 100 diseases in total with similarities to muscular dystrophy. Most types of MD are multi-system disorders with manifestations in body systems including the heart, gastrointestinal and nervous systems, endocrine glands, skin, eyes and even brain. The condition may, also, lead to mood swings and learning difficulties.

The son of our partner, Ken Weinbel, suffered from this debilitating disease so it was a study which was near and dear to our hearts. Whatever we could discover to help this delightful young man and share the information with the medical community would be a reward for all of us. The cause(s) and cure(s) were completely unknown and victims could only try to slow the progress and maintain as much muscular strength as possible to support the body. One factor was known and this was the pattern of deterioration. The degeneration of the muscles followed a very definite pattern which began in the calf muscle and then progressed upward through the other muscles. Our biomechanical quantification of movement was refined sufficiently well to detect changes in a patient’s gait significantly sooner than other diagnostic tools available then. So we embarked on several trials to verify these findings and to attempt the development of a quantification procedure which would assist the doctors who specialized in this area.

We wanted to determine whether any unique progression of the disease was discernible and in what way it affected the mobility of the patient. Using biomechanics, we could compare the walking movements of children with and without the disease. Comparisons of children with normal walking movements to the abnormal pattern of those with MS would, hopefully, reveal some useful results. Our hope was that we could quantify the rate and movement patterns with which the disease progressed. We worked on this project with the Hanover, New Hampshire local hospital. After collecting all of the films and digitizing the data, I would meet with Tom Sullivan who was the night director in the computer room at the University of Massachusetts. Typically, all computer programs would only be accepted between eight o’clock in the morning until eleven o’clock at night. There was no access to the computer during other hours. However, Tom was a humanitarian who was interested in helping find a cure for this terrible disease. We arranged a system that when I knocked on the appropriate office door, Tom would process the batch programs consisting of thousands of cards even if it were at two o’clock in the morning. By running my data in the middle of the night, I would have the results quickly. Without this assistance, I would have to wait sometimes as long as two days before I could have the data processed.

Interestingly, Tom was an innovator himself. I recall one of our discussions in 1972, after I returned from the Olympics, about his ideas to utilize the potential of hydrogen fuel for cars and solar energy for electricity and heating. It is amazing in the second decade of the 21st century to reflect on these alternative energy sources proposed in 1972. It seems that we have wasted many years to finally arrive at a place with more forward scientific thoughts.

One late evening or more correctly in the middle of the night, I invited Tom to meet Ann and me at the Yankee Peddler for lunch the next day. I would treat him to an excellent meal as a thank you, for all of his assistance with the data processing. I told him to bring the computer outputs with him and save me a trip to the computer center. Tom arrived for lunch with a huge stack of papers. We began a discussion about one of the comparisons among different trial results for Ken Weinbel’s son. I showed Tom how the gait data indicated the rate of his deterioration.

While we were enjoying our lunch and discussing the latest information gleaned from our biomechanical analysis on Ken’s son, I was only vaguely aware of the other dining patrons. We were just in the normal buzz of a lovely restaurant where conversations percolated. I barely noticed the three
gentlemen sitting at the table beside us. The few words that reached our table had to do with bank functions and numbers but I was not interested in eavesdropping on their conversation anyway.

“Excuse me for intruding,” one of the gentlemen interrupted us, “but did you say you analyze muscular dystrophy?” he asked.

“Yes,” I replied and began to explain what we were doing.

The gentleman had a focused expression on his face and an air of authority. He concentrated, attentively and intensely, to my answers and asked many probing questions regarding the procedures we used. Suddenly, he apologized for not having introduced himself and told us his name was Larry Graham. His interest in the subject, he explained stemmed from his position of president of the Holyoke Hospital and his extensive involvement with the Shriners’ Burn Hospitals throughout the country.

Mr. Graham went on to describe his current activities following the sale of his disposable paper product manufacturing business some years earlier and that, currently, he was primarily focused on his extensive volunteer efforts. For example, his position as the Holyoke Hospital President was for a yearly salary of one dollar. He still owned the local bank in South Hadley, Massachusetts, a nearby city but that was so his daughter at Mt. Holyoke College could cash her checks. He invited us to join their table which we did.

We each described our backgrounds and our current activities. Tom told him about his position at the computer center and how he helped me with many of my computer projects. I told him about my
history with Israel and my progress up to, and including, the recent Munich Olympics and my travels to East Germany. Ann told him about her work on the nervous system in her graduate studies and the on-going efforts at our company, CBA. He asked if he could visit our office, so we could show him the methods we used and some of our current projects.

I advised him that I worked from home, and although I used state-of-the-art science and advanced computer technologies, my desk was located in my kitchen. He shrugged off this situation and pointed out that the ideas and concepts we were exploring were more important that the physical environment. We agreed to meet two days later.

That Thursday afternoon in October 1973, Larry knocked on the door of our small house in Belchertown. Ann was digitizing data from the 1972 Olympics. I was on the Teletype connected to the University computer. As usual, we were working diligently.

Our Laboratory and Office at our Kitchen in Belchertown Massachusetts

Larry looked around and was oblivious to the fact that the office was in our kitchen. He carefully examined some of the publications, data sheets and the digitized results and graphic presentations, which were taped to the wall. Then we took him downstairs and described the procedures of analyzing the Universal machine, which was sitting next to a window overlooking the lake. He was so engrossed in our activities and scientific methods that he failed to notice the beautiful view just steps away from where he was standing. He carefully noted all the cameras pointed at the Universal gym equipment. He was very thorough and asked many questions so that hours seemed to fly by in an instant.

After all of this time and questions, Larry stood quietly thinking in our kitchen. Finally, he turned to Ann and me. “Okay you two, here is my assessment of the situation. This is not the way to run a business. Your potential is enormous. However, you are working extremely hard and spending many hours producing a fantastic scientific product but your business practices are appalling and very
amateurish. I learned at my father’s knee how to run a business and I was very successful. Not only did my company generate excellent profits, but also it was efficient and growing until the day I sold it to a larger company, which made me an offer that I couldn’t refuse. In addition, I have established a bank and continued as part of its Board of Directors. I am not trying to blow my own horn, but just to illustrate that I know what I am talking about and believe that I can help you. You have each demonstrated to me that you are honorable people and have excellent work ethics, in addition to the valuable and unique work that you do. I think we would make a wonderful and successful team, if you are interested in my help.”

In unison, Ann and I said, “Mr. Graham, what would you suggest?”

Initially, Larry wanted to examine our books and corporate records, meet our partner, and evaluate where the most appropriate office location would be. After he had examined our checkbooks and financial records, he learned that we very messy but, in spite of that limitation, he could see we were already profitable. The next step was to meet our partner, Ken Weinbel, and then we would all decide what should be the next step. If all went well, Larry said that he wanted to find an office in a better location and he would purchase all the equipment that we needed as part of his investment. The next step was to drive to Hanover, New Hampshire to meet Ken Weinbel.

Although Ken was my first and current partner in CBA, at one point in the past, we had anticipated adding my professor, Dr. Stanley Plagenhoef. Ken and I had incorporated CBA in New Hampshire during the 1971 summer break, so when school resumed in the fall, I had been very proud to announce this development to all my friends and teachers. My friends were happy for me but skeptical since all of them were doctoral students and their interests were more on their own studies and a future in academia. This was the same general response from the faculty members except for one man. Dr. Plagenhoef was outraged that I had started a biomechanics company without his approval and involvement. I was so stunned by his reaction I was momentarily speechless. His reasoning was that I was his student and was not allowed to have a company in the business of biomechanics without his participation. I told him that he was more than welcome to be involved and that, in fact, I had eagerly anticipated that he would want to be a part of the company. For the next few months, Dr. Plagenhoef traveled with me to Hanover and he participated in the analysis of many of the sporting events that we had filmed in Munich. In addition, he worked with us on a project with Uniroyal shoes.

Times were tense at CBA whenever Dr. Plagenhoef was in the office. He was a stubborn, rude individual and treated the people helping in the office with disdain. In Amherst, at the University, his behavior was equally unpleasant particularly towards me. He also recruited one of the other faculty members, Dr. Ricci, into his web of hostility. Until that time, Dr. Ricci had been very warm towards my family and me. In fact, when I had first arrived in Amherst, Yael, Geffen, and I felt as though Dr. Ricci had adopted us. How this reversal of attitude could occur was unfathomable at the time and continues to puzzle me.

CBA continued to use the computer system at the University of Massachusetts as well as the one at Dartmouth College in Hanover. One day, as I walked through the maze of engineering offices that separated the parking lot from the computer center, I noticed a computer-generated output from our office in CBA. I was shocked to see that Dr. Plagenhoef’s name was on the output, so I asked the young man standing beside the table what it was. He responded that he and his professor were working on a prosthetic hip project for Smith-Kline and that Dr. Stanley Plagenhoef’s company was providing three-dimensional walking data to them. He was struggling to try to determine why the forces were not correctly aligned. I explained that the data was not three-dimensional since, at that time, it was impossible to calculate all of the orthogonal axes needed. What the data presented was two separate walking motions taken in sequence with each single motion representing a two-dimensional result. Combining two separate actions into a three-dimensional representation would be impossible. Therefore, his efforts would never align the forces.
I confronted Dr. Plagenhoef as soon as I was able to track him down. He was as inflexible as always. He did not care that the professor and Smith-Kline were being misled by the data which he deceptively offered as three-dimensional.

“You know it is not three-dimensional. You are lying to them. It is worse than that because they are working with a reputable medical company on a hip replacement which will be put inside some innocent person’s body.” I was outraged by his immorality. He was unmoved and left the room without another word. Apparently the matter was moot.

Shortly after that, Ken and I discussed the advantages and disadvantages of including Dr. Plagenhoef in our company with a third of the shares. The advantages were that he had quite a positive and international reputation in the field of biomechanics and he had already demonstrated that he could attract paying projects since we had worked on Uniroyal and the Smith-Kline with him. The disadvantage was his difficult personality, his questionable ethical behavior, and his proven track record of keeping the project money rather than putting it into the company.

Finally, Ken and I decided that his positive contributions were greater than his limitations. Ann was opposed to giving any shares to Dr. Plagenhoef since she felt that we did not owe him anything. She appreciated his contribution to our knowledge and for having been our teacher but she continued to doubt his ethics and veracity. Her opinion was that if he could be deceitful once, there was nothing to prevent him from being dishonest again.

Nonetheless, Ken and I decided to meet Dr. Plagenhoef in a restaurant in Putney, Vermont, since it was a good halfway point between our homes. The meeting was another one of those jaw-dropping shocks that I should have anticipated. Dr. Plagenhoef insisted on owning the majority of the shares, Ken Weinbel would have only a few token shares because of his financial investment, and I was to have zero shares. I would be allowed to work on projects when Dr. Plagenhoef felt that I could contribute. Ken and Dr. Plagenhoef began to argue and shout at each other to the bemusement of other diners. Finally, I mentioned that I was the youngest one of the three yet I was the only person at the table who was acting like an adult. This statement brought the conversation down to a normal sound level. Finally, Ken and I told Dr. Plagenhoef that we would discuss the situation and let him know what we decided.

After Dr. Plagenhoef left the restaurant, without contributing any money to the cost of the meal, Ken and I agreed that Dr. Plagenhoef would not be a positive nor contributing factor to CBA. In fact, it had become abundantly clear that his goal was to take over our company and dispatch us as soon as he found ways to accomplish this feat. It was quite a relief that both of us saw the same perspective and were readily able to agree that Dr. Plagenhoef would not be joining us.

By 1972, however, we were ready to entertain the possibility of Larry Graham becoming a partner in CBA. We met in Hanover, New Hampshire at Ken’s home. Everybody was enthusiastic about growing and having someone with Larry’s business connections and skills to work with us. We decided to share the company, one-third each between Ken, Larry, Ann and me. Thus, we embarked on the beginning of a new phase in the growth and development CBA.

Before officially becoming a partner, Larry wanted to conduct a due diligence study with an independent company to gauge the upside potential of CBA. Larry recognized that, like most inventors who own companies, I was a dreamer and what could sound like a good idea to me may not have commercial value. Larry’s intention was not only to create a better, more competitive company, but also to make sure that all of our efforts would be rewarded with profits and the company would be able to stand on its own merits.

Ken Weinbel was acquainted with a graduate program at Dartmouth College which studied the viabilities of companies. He contacted one of the professors, Cliff Lewis, who taught the course and who also had his company, Marketing Communications Inc. Cliff was more than a little curious about a foreign Olympic athlete starting a company whose purpose was to measure motion. He readily agreed to study our company and assigned it a top priority as a graduate student project. The person in charge of the research was Professor Bither at the Amos Tuck School which was a leading professional school at
Dartmouth College. These two groups and their students spent an entire semester researching CBA. They examined the potential products, companies, and the financial likelihood of success as well as of failure.

Their 100-page report covered all of CBA’s potential advantages and disadvantages. Their main points were essentially:

1. CBA represents the first incorporation to bring biomechanical analysis to commercial usefulness.
2. The market potential was unlimited. The biomechanical analysis could be used wherever forces are applied in a biological link system, i.e. animal, human, horse, etc.
3. Commercial uses could include the entire market for:
   a. Athletic equipment design, e.g., ski boots, special shoes, golf clubs, tennis rackets, etc.
   b. Safety equipment design, e.g., automobile air bags
   c. Insurance claims, especially with disability related to real or fraudulent causes
   d. Designs for artificial limbs
   e. Surfaces modifications where the human body interfaces, e.g., shoes, floors, etc.
   f. Educational opportunities, e.g., clinics for golfers, tennis players, ballet dancers, or other sporting events

Larry was very impressed with the results of the study, and with us as individuals. He realized that CBA was a potential gold mine and decided to plunge into our exciting adventure without delay.
In just a few weeks, Larry found an office for us on Route 9 near Amherst College, which was one of the five institutes of higher learning in the town. The space was between a sandwich shop and a paint store at 316 College Street. We had a reception area separated by a wall from the rest of the office. Behind the wall was the digitizing and computer area. The remainder of the office had desks for staff and computing, two large testing areas, a conference room, as well as, showers and bathrooms. We could conduct any number of research projects within the different areas. Larry’s investment in us was substantial. It included furniture, new computer terminals, an oscilloscope, a new digitizer, a screen saver terminal by Techtronic, and new high-speed cameras, which operated electronically, rather than the old spring, loaded ones.

We did not discuss the amount of his investment but I believe it must have approached $100,000, which would be closer to $500,000 in today’s dollar value. It was not that I was disinterested in Larry’s financial contributions but my interests were on the incredible new equipment and more sophisticated office/laboratory environment. With this new and improved setting, it seemed that our biomechanical opportunities were unrestricted. My excitement grew with the idea that CBA was ready to go “Big Time”.

This was how our company and our lives changed. All these changes and a new, wonderful partner arose from a chance meeting at a dinner in the Yankee Peddler. Both then and now, we reflect on the luck we had in meeting Larry Graham and realize what a fantastic opportunity he created for our future successes and us. We will always remember Larry with fondness and joy.
Our staff became an amalgam of brilliant and eccentric personalities. Ann ran the whole office and did hours and hours of manual digitizing. Carl Peterson was a programmer from Dartmouth College and he was a fast, creative programmer in the BASIC language. Together, Carl and I created the original biomechanical software in 1971. Carl was such an unusual person that one day we learned that he would play his trumpet in the shower at the dorm. In spite of some of his personality quirks, he was a brilliant programmer. We also hired Alan Blitzblau, who worked in the Computer Center at the University of Massachusetts, but was available part-time to work with us. His specialty was FORTRAN and APL languages. Alan was responsible for many of the software modules that we developed and he worked
with me for 18 years. Alan’s family lived on their own farm and raised goats, chickens, and grew much of their own food. It was a wonderful treat during the summer months when Alan would bring homegrown tomatoes and other vegetables to share. I met Jim Walton at a conference where he presented a research paper related to three-dimensional movement. Jim, at that time, was a student at Penn State University. I persuaded Jim to complete his doctoral program, quickly, and come to work with us in Amherst. I was very excited about the work that he had done in resolving three-dimensional results from multiple camera views. Jim was very instrumental in the developed of that part of our software program.

In addition, we had two genius undergraduate students working for us, Peter Smart and Justin Milliun.

They were both experts in hardware and software. Justin and Peter were particularly valuable with the creation of some of our more usual testing and product needs.

But the most important programmer in our history literally walked in off the street. One day, I was working in the front office concentrating on our current tennis ball project. It was 1974, so we had been in this office for more than a year. Because our office was located between a sandwich shop and a paint store, we frequently had people coming through the front door who had actually intended to eat or buy paint. In addition, many people were mainly curious about what we actually did since the sign above the door was a mystery topic to most folks. All of us had all become immune to these unexpected gawkers.

http://arielnet.com/ref/go/1126
However, this time a hippie, whose hair was so long and his beard so covered his face that he resembled a bear more than a man, opened the office door and stepped into the office.

My first thoughts were that he was homeless and hoping for some financial assistance. Before I could reach into my pocket, he introduced himself as Jeremy Wise. Furthermore, he had not just randomly wandered by, but was the professor of two of our best technical staff, Justin Milliu and Peter Smart!! What a shock I experienced at that moment.

Dr. Wise explained that his two students had described our company to him and suggested that he visit us. I chatted for a few minutes about these two student geniuses and then I took him on a tour of the office.

He focused on our Data General Nova-3 computer. “I am very familiar with that computer,” he said, “and Peter and Justin thought that perhaps I can contribute to your company in some way.”

“What’s your background?” I asked with no expectation of any area that would relate to our research projects.

Now this guy, who looked like a hippie, dropped another bombshell. Jeremy had a Ph.D. in Nuclear Physics, had performed his dissertation research at Brookhaven Labs in Long Island, and currently was a professor in the Physics Department of the University of Massachusetts. I was speechless and wondered what to do next.

At that point, I was perplexed as to whether this fellow was for real or some fruitcake imagining his place of grandeur in the Universe. This was the early 1970s and the United State was riding a countrywide wave of anti-war protests and lots of drug use. He could see the skepticism in my eyes.

“Let me program something for you. Give me a test to see if we are compatible and if I have any skills or abilities that you can use,” he suggested.

Suddenly an idea popped into my mind, so I responded: “Why don’t you program the stock market for me?” He asked for details. I told him to select ten companies, learn the symbols, and look in the business section of the newspaper for all of the details that are published. Then prepare a printed report with all the functions used in the stock market exchange and anything else that he considered would be of interest to an investor based on his program. I told him that I would pay $10 for each hour he spent on it and to come back to the office whenever the finished product.

The Computer Language he used was Fortran:

The FORTRAN Programming Language

“Whatever you do,” I said, “you need not worry about getting paid.” The minimum wage at that time was $4 per hour, so I was sure that my offer was more than fair. He agreed and left the office. At
that moment in time, I was sure that I would never see him again or, if he did return, it would be because he had failed, but still wanted some financial compensation.

To my surprise, Jeremy was back in two days.

“How’s the project going?” I asked, expecting to hear of his problems.

He responded, “I finished it. Do you want me to demonstrate the results to you?”

We sat together beside a computer and he loaded his program. Then he demonstrated the program and the step-by-step results in remarkable detail. Nothing was missing. In addition to what I had suggested, Jeremy had included some graphs and charts which showed the trend of each stock over a time period, as well as, comparison graphs for the overall market performances. I could not believe it. It would have taken me at least a year to do what he did in a few days. I said, “Jeremy, you are hired. I do not know at this moment what you will do but you are obviously a genius with computer programming. That is more than enough justification until we can find something that you like and we can use.”

So, Jeremy started working with CBA in 1974 and he is still working for us, as you read this book. His contributions have been a mainstay of the company. Together we created the most sophisticated biomechanical programs in the world from 1971 to 2017 and we continue to develop others. We created software for mainframe and personal computers, as well as, a computerized Exercise Machine. Our working and personal relationship have always been strong and unbreakable. He is a fantastic and loyal person to Ann, CBA and me. We value his friendship for all of these years and plan for our wonderful relationship to continue.

At the same time that Jeremy was working on the stock market test program, Universal Gym was looking for more input on new designs. With our larger lab and more extensive and varied staff in Amherst, we were able to provide Universal with even more detailed information for equipment designs, as well as retrofitting, some of their older models. Universal sent us all the hardware that they wanted us to reconfigure.

CBA’s contract with Universal Gym was to build exercise machines included the following:

1. Re-test: Leg Extensions to determine the muscular outputs (Force curves) and adjust the resistance intensity if needed.
2. Determine the resistive formula for a Standing Leg Curl exercise.
3. Determine the resistive formula for Lat Pull Down exercise on the Universal hi-pulley station.
4. Study the variables for junior-age boys. This data would be incorporated into the design of a new and smaller junior high machine.
6. Determine the resistive formula for: Seated Arm Curls and Triceps Extension exercises.
7. Determine the resistive formula for Pullover exercise from both prone and seated positions.
8. Determine the resistive formula for neck exercises, such as, lateral, rotation, extension, and flexion.

With our expertise in analyzing human movement and human-machine interaction, we had additional ideas. Our intension was to follow some basic principles which relate to strength development. Our goal was to create a machine that helped people maximize their strength at every point in the exercise range of movement. The human body consists of many lever systems which make up the arms, legs, spine, etc. However, these lever systems change as the person moves. For example, if someone holds a 10-pound weight in their hand with their arm extended, this weight and position are probably quite comfortable. However, if that person keeps the arm straight and tries to raise the hand holding the weight, it becomes more difficult and often, the weight is too heavy for the person to lift with the arm straight out. Imagine, a little genie that could remove weight as the arm was raised so the weight became lighter until it was possible to add some of the weight back to its original size. In other words, when the arm was
in the position of the greatest biomechanical disadvantage, commonly referred to in weight training as the sticking point, a person needs to exert more muscular effort than when the arm was in the original, mechanically advantageous position. When the human lever system is at its greatest advantage, the muscular force diminishes in order to lift the same maximum external load. Therefore, the variability that exists in muscle force is due primarily to the changing advantages and disadvantages created by the human lever system.

The following illustration graphically illustrates the changes in muscular forces that occur when the arm is bent while holding a 10 kg load. As the levers move, the amount of force needed to raise the load increases.

The task for us was to evaluate each of the Universal Gym stations from the prospective of:

(1) Determining the actual force applications  
(2) Whether the forces were correct from an exercise point of view  
(3) How to modify the unit if it was necessary and appropriate

![Illustration showing changes in a bent arm's muscular force while lifting a 10-kg weight](http://arielnet.com/ref/go/1143)

We proceeded to use our biomechanical analysis technique to evaluate the actual performance curves which were produced by someone exercising on each of the Universal Gym stations. We were easily able to establish that muscles were only working at their maximum potential during a very small

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range of the total movement (normally only at the sticking points). In other words, our tests revealed that before and after the sticking points of the exercise the contribution to the strength development of the muscle was greatly reduced. An example of a generated force curve showing the range of motion is shown below. This curve illustrates that much of the activity is below the muscles’ ability to produce force. The only time the muscle actually has to work harder is during the sticking point portions.

In order to develop maximum conditioning effectiveness, the resistance must be accurately varied. Our corrections or modifications to each station were designed to increase the resistance before and after the sticking point. With this modification to the level system of the equipment, it becomes possible to maintain the same degree of muscular involvement (effort) throughout the entire range of movement.

In addition to our project with Universal Gym, we added some extensive, complicated projects to our list of things to do. One of these would change our business dramatically. We were hired to analyze athletic shoes.

Following my 1972 scientific presentation at the Olympics, Mr. Hans Brink, the head of Public Relations, had approached me for the Adidas Shoe Company. He wanted to discuss some of the ideas which I had raised during my presentation to the coaches and athletes at the conference.

“Which ideas?” I asked him.

“We are especially interested in what you said about shoes and body weight. You said that it does not make sense that a person wears shoe size 11 and weighs 100 kg (230 lbs.), yet would wear the same model shoe size if he weighed 75 kg. (140 lbs.) You said the shock absorption should be different for different weights,” was his answer. I was intrigued that he remembered this details from my talk. Since we each had foreign accents, we had to concentrate intensely to understand each other clearly.

“Yes, people should be thought of as weight bearing machines in the same way that the car industry works with tires. Cars and trucks have tires, which are appropriate for the load they have to carry, as well as frictional requirements during use. The automotive manufacture does not select the tire based on color or design. Furthermore, they do not support the ‘One Size Fits All’ philosophy which is common with shoe manufacturers,” I said. I reached into my briefcase and pulled some preliminary work, which we were conducting for the National Bureau of Standards in Washington, D.C. The research for them dealt with the “Slip and Fall Situations” between shoes and surfaces in specific settings, such as restaurant kitchens. The floor in the kitchen is normally a smooth hard surface because it must be easy to clean. However, since food and liquids are frequently spilled, the floor is usually wet. On the other hand, the floor in the restaurant is normally carpeted. Thus, the employee needs attractive appearing shoes but which have the
appropriate frictional requirements for walking on both surfaces and while carrying a tray laden with
dishes. This is on-going research for us.” I explained.

Mr. Brinks seemed very intrigued by my ideas and our research project. He thanked me for my
time and assured me that we would receive a rapid response from Adidas. He implied that there would
be some research projects proposed by them in the near future. I thanked him for his interest and we
parted.

Soon after I returned to Amherst from the Munich Olympics, Hans Brink wrote me that Mr. Adi
Dassler, the President, wanted to meet me. They even would fly me to Herzogenaurach, the home city of
Adidas, to meet with him, their staff, and some of their engineers. Since I had agreed to participate in a
conference in Munich, Germany, in a few months, we decided to schedule the meeting around that time.
Following the conference, I would go visit with Mr. Dassler and his staff members.

The morning of the Adidas meeting was filled with discussions of biomechanics, the analytic
procedures, and proposed research ideas. The morning hours passed quickly because of the intensity of
discussions. Suddenly, the announcement came that it was time for lunch. As we pushed our chairs back
from the table to go to the cafeteria, Mr. Dassler asked me to come to his office. We both walked slowly
towards his office as we continued discussing some of the ideas raised during the morning discussions.

When we entered Mr. Dassler’s office, I thought I had been transported to somewhere in intergalactic
space. There were advanced technological gadgets and equipment all over the office. His desk and
furniture looked to be made of solid gold in addition to the gold shoes displayed on the walls. The pictures
and wall decorations were obviously priceless and were lighted in the same manner as would be found in
a museum. His office must have cost millions of German marks to build and equip. But what, I thought
to myself, did I expect from the man who was the sole owner of the largest shoe company in the world
with millions of shoes and clothes sold every year? In addition, Adidas was the brand that every child,
athlete, and weekend sports participant wanted to wear. Adidas was at the peak of consumer desire and
clearly this office reflected some of this worldwide adoration. His office mirrored the extensive financial
and power that a man in his capacity had.

While I attempted to recover from the initial shock of his office, Mr. Dassler then took me into
one of the closets in his office. It was a large, spacious, well-lighted walk-in closet neatly organized with
rows of shirts, pants, suits, and drawers in addition to an enormous number of dress and athletic shoes.

Among the hangers of suits, he pulled out a beautiful SS officer’s uniform and held it up in the light. This
was not what I had expected to see in his office and it seemed like a very odd display item for an Israeli
visitor. I asked him if he had been an SS officer in the German Army in World War II and hoped that the
answer was “no” and that the uniform was just a weird souvenir from the War.

He admitted that he had been an SS officer but justified this position by admitting that, “My
responsibilities were against the Germans, not the Jews.” Somehow, in his mind, this was sufficient
vindication.

Immediately I blurted out, “Well the Germans only fought the Germans, right?”

The discussion ended at that point and was never revisited. We then went on to lunch with Mr.
Vogler, the chief Adidas engineer. Many ideas were discussed regarding all types of shoes and their use
in different areas including: construction workers, medical personnel, and, of course, athletics. Finally,
we decided that for initial research efforts we should concentrate on their current core business and
address the athlete in the shoe. They wanted to measure the forces in the shoe and how the body reacts
with the athletic shoe.

Shortly after our meetings at the Adidas center in Germany, I received a letter from the staff and
Mr. Dassler is thanking me for taking the time and effort to meet with them. More importantly for CBA
was Adidas’ offer to work with me using biomechanical analysis on their shoes.

Our relationship with Adidas began with a number of studies on the interaction between shoes
and athletes as well as shoes with non-athletes. We had the proper cameras to analyze body movements
with their kinematic parameters, such as: velocities, accelerations, momentum, and interaction between the legs and the arms as well as other biomechanical parameters.

However, we did not have a mechanism to measure the force inside the shoes. For that, we needed force plates. A force plate is a device to measure the forces in three orthogonal directions when you contact the ground. This contact force platform device would allow us to determine the actual forces at various parts of the foot during the contact time with the ground. By measuring the forces produced by a bare-footed runner, we would have an indication of his or her individual shock absorbing characteristics. Placing different surfaces directly on the plate surface and repeating the run would give an indication how much, if any, the surface provided any shock absorbing characteristics. Finally, wearing different shoes, we would be in a position to evaluate the response of the shoe to the runner.

One goal was to develop shoes with appropriate shock absorbing function. We were interested in designing shoes that absorbed impact forces but, as the runner transferred weight forward towards the toes, returned energy to the runner in a rebound action. My idea was to prevent injuries due to impact and, in addition, to return energy to the runner during the push-off phase of the stride. With non-athletic shoes, we wanted to determine the frictional capacities of the shoes and the requirements associated with each task. This was a natural outgrowth of our National Bureau of Standards study on restaurant shoe requirements.

Thus, one of our initial hardware purchases for the Adidas project was a force platform. At that time, the Swiss company, Kistler, was only one that made force plates. Their platform was based on the Pizeo-electric Principle with specialized disks internally imbedded near the four corners and which produced incredibly accurate results. We purchased two of these force plates at an unbelievably high price at that time of $30,000.00. (In 2016, $30,000.00 would be $172,646.00 due to inflation.)

Our next task was to construct a mechanism to load the shoes inside and see how the material responded. This device used a hydraulic cylinder and was controlled by a computer. Since there was no device like this in the world, we were forced to invent one. This device allowed us to impact materials and this testing procedure was unique. All other testing equipment available for material testing could only stretch materials. Stretching seemed inappropriate to us since runners pushed down upon their shoes. No one pulls up on the soles of their shoes during normal usage. In addition, the computer allowed us to change the force impact levels so they simulated forces produced by actual human performances. If the test impacts were too small or too large, the results would be meaningless in the real world of footwear.

In addition, we needed to measure the response of the muscles and the muscular involvement at each phase of a stride during various activities. Evaluation of the electrical activity of the muscle, during movement necessitates the use of special devices known as Electromyography (EMG). At that time, small disk electrodes were placed on different muscle groups and the electrical activity was recorded during the various activities such as walking, jogging, or running. The electrical activity could then be coordinated with the force plate results and the biomechanical kinematic parameters.

Employing cameras, biomechanical analyses, force plates, and EMG, we were able to measure what the human body was doing inside and outside of the shoe. We configured the force plates according to the motion being studied. Running strides required different placement locations and differed from a straight-line activity, such as the shot put. For each sporting event, the plates were relocated as appropriate for the event’s execution.

In 1972, no one had yet started thinking about how shoes related to the athlete’s actual performance. We were aware that even in a gentle exercise, such as jogging, there is a perceptible change in the elements of each stride when compared to walking. In our measurements, we found that many joggers land first on the heel and then they roll forward. This is very different from walking. Joggers can generate forces which are three times their body weight when they land on the ground. This sends a shock wave through the ankle toward the knee, the hip, and then up through the spinal area. The heel in an ordinary shoe may suffice for an easy walk but it will not do for the much greater loads imposed in jogging and, even worse, when running fast.
Some joggers land with their entire foot, such that the impact crushes the arch. Other joggers imitate the action of runners who touch down on the forefoot, roll back toward the heel, but may never actually bring the heel in contact with the surface. A third technique is that the jogger lands on the heel, rolls towards the outside edge of the foot prior to landing on the full foot, and then pushes off with the ball and toes.

From the standpoint of absorbing the punishment of the 3-times-body-weight force, it is preferable to land on the forefoot so that the ball of the foot, with its rounded contour and spongy character, can absorb some of the landings. The faster one runs, the more severe the impact. We measured how the combined action of the ligaments, muscles, and tendons was able to spread the trauma of the touchdown.

We examined the primary biomechanical differences between walking and running. One way to distinguish walking from running, is by examining the swing phase of each gait. Running utilizes a double swing phase of the legs meaning that one leg swings forward, then the foot touches the ground, followed by the other leg swinging forward. In running, the body can be totally airborne for a period of time.

Walking, on the other hand, has at least one foot in contact with the ground for the entire gait cycle. In walking, one must elevate the body and then fall forward and employs a double support phase. The biomechanics of walking simulates an egg-rolling end over end. A walker pushes off almost vertically, lifting the body, combating gravity, during which the leg muscles perform positive work. The potential energy of the uplifted body becomes kinetic energy during the fall phase which is accompanied by positive muscle movements.

Jogging, even at a slow pace, such as seven kilometers (4.5 miles)
per hour, involves a substantially different locomotive operation. For the biomechanics of jogging or running, the analogy is not a symmetric end-over-end rolling egg but rather a symmetrically bouncing ball. Running is associated with the foot, first striking the ground, transference into the mid-support phase, and finally foot push off. In running, the leg must actively contract to prevent the ankle, knee, and hip joint from bending due to the weight of the upper half of the body and the generated force.

Additionally, we found that muscles accumulate energy in the same way that a ball with elastic properties does upon impact. That elasticity contributes to the running dynamics much as a trampoline assists a gymnast. The action could also be likened to dribbling a basketball where one combines the force of the hand and the elasticity of the bouncing ball. An over-inflated ball will bounce higher compared to a ball having a low internal pressure since the compliance coefficient (i.e. property of material undergoing elastic deformation accompanied by change in volume when subjected to an applied force) is greater. The same response occurs in humans since the muscular compliance factor determines how much energy the muscle can recover.

CBA’s research with shoe designs was an active effort covering years of work. We learned everything that we could about feet as anatomical units and as their connectivity to the rest of the body. We had to design very specific equipment to measure the forces impacting the shoes as described earlier. Another device we developed was a mechanical leg which was controlled by the computer. The leg was designed to simulate specific points of impact which exactly determined by the kinematic measurements obtained during actual running or walking events. This data yielded more precise impact information for different areas of the shoe and reflect actual measured running or walking conditions.

As previously mentioned, we invented a testing apparatus designed to apply the computer-controlled stress levels on different parts of the shoes. The purpose of the device was to determine the force and recovery characteristics of the material in different parts of the shoe in response to a wide range of duration and direction of force application. The device could be programmed to duplicate the force and the length of time that the foot actually produced during the various modes of walking and running. It was the only mechanism in the world that worked under compression and tension according to our software instructions.

Following our extensive research on the motions of walking and running, we provided Adidas with the information they had requested, as well as numerous recommendations for redesigns of some of their athletic shoes. Many of our ideas were incorporated in their shoe designs for several years.

In 1975, the International Society of Biomechanics met in Yavascula, Finland. I was invited to present a paper on the “Design of Athletic Shoes”. I had to be careful not to reveal confidential information but to focus on the methods which I was using in research and design concepts in athlete shoe designs.

The invention of Air Shoe

http://arielnet.com/ref/go/1115
This presentation was extremely helpful in allowing our biomechanics company to present some of the exciting and dynamically new shoe designs. Our research for Adidas had given us the knowledge and the equipment that no other company or individual had available for studying shoes.

One person who heard about our research for Adidas and my shoe presentation in Finland was Roberto Mueller, an Argentinean who lived in New York. I received a phone call from him shortly after I returned from Finland. Mr. Mueller inquired about our research techniques and what we were doing in the area of sporting shoes. I told him that our studies were completely confidential to each client and we would not share any information with him relative to our clients’ research. He was quite relieved to hear my statement and proceeded to inquire whether we could meet and discuss topics relevant to him, but which, in no way, would conflict with our other clients. Naturally, I agreed and we set an appointment for our laboratory in Massachusetts.

Shortly after this phone conversation, Mr. Mueller appeared in my office. He was elegantly dressed and had the impeccable manners of a sophisticated South American diplomat or extremely successful businessman. He introduced himself with a strong accent (although I probably should not talk!). At that time, we had several Israelis working at CBA on various projects. One of them was Avraham Melamed with whom I had roomed at the Munich Olympics and who was now a student of mine working toward his Ph.D. at the University of Massachusetts. Robert Baron was another Israeli who worked in the computer science department.
Mr. Mueller and I were in the conference room discussing future projects for his shoe company. In fact, he told me that he wanted to build a whole new line of shoes for his company, Pony. I liked Mr. Mueller but I was sure that he must be the son of one of the Nazis that had run away from Europe after World War II to escape the justice to be imparted by the victorious Allies. During one of the coffee breaks, I quietly murmured in Hebrew to Avraham and Robert that, “This Roberto Mueller from Argentina must be a son of a Nazi. After all, many of the Muellers ran away from Germany to Argentina after the war.” I continued, still in Hebrew, “Whatever he wants to do with us we will charge him three times because of his Nazi background.”

After the coffee break, we returned to the issue of the proposed research projects that CBA could perform for Pony based on Mr. Mueller’s expressed interest. Eventually, lunchtime arrived and we organized the group into separate cars to go to one of the local restaurants. I drove my VW camper to the restaurant in town with Mr. Mueller sitting next to me in the front and two members of my staff in the rear seats. Suddenly, in perfect Hebrew, I heard, “So, how are things going?”

In the past, it had occurred that I had found myself talking to someone in Hebrew thinking I was speaking in English. But it had never happened that someone spoke to me in English but I heard it in perfect Hebrew. I looked around and realized that this question had come from Mr. Mueller, our Argentinian German Nazi visitor. I leaned toward him and asked, “Did you just talk to me in Hebrew?” He answered in Hebrew, “Yes, in fact I served in the Israeli military for three years.” “Are you Jewish?” I asked in continued astonishment.

“Of course,” he answered in Hebrew. Needless to say, I experienced extreme embarrassment. I asked him if he heard what I had said to Avraham and Robert in the office. He nodded again and responded in Hebrew, “Of course.”

Letters from Pony Shoe Company

I stared out of the car window at the Amherst trees and sky, thinking to myself that I certainly knew how to ruin a good business prospect. “So now what?” I asked him.

“From that comment, I realize that we will experience an excellent business relationship. We will do business together and be good friends because of your background, knowledge, biomechanical

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expertise, and feisty attitude!” he replied. “Please call me Roberto from now on instead of that stuffy ‘Mr. Mueller’ title.” He was right. We became good friends and worked closely for many years.

The parent company of Pony was CITC (Consolidated International Trading Company). We would have to negotiate with CITC regarding the type, extent, and cost of the research that Roberto wanted us to perform for him. The “King of Shoes”, Mr. Jonas Center, owned CITC. It was amazing to me that Mr. Center was a lawyer who owned a shoe company. He became the owner of the company when one of his former clients had paid his legal fee by transferring ownership of the shoe company to Mr. Center.

Although that shoe company had gone out of business but Mr. Center had been able to retain its exclusive contract for the importation of all shoes from Korea. At that time in the 1970s, nearly all shoes were manufactured Korea, so it resulted in a terrifically profitable business for Mr. Center. He eventually developed some of his own shoe ventures, including Pony, as well as allowing other companies to pay the license fee for other Korean shoe imports. One of the more notable companies importing Korean footwear under Mr. Center’s contract was JC Penney’s.

I drove to New York to meet with Mr. Center, Roberto, and the engineering staff. Everything went well and we agreed on an initial shoe project for Pony. It was a strong and rewarding relationship between our companies and it lasted for many years. We developed the most functional shoes in the world for them and, even by today’s standards, the shoe designs were excellent.

The long relationship with Pony and CITC involved several large projects associated with the design of new shoes. Our first research projects were to study existing basketball and tennis shoes. After we analyzed what was currently available and determined the force and performance needs of the players, we designed the optimal shoes for each of these sports.

The research for Pony and the CITC companies spanned nearly a decade from 1975 to 1984. Thousands of pairs of shoes were supplied for testing to CBA. Hundreds of data collection sessions were conducted at our laboratory, at the Olympic Games, and at national competitions. CBA had an enormous data bank for athletic performance and for the shoe requirements in order to develop the best shoes in the World.

In 1981, CITC contracted CBA to do additional research. They wanted us to construct baseball and walking shoes. In the meantime, CBA had received royalties on every shoe that was manufactured by Pony or any of the related companies which utilized our research designs. Our contract resulted in 10 cents for every shoe CITC produced utilizing the CBA research.

“Computerized Footwear” article as published in Canadian Footwear Journal
http://arielnet.com/ref/go/1118
Luckily, Korean shoe imports were still the primary source for athletic shoes at least for the mass market in America. Adidas and Puma were imported from Europe so we derived no royalties from them. However, those brands were more expensive which resulted in smaller sales volumes for them. Millions of shoes arrived in the U.S. from Korea utilizing our designs. The royalty stream allowed us to purchase new equipment including our own high-powered computer in our laboratory. Ann and I were not the personality types to spend money on fancy clothes or expensive cars. The money was returned to CBA. Our new partner, Larry Graham, was pleased that this was our philosophy and practice.

Besides contributing to our economic profitability, our research with Pony and CITC gave us national notoriety in leading magazines across the field. Pony and CITC approved each article and, frequently, they contacted the journals directly and suggest that CBA was an interesting topic for their readers. It was a good marketing tactic for Pony, to be sure.

One of the journals which the Pony staff contacted for an article was the Canadian Footwear Journal. The name of the article was “Computerized Footwear” and began with the following statement:

How one man's mind is thrusting athletic footwear design into areas which border on science fiction, but which are based on science fact.

Working with Pony, gave us access to many great athletes and we worked with them on their performance skills as well as trying to develop the proper shoes for their activity. Many of the shoes we
created were instrumental in helping people achieve world records. I will mention only a few of our unique shoes that were designed for these special people.

At that time, Mac Wilkins was one of the best U.S. discus thrower. We traveled to several international track meets to obtain kinematic data on Mac while he performed in actual competitive environments. After obtaining this film data and performing biomechanical processes on it, we invited Mac to come to our laboratory. Within our laboratory setting, Mac attempted to recreate the discus throw movements utilizing two force plates, EMG, as well as additional kinematic calculations. These were long, laborious procedures, but necessary if we were to design shoes for Mac that truly reflected his actual performance.
Mass meets machine—the computer tells all

FUTURE SHOE

BY JAMES C. G. CONNIFF

At as much speed as I can generate in such close quarters, I pound up the wooden ramp onto the rectangular-shaped force plate and across its hard white surface. By then, I am moving fast enough to crash into the laboratory wall, but Gideon Ariel reaches out and grabs me. We are conducting some experiments in the forces the body develops in motion. This lab is one of the most sophisticated anywhere for capturing, computerizing, analyzing and storing the data that emerge from what Ariel calls "rapidly applied dynamic load."

Right now, I am the rapidly applied dynamic load under investigation. As running enters the 1980s, laboratories supervised by exercise scientists such as Gideon Ariel will be able to determine exactly what happens to runners' feet, their legs, their bodies and their running shoes when they run. A decade ago this might have been mere Star Trek fantasy. But who ran then? Today, with the numbers of joggers and runners climbing beyond 30 million, everything about running—especially about running shoes—is big business. And in a biomechanical sense, exercise scientists, physiologists and podiatrists will tell you that we've barely scratched the surface.

The lab we are in is a storefront operation that jammed itself, back in 1971, between Radio Shack and Erik's Giant Subs on College Street in Amherst, Massachusetts. The sign out front says Computerized Biomechanical Analysis, Inc. Inside, the place hums with wall-to-wall electronics.

Gideon Ariel, a 6'2" Tel Aviv-born scientist with a Ph.D. in exercise physiology and extensive post-doctoral credits in computer science, got C.B.A. rolling by investing an estimated 10,000 hours over a seven-year stretch to devise the programs that tell his computer how to do the intricate things they do. Right now Ariel owns C.B.A., but he's thinking of going public in a few years. Besides athletic experience as a member of the Israeli discus and shotput teams at the 1960 and 1964 Olympics, he brings to his esoteric specialty expertise in the biomechanics of human performance, motor integration, cybernetics, and the physiology and biochemistry of exercise. His book, Optimum Body Power, will be published by Bantam.

Tying that force plate to the computer, programming the computer to analyze the body in motion and then interpreting the results are the guts of Ariel's work. With its West Coast companion, C.B.A.'s new multimillion-dollar Cato Sport Research Center at Cato de Casa near Los Angeles, Ariel takes on such prestigious assignments as computerized biomechanical analyses of whole teams such as the Dallas Cowboys, and serves as director of computer science and biomechanics for the United States Olympic Committee.

The rush at the force plate I have made is done to compare my running characteristics with those of my 25-year-old son, Mark. Mark is in contact with the plate for .4 seconds too long. He stopped at the plate, not an uncommon practice for people getting used to the unnatural laboratory environment. Even Bill Rodgers had to get used to it when C.B.A. tested not Bill's running style but the shoes he was wearing. Mark has a breaking force of only 47 pounds because he fails to stride through. His pushing force is, accordingly, slight—21 pounds. And he has a lateral force of 47 pounds because his body is not quite positioned over his foot. I come through with a striking force of 374 pounds (well over twice my 165-pound weight), and no breaking force at all because I follow through. I am on the plate only 220 milliseconds, and I exhibit 59 pounds of pushing force that almost smashes me into the wall.

To get a total picture of the myriad forces in action while running, Gideon says these experiments should be filmed at a rate of 200-300 frames per second. His computers can convert that picture into stick figures that show on the display the way the legs move in running at a variety of speeds.
In the discus throw, the athlete turns more than 360 degrees. This means that the rotational friction of the shoe sole on the rotating leg, which is Mac left leg, should be minimal. However, just prior to the release of the discus, the athlete should have no slippage either forwards or backwards. Any foot slippage or movement will result in a loss of energy. If the energy is not lost because of this foot movement, then the thrower can impart more force, or energy, into the discus. Providing that all other factors are correct, the result of great force on the discus should produce a longer throw.
With these frictional needs in mind, we designed a shoe that would minimize the foot movement in the forward and backward plane, but would not inhibit or reduce the spinning or twisting motion of the foot. Careful examination of the shoes revealed small dimples on the sole. These dimples were structured to provide minimal rotational friction but allow the foot to remain solidly on the ground while preventing forward and backward sliding. This shoe contributed to Mac’s world record in the discus.

Another shoe we designed for Pony was for sprinting. The sole of the shoe had a wedge, which kept the heel elevated. This provided two advantages to the sprinter. The first was to change the posture and balance by shifting the weight forward over the toes. Secondly, by elevating the bottom of the sole away from the heel, the runner was able to utilize the elastic energy stored in the foot and calf segments to rebound. Both of these advantages contributed to saving a few milliseconds on each stride. For a 100-meter sprint, this could result in a 300-millisecond advantage. At that time, such a shoe design was legal and is shown in the following photo.

For sports that require cleats and other traction devices, we used our technology to create shoes with the optimal location for the cleats. Activities that benefited from this optimization included long jump, high jump, baseball, and golf. An example of one of these shoes where cleats could be screwed into the sole just before competition or practice began is shown in the following photo.

The most popular shoe that Pony developed, based on our research and ideas, was the jogging shoe with the Variable Sole. The “variable” in the name reflected the two different parts and needs of the sole. The rounded dimples, or buttons, on the outer side and sole were for shock absorption which occurred when the foot initially hit the ground. The ridges or tractor-tread design under the ball of the foot was to provide traction during the portion of ground contact when the foot rolled toward the push phase. This part of the design increased traction on the ground during the time that less shock absorption was needed. The following photo shows the jogging shoe with the Variable Sole design.
During our years of research with Pony, we made many unexpected discoveries for them and their shoes. A few of these realizations were:

1. Sprinters have no need for spikes. The need for shock absorption qualities is also minimal because the body motion is vigorous and effectively counters the landing. The sole should be firm to enhance the push-off.
2. The slower pace of the long distance runner and a large number of repetitions of foot contact make friction, wear, and shock absorption extremely important. We recommended that the sole flex should allow a smooth convex curve as the heel moves upward.
3. Cross-country runners should wear the same basic shoe as distance runners, but with two additions. Because of the possibility of stepping on small projections (stones, ridges, etc.), the sole must have more rigidity for the distribution of the force. Uphill running causes the forces of impact to be entirely on the ball of the foot. Therefore, the sole should have better shock absorption qualities than the flat racers shoe.
4. Olympic walkers have the end of the heel make ground contact first with the toe high, just as the opposite foot leaves the ground. The time of double support is virtually nonexistent. The heel has almost no downward force when it touches for the first time because the motion is almost completely horizontal. The inner sole should be soft so the surface will shape to the toes. The uppers must be very flexible to adjust to the drop of the longitudinal and transverse arch. The shoe must be fitted firmly about the metatarsals and form-fitted to the heel without putting pressure on the Achilles' tendon.

In addition, a major change that should be considered for all track shoes was the implementation of a higher heel. It appeared that most manufacturers had reduced the size of the sole and heel in order to reduce the weight. However, weight should not be sacrificed without including appropriate shock absorbing replacement. Weight should be a significant factor with competitive shoes, which are used only for the race itself.

For athletes in training and for the average person who runs for fitness, weight reduction in the shoe should not be necessary. For athletes, the shoe weight should provide shock-absorbing protection. For weekend warriors, the shoe support should be increased to protect the skeletal system, as well as
increasing the energy demands. After all, the primary reason that most people give for running for exercise is to burn calories. Therefore, a heavier shoe which requires more calories for the exercise should be a desirable product rather than try to find the lightest shoe possible. This is straightforward biomechanical logic.

Other considerations for running shoes are that the sprinters’ heel should be lower than the heel for distance runners. In addition, the heel should be rounded on the outside-back edge as well as sharply edged and slightly higher on the inside of the heel.

Based on this extensive research, we designed optimal shoes for many different sporting events. Another idea I had would help Pony adapt to the many varieties and styles of the running foot. People vary greatly in height, weight, and shoe size. In fact, we had observed just in the subjects we tested, that it was not unusual to find slight size differences between the left and right foot. How could this accommodation be effected?

My answer was “Air”. This idea stemmed the automotive concept where tires are designed to fit the size and weight of the car or truck. Based on all the research that I had conducted with shoes over many years, it became clearer to me that athletes needed an Air Shoe. A shoe that could adapt to forces and weights in various activities would be an excellent choice for the person wearing the shoe as well as streamlining production for the company. In addition, air could provide the necessary adjustment in sizes and shapes. Air shoes could reduce the numbers of different shoe sizes and, thus, reduce the overhead costs for both manufacturer and retail outlets.

Early in the 1970s, I had first considered the use of air in shoes primarily for shock absorption. I had suggested the idea to Hans Brink, Mr. Vogler, and Adi Dassler of Adidas in one of our initial discussions with them.
discussions. Adidas had manufactured a shoe with bubbles with air inside the sole, the Adidas 72, which was the most successful jogging shoe in the world at that time. However, these were token air pockets and not scientifically designed to provide any particular shock absorption. Adidas did not pursue the idea of Air Shoes using my diagnostic procedures primarily because of the cost of the development and expected sales price.

**Ariel Performance Analysis System**

Shortly thereafter, I was the consultant for Tiger Shoes, which was one of the CITC companies, as was Pony. I presented to them the idea for air in the shoes in the same fashion that I had previously presented to Adidas. Tiger was more receptive to the concept which Adidas had abandoned. To test the concept, we made an inflatable air bladder similar to an insole which could be inflated according to the specific need of the athlete. This bladder was designed with valves that allowed air to flow from one area to another. For example, air initially in the heel would support foot strike and then the value would allow the air to move forward and support the ball and toes of the foot for takeoff. This movement of air through one-way valves allowed a dynamic reaction to the athlete’s movement, rather than rigidly determined or fixed air pockets. We made many prototypes according to where the athlete landed on the foot. Some of the athletic events produced greater shock absorption in the heel and others had more in the ball of the
foot and near the toes. We tried to optimize the best location for the air based on the athlete’s running event. Then we tested the response of the air bladder within the shoe utilizing the mechanical leg and hydraulic test equipment on the force plate. For different events, we needed to have different structures. Once we perfected the locations for the air and the valves, the bladder would be built into the sole rather than merely an insert. Every shoe would then have an external valve to inflate or deflate as needed by the athlete. This would accommodate the athlete, the event, and size differences. It would also reduce the need for so different sizes that shoe manufacturers had to produce and would, also, help every person adjust the shoe for each foot.

My work with Tiger Shoes was well before Nike, as a company, even existed. I was not the only consultant working with Tiger Shoes. Another one of Tiger’s consultants was Bill Bowerman from Oregon. Eventually, he left Tiger and started Nike Shoes. Later, Phil Knight joined Nike and the company has soared.

When the information was first published in the newspapers, many people laughed at the idea. I was frequently asked, “Gideon, does that mean when you buy a jogging shoe you need to buy three, in case you get a flat? Or should I run with a pump to fill up the air?” In fact, *Sports Illustrated* published the following sketch

However, other publications, such as *The Runner*, thought it was a good idea.

An independent manufacturer was interested in producing air shoes for me. One of the models is shown below:
The Ariel Air Shoe 1974

The shoe had a specialized bladder in the built-in inner sole, which could be inflated and deflated through an external valve at the back of the shoe. The bladder was especially designed to allow air to flow from one air pocket to another pocket via one-way valves. In this manner, the air was moved by the athlete’s impact rather than being located in static, unchanging bubbles. It was a fantastic concept and is still is a great shoe design. However, the manufacturing costs would have exceeded those for a non-air shoe. Over the years, we have never found a shoe manufacturer willing to produce the adjustable Air Shoe. So, the best shoe in the world died, as so many good ideas perish, on the pyre of economic considerations. I continually dream that, in the future, some company will decide to manufacture it.

http://arielnet.com/ref/go/1123
By this point in time, our notoriety had spread around the world. Our phone rang incessantly with urgent requests from companies imploring us to help in designing their particular shoes. One was the Brown Company located in Boston, Massachusetts, requesting assistance with the design of their nursing shoes. Our friends from Spalding sought our input on designing a non-specialized shoe for the average person. The UniRoyal Company wanted assistance in improving their basketball shoes and Dr. Scholl searched for studies to improve their sole inserts.

We were working on one of the shoe projects, when one evening I received a telephone call at home late at night. The voice on the phone identified himself but it was not one that I recognized. He asked many questions about Biomechanical analysis and, based on the questions, I was sure it was one of my students. I assured him that all of the questions would become clear as the semester progressed provided he attended every class. Ann was walking around the kitchen listening to my side of the conversation. As I looked more and more confused by the conversation, I decided to ask, exactly, with whom I was talking. I repeated his name out loud for Ann to hear, “George Allen of the Redskins”. Ann’s eyes widened with surprise and she indicated that he was the head football coach. In my own defense, I was familiar with soccer, not American football. Furthermore, I was clueless regarding professional teams, players, or coaches. I responded with, “Are you some kind of coach?” The response nearly floored Ann, a devoted fan, but seemed not to deter Coach Allen. He replied that he was indeed the head coach and he invited me to visit his training facility in the outskirts of Washington, D.C.

We arranged a time and Ann and I flew to the meeting. The next day, one of the assistants drove us from our hotel to the meeting. We had a lengthy discussion with Coach Allen and he was particularly keen to analyze his place kickers. We agreed on a project and left to return to Amherst. It was a short project which we quickly completely and sent the results to the team. A copy of the letter with Coach Allen’s likeness at the top is reprinted here:
Dear Gideon:

Thank you for your recent letter sent to Bill Hickman. Enclosed is a check for your expenses submitted for your visit to Redskin Park.

Keep me informed if you have any other suggestions. We can take the time to go into a lot of facets of your program -- I am more interested in the things that I mentioned to you.

With best regards,

George M. Allen  
Head Coach and General Manager

In addition to all of our shoe studies, CBA also attracted many other types of projects. One day, we received a phone call from a visual specialist who asked about our thoughts on baseball skills. It transpired that he was working on the pitching and batting skills of the Kansas City Royals. He believed that a baseball batter had to continually switch from side vision to forward sightings prior to the ball being pitched. How successful the batter was in mastering this alternating vision and being able to track the ball after the pitcher threw it, determined the success, or lack thereof, of his hit. The specialist had a battery of tests which all of the players took and practiced in an effort to improve their hitting skills. We designed a research project to examine the coordination between the pitcher and the batter.

In this study, we focused our attention primarily on comparing Steve Busby and Doug Bird, who were pitchers for the Kansas City Royals. The goal was to examine the patterns of motion in throwing a fastball and a curve ball and to evaluate the batter’s response to each of these two pitches. The KC Royals arranged for us to film a game against the New York Yankees in NYC on July 14, 1973. We had to design a unique filming system using mirrors on each camera so that every pitch showed the pitcher and the batter, simultaneously, in the same frame of the 16 mm film. By using the mirror system, we could coordinate the movement of the pitcher, exactly, with those of the batter.

As mentioned previously, this was in the days before instant digital video recordings. We filmed the two pitchers during the game and then took the film back to Amherst for processing. I must confess that I have no idea who won the game that day since my main focus was on acquiring good, clean, useful film data. In the days that followed, we performed our biomechanical analysis on the two pitchers. In addition, we processed data on the batters to detect any information on how they watched the pitcher and attempted to track the pitched ball.

Our results revealed that Busby demonstrated an extremely good pattern of using his body segments efficiently. His front shank and thigh decelerated abruptly just prior to the release of the ball contributing to the speed of the hand and ball. Busby used his knee extensors throughout the throw, as well as using his front leg to good effect. However, he tended to lose his thrust, just before the release, when delivering his fastball.

The biomechanical results for Doug Bird indicated that, although he was also efficient, he did not use his body’s link system as well as Busby did. He produced the same deceleration pattern as Busby, but with less magnitude. Bird’s deceleration was not as abrupt at release and this resulted in a less efficient pattern. In addition, Bird failed to fully use his knee extensors.

We concluded that the magnitude of the elbow extension differences indicated that Busby was the stronger man. Bird needed to improve the strength in his upper body segments which would allow him to increase the velocity of his throwing hand. Busby’s throwing sequence was almost perfect. He used his front leg to the maximum potential possible. He was 25% stronger than Bird, in the force of the direction of his throw. Bird needed to strengthen his body to achieve a stronger throw.
In addition, we determined that the throwing motion for both pitchers relied on the strength and timing of their lower body segments. With strong leg and trunk segments, the pitcher could plant the front throwing leg which would abruptly stop the forward motion. The forces would transfer through the arm and allow the ball to gain additional speed. Much like a car hitting a wall, which throws an unrestrained driver through the windshield, stopping the leg and trunk abruptly allows the forces to transfer through to the ball.

Now both the players and their coaches understood more about them as players and about the intricacies of pitching. In addition, the vision specialist had more information to help the batters, as well. As with most of our CBA projects, much more information was gleaned than anyone imagined before the studies began.

It was at this time, that my father, Moshe, decided to travel to America to visit me. His plane was scheduled to arrive in JFK one afternoon in the spring of 1975. I was extremely nervous about his visit since my emotions were at war with positive as well as negative thoughts. On one hand, I anticipated the pride I had to show him my many accomplishments in academia as well as in my business and personal life. Despite these many accomplishments, I was unable to shed the shadows of my childhood experiences of his denigration and disapproval of nearly everything I had ever wanted or accomplished. However, Ann and I prepared for his visit as best we could.

We drove to New York in my VW camper. I paced the terminal floor anxiously while I twisted and turned to stare at the door as each new arriving passenger emerged. After a very long time, my father finally appeared looking weary and haggard after his long flight. Many hours later, Ann confessed that she had been surprised to see me approach the tiny man who had struggled out of the customs area with his huge suitcase. Her assumption was that I was inquiring about how many other people were still in the line behind the customs door. She could not imagine that the large, muscular man that she knew me to be could be related to the small fragile man with the enormous suitcase.

I introduced my father to Ann and realize that each of them had unreadable expressions. I picked up my father’s suitcase and off we went. It was a four-hour drive to Amherst which must have seemed even longer after his fourteen-hour flight. My poor father must have been completely exhausted by this point. A few days later, I learned that he had packed his suitcase a month before he began his trip and arrived at the Tel Aviv airport 6 hours before the departure time. This was typical of his personality to prepare meticulously, as well as allowing unfamiliar circumstances to overwhelm his logical sense of things.

We finally arrive at Poole Road. As we were winding our way through the budding green of the tree leaves and passed the few patches of brown more pronounced than the small patches of melted snow, my father asked with a very small voice, “Where is your tree house?”

I was confused by this question so I replied, “What tree house?”

His explanation was that since I lived on Poole Road that meant that I lived in the water so my house would have to be up in a tree to keep my household dry. I was speechless! We turned into my driveway and ahead was the cute, little red house set on the edge of the tiny hill overlooking the lake. Although my father never mentioned this again, I have no doubt that he was extremely relieved to learn that he would not have to climb a ladder into my home.
As his visit progressed, my father relaxed and enjoyed the natural quiet and beauty of my lakeside house. He was a quiet man with complex thoughts and emotions. He possessed amazing artistic talents which had never been realized. No one had ever encouraged him to peruse his artistic abilities and his workdays had consumed all of his time. It was during this visit that I realized how little we actually knew about each other. My father did not really understand the work we were doing at CBA. He attended the classes which I taught at the University, looked at the articles written by and about me, and studied the framed Ph.D. diploma on the wall. It was impossible to determine whether he was shocked, surprised, frightened, or proud, since he watched everything and said nothing. Sadly, for us, our past was greater than our future.

One interesting project was activated during my father’s visit. The United States Department of Commerce oversees the National Bureau of Standards. The previous year, the National Bureau of Standards had approached us regarding some specific questions about our testing procedures and the types of results that we could produce. After these extensive conversations with the professional staff, I was invited to Washington, D.C. I was asked to present the type of research that we conducted which was a truly unique application for the products for which they needed to establish regulatory standards. For this initial presentation, I was asked to present the methods we used to measure human performance in sports, industry, and normal life activities. In addition, I should show some examples of research we had conducted and some of the apparatus that we used to analyzed products or performances. After that presentation, we could focus on the scope of the research they wanted us to conduct for them.

Ann and I recognized that it would be a fantastic opportunity for my father to accompany us to Washington. He would have a chance to see one of my presentations and we could treat him to some of the special tourist sites that are available there. As usual, he was slightly apprehensive about the new twist in his life but he agreed to go with us.

After the relatively short flight from Hartford, Connecticut, we arrived in the Capitol of America, Washington, D.C. We stayed at the Hyatt which was a luxurious hotel close to the center of the city. It was also conveniently located near the location of the lecture on the following morning. After dinner, we rode the elevator upstairs to our rooms. I had a room with Ann and my father had his own room adjacent to mine.
to us. The following morning, I knocked on the door of my father’s room. Nothing happened, so I turned the doorknob and discovered that the door was not locked. When I opened the door, I saw my father seated on one of the beds dressed as he had been the night before.

I asked him, “Father, how did you sleep?”

“I did not sleep,” he answered.

“What? Why not?”

“Well he did not show up,” he replied to me.

“Who did not show up?” I asked.

“The other man,” was his reply.

“What other person, what are you talking about?” I asked with mounting confusion and consternation.

My father pointed to the bed which was beside the one on which he was perched. As was common in hotels, his room was appointed with two twin beds. Since my father had neither experience nor a rational explanation for a second bed in a room for only one person, it was beyond his wildest imagination that he would be in a room alone with the second bed available yet unoccupied. With no perspective of travel in a modern world, he could not imagine that the second bed would be unused. No hotel would be so foolish to waste a bed. My poor father; despite being 75 years old and moving to Israel as a young man, still lived in the Poland he had left in the 1920s. He had never been in a luxurious hotel nor experienced a room with two beds just for him. Unfortunately, we still had to continue with our scheduled presentation at the National Bureau of Standards despite my father’s lack of sleep. Despite his fatigue, my father appeared very attentive to my presentation and the subsequent question and answer period which followed. It was surely an interesting day that allowed him to see his son working and exchanging ideas with scientists and government officials.

Not surprisingly, my father was quite tired by the end of that day. That night, however, he slept extremely well in his newly discovered luxury of two beds in one room with both of them for him. The next morning when I knocked on his hotel room door, it was locked. When he opened the door, I saw that he had used the second bed for his clothes and his suitcase.

We spent the day at the Smithsonian Museum. His favorite section was the “Air and Space Museum”. When he was presented with the opportunity to touch the space shuttle and the capsule, which had landed on the moon, he was speechless. He expressed no desire to see the antiquities or historical sections since he was only interested in the newest scientific displays. In spite of his lack of experience in travel, he was very progressive in his modern and technological interests. He expressed interest only in things of and about the future and disdain for antiquities and things from the past.

Years later I visited my father in Israel in his apartment. After the visit, I was walking down the street and encountered one of his neighbors. We chatted about my life in America and then the neighbor told me about my father’s impressions of his visit with me. After he had returned to Israel, he described
my house, the beautiful New England countryside, and his trip to Washington, D.C. His biggest surprise was associated with the National Bureau of Standards. “You would not believe it, but my Gideon talked to the U.S. Government. This is okay. But what I could not believe was that they listened to him!”

After the presentation to the gathering of experts at the National Bureau of Standards, we discussed some specific needs that they wanted to address. These discussions resulted in some of our more unusually unique biomechanical studies. One research project was to analyze and redesign paper matches. Paper matches are enclosed in a “matchbook” or “matchbook cover” which is a thin cardboard covering that folds over match sticks in a “book” or “pack” of matches.

The matchbook covers have been used as a form of advertising since 1894, two years after they were patented. Since then, matchbook covers have attracted people who enjoy the hobby of collecting. Many historians point to the Mendelson Opera as the first to use matchbooks for advertising purposes. They hand wrote their promotional information on blank matchbook covers made by the Binghamton Match Company between 1893 and 1894. Inspired by the Opera’s innovation, Diamond Match salesman Henry Traute began approaching manufacturers to advertise their products on his company’s matches. His sales pitch was that companies could use them to promote their product. Since matches were used frequently during the day, the company’s product would be viewed by their users many times a day. Among the first companies to order advertising matchbooks were Pabst beer, American Tobacco Company and Wrigley's Chewing Gum. Mr. Traute also encouraged his customers to give away matchbooks as a promotional item.

When the National Bureau of Standards approached us for assistance, the design for paper matches continued to be a folded cover with the matches arranged in rows inside above an abrasive strip. There were advertisements on the outside and back covers for everything from hotels, to restaurants, and various products. The cover of the matchbook flipped up to reveal the matches arranged horizontally across the bottom, almost like flowers in a garden, just above a corrugated striking surface.

Matches were developed with one end coated with a material that can be ignited by frictional heat generated by striking the match against a suitable surface. To use a match required merely tearing one of the matches from the row, closing the cover, and striking the head of the match against the strip to ignite it.

The impetus for their attention was the frequent episodes of fires which resulted from repeated efforts to ignite a match. When there were fewer than five matches remaining in the package, the striking surface had usually been worn smooth. Thus, rather than providing a sufficiently rough striking surface, the head of the match slid across the surface without igniting into flame. In addition to the increasing smoothness of the striking surface, the paper match itself began to deteriorate with the repeated efforts to ignite it. Therefore, as the match became weaker and more flexible, people would grip it closer to the head of the match and continued striking it across the less-than rough surface. By the time that the match finally ignited, the fingers were gripping the match too close to the flame, the fire would burn the fingers, the match would be dropped, and fires ensued.

Subsequently, after we completed our biomechanical research on match striking, we suggested two main solutions. One solution to this problem was to add a stronger material to the matches so they were more resistant to bending during the striking action. The second recommendation was to increase the amount and/or roughness in the striking area. These changes would reduce the weakening of the match during the striking process and, hopefully, reduce the chance of burning the fingers or causing a fire.

The National Bureau of Standards had a second project which had initially seemed strange and unusual, but we soon learned that it was a practical and safety-related assignment. The study was to evaluate the current shape of ketchup bottles and determine if their proportions could be biomechanically altered to produce a safer container.
Once again, the impetus for the study was the surprisingly large numbers of injuries resulting from ketchup bottles slipping out of the hand while attempting to shake out the ketchup. The situation rarely occurred when a new bottle was opened because both the bottle and contents were at room temperature and the ketchup flowed quite easily in this condition. However, when someone took a glass bottle of ketchup from the refrigerator, there was usually a different result.

Usually, a ketchup bottle is taken from the cold climate of the refrigerator and placed on the table or countertop where normal thermodynamic reactions occurred. The warm air and the cold bottled contents produce condensation on the outside of the bottle. Two other factors influencing the situation are the density of the cold ketchup and the size of the mouth of the bottle. Thus, it is a confluence of factors which prevent the contents from easily exiting the bottle. Since the cold ketchup is less fluid, it resists pouring. It is almost an automatic reaction to attempt to shake the contents out with short, violent shakes or hit the bottom of the bottle with the palm of the other hand. Unfortunately, in normal conditions, the bottle will have become slippery with the condensed moisture, so that the shaking motion frequently resulted in the bottle flying from the hand much like a spear. The Bureau had a surprisingly large number of injuries resulting from parents unintentionally losing control of the bottle and launching it at their children.

Following our analysis of ketchup bottles, we presented our results and some suggested remedies. Why not change the shape of the bottle or use one made of plastic? However, one of our subsequent studies revealed that, regardless of the brand used, people insisted that ketchup always tasted better from a glass bottle rather than from one of plastic. This was a factor that each ketchup manufacturer would have to address.

Another of our recommendations was that manufacturers design the mouth of the bottle to be slightly wider so that the ketchup could flow out more freely thus alleviating the need of aggressive shaking. It is a rewarding comfort that many of the modern ketchup bottles are made from squeezable plastic materials.

The third project with the National Bureau of Standards involved the slippery conditions on kitchen and restaurant floors. Normally, kitchen floors are smooth and easy to clean with soap and water. However, spilled food and beverages which are found in kitchen preparation areas lead to slippery walking conditions. Workers, carrying trays laden with dishes full of food or stacked with dirty plates and utensils, frequently executed quick turns or merely step on a slippery area which results in falls. On the other hand, the restaurant’s dining areas are often covered with rugs. Thus, the shoes of food service personnel needed to have good slip resistant soles for walking in the kitchen and smoother bottoms for moving about the dining area.

This was a project that was easily accomplished with our video technique of filming the activities in actual settings as well as using our hydraulic force platform testing equipment on the shoe sole materials. We presented our results to the Bureau and they were able to determine standards for restaurant working environments. In additions to recommendations for shoes, we suggested that in the slippery areas in the kitchens, it might be appropriate for grooved mats to be used. These mats should be less slippery when wet, yet be washable to keep the area clean and sanitary.

While we were working on the various National Bureau of Standards projects, I received a call asking me if my company could analyze bodily contours. It transpired that the woman was calling from Kimberly Clark in Nina, Wisconsin. I told her that we could measure any surface with dimensionality, regardless of whether it was a human or an object.

Letter to Kimberly-Clark
“Can you measure the contour of a nose on the face?” the woman inquired.
“We can try,” I answered, a bit perplexed by the question.

We arranged a convenient time for her to visit our laboratory in Amherst. The woman was Dr. Elaine Jeveli, and, coincidentally, she had lived in the small city next to Amherst, Northampton, for many years before moving to Wisconsin. We chatted briefly about our shared local experiences regarding restaurants and traffic patterns and then got down to the purpose of her visit.

We were surprised to learn that the information that she needed was not for the face. It transpired that her task was to improve the fit and function of feminine hygiene products. Because the female body has irregular rather than smooth continuous shapes and dimensions, as well as undergoing dynamic changes during normal movements, feminine hygiene products were frequently less efficient than desired. Her goal was to ascertain whether the differing shapes of the female and their movements changed the products in consistent ways. If they could design the product to fit better and perform more effectively, then the company and its clients would be more satisfied. This was certainly a new and different kind of challenge for our company. The letter to Dr. Jeveli follows.

There were separate considerations for providing answers to the questions posed. One portion was to measure the product itself from three orthogonal dimensions. The second issue was to determine how the product was altered or deformed under specific movement sequences by the woman wearing them.

Initially, we had to devise a method to quantify three-dimensionality. This had never been done, so we were faced with a truly unique challenge. Fortunately, we had some extremely talented physicists and engineers who were able to design a static test apparatus to quantify the three dimensional aspects of
each pad. They designed a special calibration frame, with the pad placed in the center, which allowed the calculation of all angles from each orthogonal coordinate. A photo of the apparatus and one sample is shown.

![Apparatus and sample](image.png)

Pads instrumented with micro load censors to measure pressures inside the pads

Following the quantification of the three-dimensional contours of each of the products to be evaluated, we proceeded with the tests to determine functional deformation. Specific tasks were devised that could be performed by each woman and could be consistently duplicated between and among the test subjects. The tests included sitting on a firm chair, sitting down and getting up from this chair, walking, and climbing stairs. Following each of the tasks, we photographed the product to determine the deformation. Following the tests for each of the individual tasks, we combined all of the movement tests before evaluating the products again. We found that the process of sitting down and standing up created the most pronounced changes in the shape. With deformations to the shape, functional effectiveness was reduced. These results were communicated to Dr. Jeveli and she was more than satisfied with our findings.

Following our tests, we were invited to Nina, Wisconsin to present our biomechanical methods. After the main presentation, we were asked to comment on their on-going baby diaper evaluations. Their procedure was to have women from the surrounding area come to their test facility to evaluate the
behavior of their infants. Each child was diapered with cloth diapers as well as with various company products. For each individual diaper product, the mother was asked whether her child looked comfortable.

Our suggestion was for them to evaluate the baby’s movements in more scientific and quantifiable ways. They should film the babies walking with no diapers, as a baseline, and then film them as they walked with each of the different diaper choices available. They could block the identify of each child to properly protect the children’s privacy and then perform biomechanical analyses for walking naked and for each of the diaper options. Following this testing protocol, they would be able to quantify actual human movements rather than base their decisions on observation or subjective opinions. Our understanding is that they proceeded to devise more objective testing methods based on our recommendations.

Our research projects brought us income, in addition to, credibility and some excellent publicity. By 1975, CBA Inc. was financially able to purchase almost any technology wanted or needed to improve our methods of analysis. We were frugal in managing our business and never allowed expenditures to exceed income. With careful shepherding of our funds, we were able to purchase new digitizers which were more sophisticated than the first digitizer which I had invented. We purchased additional force plates, EMG equipment, and faster computer terminals with storage capabilities. It will surprise current readers that, at that time, a 5MB storage disk was a huge circular container approximately 2 feet in diameter, nearly 2 inches in thickness, and cost about $10,000.00 each. The memory bank to power and hold these disks was more than 8 feet tall and dwarfed the computer and the graphic terminal. The Analog to Digital (A/D) converter board for the Data General computer was 15 inches square and cost around $25,000. In today’s digital world, the same A/D board is approximately 3 inches by 2 inches and would fit on the screen of a digital phone.

One of our most amazing purchases was the Megatek Equipment Graphic System. This system allowed us to present our three-dimensional data on a display screen with exquisite and elegant movements. At that time, a three-dimensional presentation was possible only with hard-wired, elaborately constructed computer driven boards. With this system, however, our stick figures could be animated, turned to view from any perspective, and presented in a variety of different modes at a rate that was nearly real time. This Megatek System was extremely expensive, priced about $150,000, but it set our company apart and provided a uniquely attractive tool for our increasing number of television interviews. With all of this equipment, CBA was the most advanced biomechanical company in the world. Actually, we were the only biomechanical company in the world.

We were fortunate that we had enough corporate contracts to run our business and acquire new equipment as we grew. Although there were some universities with biomechanical programs, they usually had minimal equipment, most of their tools were older, and most departments were poorly funded. Because we were a corporation, we operated on our own funds generated by the work that we performed without concern for state-funded budgetary problems.

In 1976, I received a call from our old Spalding friend, Egon Rahmacher, congratulating me on our new equipment. He wanted to meet so we set a time and showed him our new equipment and demonstrated some of their applications. During our discussion, he told me he wanted to conduct a major project analyzing tennis balls. There were so many questions about what actually happens to a tennis ball when it impacts the racket and when it hits the ground. For example, how long does the tennis ball remain in contact with the racket and how long does it stay on the ground? How much velocity is lost between the impact with one racket and when it hits the opposing racket? What is the coefficient of friction with the ground and with a variety of different surface materials? How does the Spalding ball compare with its competition? These were just a few of the many questions that arose during our conversation.

We agreed upon a number of questions that Egon wanted to investigate. Because of the scope of the project, we told him that we would design some research protocols and discuss them with him next week. My staff and I discussed the most important factors to be studied, equipment that would be
involved, and outlined the tests to be performed. Egon agreed with all of our suggestions and told us to proceed.

The first thing we needed was a special ball-throwing device that would allow us to control the speed, direction, and spin of the ball. Then we had to design the laboratory setting that allowed us to record the flight of the ball and its force responses on the force platform. We could control the actions of the ball with this sophisticated ball-throwing machine. By changing the surfaces mounted on the force plate, we could examine the ball’s behavior when different materials were hit. Based on our initial results, Spalding could, then, design a new tennis ball taking into account the data that we acquired. The final test phase would be to investigate whether the newly designed Spalding tennis balls had favorable characteristics compared with other brands of tennis balls.

**Analysis of Products**

Analyzing many products

http://arielnet.com/ref/go/2010
Digitizing World Record Holder in the Javelin

The APAS System
http://arielnet.com/ref/go/1124
New Computer and Electronic Equipment
http://arielnet.com/ref/go/1125
The first evaluation began with a dynamic test to measure impact conditions on the ball, racket, and various tennis court surface materials. We used a specially designed and controlled ball-throwing device to shoot a tennis ball at a tennis racket that had been fixed in a special mount on the force plate.
The speed, spin, and direction were programmed to duplicate those of actual tennis performance which we had calculated from actual games. We had studied both professionals and amateur players so we were able to apply appropriate values to obtain realistic results during our current ball and racket tests.

The racket response and ball impact were filmed with a specialized camera that filmed at a rate of 10,000 frames per second. The camera was so rare and expensive to operate that we actually hired the owner of the camera firm and one of their trained technicians to operate the camera for us. Each ball test shot utilized an entire roll of film and took only three seconds to shoot. Because of the uniqueness of the camera and the difficulty in operation, we would have used our entire filming budget just learning how to operate the camera. It seemed like a small price to pay to rent the camera and the operator for a few hours of work. We were able to record the impact of the ball and detect the deformation of the ball and of the racket following each hit.

Our tests revealed that when a tennis ball strikes a smooth surface, it deforms significantly. The body of the ball spreads out while the top and bottom are flattened. Then the ball’s body continues to move in the direction that it had been traveling prior to impact. Whether the ball remains in one position on the surface or slides forward depended on the surface material. The higher the coefficient of friction, the less the ball slides; the lower the coefficient of friction, the more it slides.

In other words, on a stiff or rough tennis court material, the ball would hit and rebound with little horizontal movement. But on a smoother surface or when it hits a line, the ball would hit, slide, and then rebound. In a situation when the ball hits a line and slides, two observers could have totally different reactions. In one case, the ball would be called in or good, while the other person might see the ball as being out. Actually, they would both be correct. People do not actually see the ball hit the ground. They watch the ball as it moves through the air and the trajectory that the ball follows is what is detected visually. Thus, the incoming angle could indicate that the ball landed inside or possibly on the line. But after the ball deforms and slides along the ground, the out-going angle would reveal that the ball was outside the line and be called out. It is quite difficult to see where the ball first impacts the court and where it leaves. This situation has produced many heated discussions between players and umpires. The more modern system with instant replay and challenge systems have helped to resolve this situation.

We also measured the velocity of approach, the rebound angle, the rebound velocity, and the coefficient of restitution, which is the ration of the velocity of approach to the velocity of the rebound. We studied kinetic measurements of the forces, moments, holding time, momentum, and friction. All of these factors would affect the player’s ability to hit and return the ball and, frequently, determine the individual’s personal enjoyment or frustration with the game.
Our research revealed that faster, or livelier, tennis balls are not necessarily a desirable factor for the tennis game. Test results indicated that a tennis ball with a longer residence time on the tennis racquet was easier to control. At the same time, a longer flight time after rebounding from the surface enabled the player more time to react to the shot. The experimental results combined with antidotal comments by the players we interviewed indicated that most players enjoyed playing tennis when there were more hitting rallies rather than quick service games without forehand or backhand interplay. Using these results, Spalding designed a new ball with different internal pressure.

Based on our studies, Spalding designed a new tennis ball with specific characteristics. The hardness of the tennis ball was an important component of its behavior, particularly, since playing surfaces significantly affected the behavioral characteristics of the tennis balls. They also created the ball with more density in the core and the felt outer core covering which reduced the internal ball pressure. The interactions of materials enabled the ball to retain its playability and eliminated the need to ship or store the balls under pressure. This greatly reduced the cost of manufacturing. Spalding named their new ball “Australian” and it was very successful. We were quite pleased as well when Spalding rewarded us with a royalty of one cent on each ball that sold.

We could conduct all of these projects with a staff of five and enlisted university students to help us process some of the routine data processing when necessary. It allowed the company to function very efficiently. We could use our highly-educated staff to design and interpret the data while relying on students for much of the most mundane work. The students worked hard but were happy to receive the lucrative financial reward that we provided.

That year, I had a joint appointment in the Exercise Science Department and the Computer Science Department which gave me access to amazing levels of intellectual and academic power. If I needed any help in the area of engineering or computer software development, I could easily find it. There were other advantages, as well.

One advantage of my joint appointment was that I could take both undergraduate and graduate courses in any area that intrigued me or seemed necessary to improve my background for biomechanical work. I decided that I needed to take all the basic engineering courses including Statics, Dynamics, Strength of Material, and Hydraulics. I also considered it important to take the undergraduate prerequisites in Physics before I proceeded with the graduate classes.

One of the pre-requisite math classes was Numerical Analysis and was taught by Dr. Albert Storey. My experience with math classes was that they were taught by quite, calm, staid professors writing lengthy mathematical proofs on the blackboard. Normally, I was able to copy the equations from the blackboard and study them at home. However, all of my math class experiences flew out of the window in Dr. Storey’s class. Albert Storey was young, dynamic, and very enthusiastic about his subject. He was my first professor who seemed to bounce rather than walk. He jumped and hopped up and down as he moved around the room all the while continuing to elaborate on the day’s mathematical concepts. He even jumped up onto the desk and held some of these imaginary sets of numbers in the palms of his hands and waved them in the air. I believed that, to Dr. Storey, these imaginary sets were actually real. I do not mean to imply that I thought he was crazy but he was so immersed in his subject that these sets were as realistic as he could make them, in order for the students to comprehend the mathematical idea he was presenting. However, his most difficult tactic for me was that while he wrote equations with his right hand while he erased the board with his left hand. This forced me to learn how to write very quickly! Dr.
Storey was the most animated person I have ever seen teaching any subject matter but to be so enthusiastic about mathematics was truly unique. If all teachers were as excited about their subjects as Dr. Storey was, more students would be enchanted and captivated about learning.

Dr. Storey gave mandatory quizzes every Friday. If you missed the test, you automatically received an “F” without exception. After a Wednesday class during the fall semester, I informed Dr. Storey that I would be out of town on Friday at a conference and would miss the quiz. I inquired whether there was any way that I could take the test early or the following Monday. He was unsympathetic and presumably did not believe my explanation regarding my absence.

“Bring me a copy of your talk and the details about the convention. I’ll look through the material and see if there is an acceptable justification for your absence,” he told me skeptically as he walked off in the direction of his office.

I hurried to our CBA office to prepare the papers. I printed the research papers that I was to present and all of the details about the convention. Included was the program listing and I circled my name in the two sessions where I was presenting. I also included the thesis for both my master’s and doctorate and 15 of the articles that I had published as of that time. I put all of this material in a large envelope and delivered it to the mathematics department office for Dr. Storey. Then I left for the conference.

The following Monday I went to the Numerical Analysis class, as usual. When Dr. Storey entered the classroom he shouted “DR. ARIEL!” several times, very loudly. I sat wide-eyed and silent not knowing what to do. “DR. ARIEL, why didn’t you tell me who you are and what you have accomplished? You do not have to come to class and you do not have to take any of the quizzes. I am honored that you attend my class,” he continued.

I was amazed by this response and I must have blushed a bright red with his outburst. I assured him that I wanted to take the class to learn the information and that the quiz was a good way to determine whether or not I actually understood the concepts. He proceeded with his lesson but, after the class, he apologized for what he thought was an insult and I assured him that I was not offended in any way. Plus, I told him that I enjoyed his class very much and was learning quite a lot from him.

Another undergraduate class I registered to take was in engineering and was taught by Dr. Paul Tartaglia. Professor Tartaglia assigned the class five homework problems at the end of the first class. Instead of using a slide rule, paper, and pencil, I decided to solve each problem by writing a computer program to do the necessary mathematical steps and used a simple BASIC language for the code. My idea was that if I was able to determine how to solve the engineering problems using the step-by-step logic that computer programs require then I could be assured that I understood the problem as well as the underlying Physics Principles. My goal for taking the class was not to obtain an undergraduate degree in engineering. My goal was to understand the Engineering and Physics. I submitted the assignment printed on the yellow paper which all computer terminals used at that time.

At the beginning of the next class, Professor Tartaglia called me up to the lectern.

“This is cheating,” he informed me holding up the yellow pages. “I assigned the problems for you to solve at home using your engineering book and slide rule. I expected you to write all of the mathematical equations which you used to arrive at the final answer. Using the computer to solve the problems was not an option. You will have to either do five new problems or receive an ‘F’.”

Needless to say, I was shocked at this response. I explained to him what I had actually done to produce the pages of answers that he held in his hand. I explained that to write the program for each problem was much more time consuming than merely solving the individual problem. For me, understanding the problem and the subsequent answer was much more important to me than to just follow some rules of computation. I stressed that I was interested in building a foundation of engineering and physics knowledge. This was the reason I was taking his class and why I had spent so much time on programming the assigned problems. I invited him to visit my CBA lab to see what we were doing for projects and what type of equipment we had.
Dr. Tartaglia learned, as Professor Story had found before, that I already had my Ph.D. Paul became quite friendly from that point forward. He was always willing to explain things that I asked. In fact, when I needed to construct the Cam for the Universal Gym Company, I hired Paul to do the calculations. After those projects, we hired him as our in-house engineer while he continued to teach at the University. Unfortunately, after about two years, he was offered a job at another university. It was one of those wonderful opportunities that only come along once in a lifetime so we reluctantly saw him leave although we were happy for his good fortune.

My life had become very full. In addition to our numerous CBA projects and the extra classes which I was taking, there was also my involvement with my joint appointment with the department of Computer Science. My focus in Computer Science was Cybernetics which is the interdisciplinary study of the structure of neurological regulatory systems. Cybernetics is closely related to Information Theory, Control Theory, and Systems Theory. Cybernetics is most applicable when the system being analyzed is involved in a closed-signal loop. In other words, action in the system causes some change in its environment and that change is fed to the system via information (feedback) that causes the system to adapt to these new conditions. Thus, the system's changes affect its behavior. This circular causal relationship is necessary and sufficient from a cybernetic perspective. I had learned about this area by taking classes from the head of the department, Dr. Michael Arbib. Dr. Arbib was a world-renowned expert in Neuroscience with a particular interest in the architecture of the brain.

I had taken nearly all of the courses in the Computer Science Department that were available to me and I was fortunate to have had Dr. Arbib teach several of them. Thus, he and I had enjoyed the luxury of spending many hours discussing the interrelation between the nervous and the musculoskeletal systems and how they should coordinate to produce movement. Dr. Arbib’s interest was how the brain structure and functions interacted to produce movement. My focus was on the resulting motions of this neurological structure and function. We concluded that it would be of scientific benefit for both of us to combine our strengths to investigate some activities that each of us could monitor or regulate from our own unique perspective.

The Department of Computer Science, under the innovative leadership of its Chairmanship, Dr. Arbib, received a number of grants leading to some amazing research studies. Even after all these years, I am honored and proud that our assistance at CBA significantly contributed to these studies. CBA provided of our equipment and expertise without compensation. My staff and colleagues at CBA were interested in the research and were more than willing to contribute time and effort merely for the good of science and as contributions to knowledge. Another aspect that has changed is that current day researchers are confronted with the monetary demands of test subjects. Having to pay test subjects was completely unknown during the 1970s since there was an altruistic environment on most college and university campuses.

I felt a personal obligation and responsibility to Dr. Arbib as an Assistant Professor in his department. I was able to use some of the research working towards a post-doctoral degree in Computer Science and I was considered as a Post-Doctoral student in the department in addition to my professorship. Dr. Arbib hired me in his department in coordination with the Exercise Science Department. The goal was to conduct research that would expand and diversify what each of us could do on our own. This more extensive perspective on the understanding motion would enable him to obtain larger research grants. One of these grants was for $700,000 to the University of Massachusetts was from the National Institute of Health (NIH).

The NIH research proposal was designed to study the logic of movement with a focus on the nerves in the cerebellum. The cerebellum (Latin for little brain) is a region of the brain that plays an important role in motor control. It may, also, be involved in some cognitive functions such as attention and language and in regulating fear and pleasure responses. However, its movement-related functions are the most solidly established. The cerebellum does not initiate movement but it contributes to coordination, precision, and accurate timing. It receives input from sensory systems and from other parts of the brain
and spinal cord and integrates these inputs to fine-tune motor activity. Because of this fine-tuning function, damage to the cerebellum does not cause paralysis but, instead, produces disorders in fine movement, equilibrium, posture, and motor learning.

The funding requested from the National Institute of Health was to provide a two-front approach to studying the cerebellum. One aspect was to create a computer graphics simulation of the spinal circuitry with both reflex movements and limb locomotion. The second portion of the study was to provide experimental data on the biomechanics of movement using the computer analysis of cinematographic records which I and my CBA laboratory could provide. At that time, our CBA laboratory was the only one in the world that could film movements and provide the orthogonal components of the displacement of the limbs as well as the velocity and acceleration of those parts. In order to more accurately arrive at a computer simulation of the brain’s activity based on movements, the internal controls could best be estimated if specifically measured data could be provided. That was the unique contribution that I was able to provide to Dr. Arbib and his Cybernetics department and colleagues.

Two professors at the Department of Computer Science were Dr. Spinali and Dr. Kilmar whose classes Ann and I had taken. Each of these professors was investigating a different aspect of neurological controls. Their investigations would provide some direction for the research studies to follow.

One of Dr. Spinali’s research studies involved three groups of cats. One group was blindfolded from the day they were born. A second group had one of their eyes covered with a vertical slit and the other eye was covered with a horizontal slit. Thus, the second group had some limited vision, but it was restricted to only the horizontal or vertical slits. The third group of cats was the control group which was allowed to experience normal vision.

Dr. Spinali let the kittens grow for a few months, fed them appropriately, and provided exercise on a mechanical treadmill. Then the young cats, unfortunately, were sacrificed in order to examine their visual cortex cells under the microscope. The researchers found that the visual cortex cells reflected the life-conditions they had experienced. The visual cortex cells revealed actual physical development in the vertical and horizontal arrangements consistent with their visual restrictions. Dr. Spinali concluded that our experiences really could create physical templates in our brain.

However, my most unusual, or perhaps unruly, research study was about to begin. The research was to analyze the coordinated limbs patterns in walking and running cats. Why does a cat move faster in a fast walk as compared to a slow run? What causes a cat to change the gait from slow to fast or vice versa? The research goal was to measure and evaluate the movement patterns associated with cat locomotion and try to determine the programming or neural architectural control for these animals. Perhaps brain patterns or understanding the neural controls of movements in feline locomotion could provide insight for a human.

I was teamed with a brilliant mathematical doctoral student, Ruth Malucci. She was working with Dr. Arbib as his doctoral student and research assistant. Her expertise was solving simultaneous mathematical equations. The goal of our NIH-sponsored cat study was to determine which movement parameter(s) a cat used in determining its gait. This required narrowing the number of elective choices the cat had and, thus, required solving the vast numbers of options in the mathematical equations of motions generated by the cat’s movements.

The first hurdle Ruth and I encountered was to convince our cat to run on the treadmill. I named the cat “Putzi” but responding to her name was one of her few cooperative activities. She, mostly, was inclined to hide under the treadmill rather than to run on it. Actually, the treadmill was an antique Ruth and I found in one of the lab storage equipment rooms and it sounded more like a garbage truck or a cement mixer than a treadmill. When the motor was activated to run the treadmill, the sound was so loud that the windows vibrated. Imagine the trauma poor little Putzi experienced and envision the confusion she must have had. We were in a quandary concerning what and how we were going to obtain gait data from a traumatized cat. We had arrived at a difficult and challenging point with no clear solution. Without a solution, we would have to stop the study before it even began.
I decided to introduce Ruth to Ann. Perhaps they, the two cat lovers, could find a solution to the problem. Ruth and Ann became close friends very quickly and Putzi and I were mere putty in their hands. Our collective decision was to try an entirely different technique to elicit movement patterns from the cat. We took Putzi to our CBA laboratory, turned her loose so she could explore the premises, and waited for her to relax. After she was comfortable in the environment, we used food to attract her from one end of our CBA lab to the other end. The situation seemed to work perfectly. All of us could function in this quiet, non-threatening laboratory and cat food proved to be an excellent stimulus for Putzi.

Subsequently, our testing procedure followed a regular sequence with each of us performing specified roles. I operated the camera, while one woman held Putzi, then released her to run to the food being offered by the other woman. Putzi was a quick learner and understood the food-running drill after only a few trials. From that point forward, she would very cooperatively walk or run to the food and, fortunately, on most of the trials, she stepped on the force plate during the trip. The major problem, after we had solved the training strategy, was to keep her interest in the food particularly as her stomach became fuller. Putzi willing ran, trotted, and walked for her food until she determined that personal hygiene was more important. Once she began her grooming process, we humans learned that the testing session was finished for the day.

While she seemed very happy to participate in our research study, Putzi did have some other, more independent, ideas. She produced three kittens! After they had been old enough to be without their mother, Ruth raised the kittens in her home. Eventually, these kittens grew up and produced more kittens until we had a total of twenty-two cats. They were all skilled at running across the force plate between Ann and Ruth. Perhaps a more apt description was from a human to their food. It would be nice to anthropomorphize their thoughts as contributing their efforts to science but I think it was really only about food.

The cats lived at the University in a special housing room just for them. Every Friday, Ruth would bundle all of the cats into carrying crates and drive to our lab. They would stay in the bathroom-storage room area until we tested them on Sunday morning. This worked well for all of us, since the CBA staff left for the weekend on Fridays and returned on Monday mornings. Ann and I worked every weekend so we were always there to make sure our feline family was happy and content during their weekends away from their University home. Every Sunday morning, Ruth, Ann, and I would film each cat as it galloped, trotted, and walked. Their rate was dramatically linked to their hunger level. By the time they were satiated, sitting and washing their paws and faces was the only task they were interested in performing.

Since Ann and I were the only CBA personnel in the lab during the weekends, we were more than willing to help one of our fellow graduate student friends in Physical Anthropology when he asked us to help him test his monkey, Daisy. Dennis, the student, was working on the locomotion of monkeys and wanted to measure the forces which the monkey produced during a jump and how the leap affected the growth of bone development. He had successfully correlated some movement parameters with his research monkey, Daisy. However, he needed some actual, quantifiable movement data to evaluate whether any of his theoretical concepts regarding causation of some of the bony structures on the ancient artifacts that he was studying were consistent with actual activity patterns. When Dennis asked if I could help him with the project, my answer was “Of course.” Little did I know what excitement would ensue.

On a sunny spring Saturday, Dennis and his assistant arrived at our CBA lab with Daisy, the monkey. Dennis was a huge man well over six feet, five inches. He had bushy hair and a full beard. Dressed in denim coveralls, Dennis resembled Paul Bunyan, the giant, mythical lumberjack but he had replaced his big blue ox with a monkey! Despite his enormous size, he was one of the gentlest, soft-spoken people I have ever met.

After we had gather in our laboratory near the force platform, Dennis described the different activities which he wanted Daisy to perform. One test that he wanted to measure was for Daisy to jump down from a table onto the force platform. The second test was for her to jump up onto the table. In addition to the force data, we would film the movements so Dennis could use the kinematic data to complete his study.
Dennis walked around our lab with Daisy on her leash so that she would become familiar with all the equipment and whatever else monkeys need to know in new environments. In the meantime, Ann and I set up the cameras, lights, and force platform controls. After everything had been arranged, it was time for Daisy to jump up and down from the table.

Unfortunately, things that humans want are not always what monkeys are inclined to do. We quickly learned that humans and monkey behavior are not necessarily operating on the same wavelengths. Dennis would try to have Daisy jump down from the table but Daisy was interested in jumping sideways, up towards the ceiling lights, or in any direction other than the one he wanted. We tried the other test but Daisy was not interested in jumping up onto the table either. Dennis and his helper offered her bananas and other monkey treats, but mostly, she was interested in going in every direction rather than up and down. Finally, she demonstrated her complete disdain for her handlers by jumping down onto the plate and performed a bathroom task! Yuck!

After this exciting lab experience, Dennis was quite embarrassed by Daisy’s performance. Of course, scientific research proceeded after a brief clean up. Daisy was more cooperative after her independent “performance” so we were able to record her leaps up as well as those jumping down.

Suddenly, the front door opened and in walked our CBA chairman and co-owner, Larry Graham. Imagine the shocked look on his face when he saw our sophisticated laboratory filled with a monstrous hairy human, a monkey screeching and jumping on a leash, and banana pieces flying around the room. Ann and I were speechless. After a brief moment, all of us regained our speech and began talking simultaneously. Finally, thoroughly shocked and confused, Larry held up his hands and we all became quiet. Larry said that he had just completed a meeting at the local branch of the bank and decided to drop in to say “hello”. He continued that he would just use the bathroom and be on his way.

Ann and I were flabbergasted and had no idea what to do or say as we stood frozen. We had never told Larry about the cat study. So, of course, Larry had nothing to prepare him for what was waiting in the bathroom. We held our breaths as he opened the bathroom door and out flew twenty-two cats! Of course, Daisy went completely wild! Dennis and his assistant had their hands full while Daisy tried to catch first one cat and then another. The cats were racing around the lab high and low searching for food. Ann and I were torn between hysteria and trauma. Larry stood motionless, speechless, and stared into the now empty bathroom. Slowly, as though in a dream, he turned. With a confused expression on his face and in his voice, he said he would go home and would see us on Monday as he walked out the front door.

Larry was back in the office on Monday and we had a good laugh following the explanation of the whole story about the cats and the monkey. He was a good sport about the whole episode and was
actually very positive about the contribution that CBA was making to science. We learned many years later that Larry had gone home, and walked directly to the bar for a big stiff drink! His wife, Muriel, asked him what was wrong. His answer was, “Don’t ask; you would never believe it anyway!”

After several months of data acquisition, Ruth confirmed that she had enough trials of each gait. The cats were allowed to hang out in their University home while she began the lengthy and laborious task of tracing and recording the values needed for her complex and complicated mathematical equations. She spent two to four hours every day and doubled that number on the weekends in our CBA laboratory processing the biomechanical data. She was a careful research investigator and meticulously recorded the velocity, acceleration, force, and timing for each trial for each of the cats. The long hours which we spent together solidified the already strong bond of friendship between the three of us.

Now that the data collection for the biomechanical data for the study was completed, Dr. Spinali wanted to de-cerebrate the cats. His goal was to determine whether or not the cats possessed spinal generators. The neurological concept of the spinal generator was based on the theory that there is automatic or reflex type actions resident within the spinal column which eliminated the need for higher-level brain or neural input to produce movement. It became clear that Dr. Spinali’s portion of the study from the NIH, which was providing the funding for the research we were pursuing, was totally unacceptable to some of us.

De-cerebration meant that Dr. Spinali would cut the connection between the spinal cord and the brain but not euthanatize the cats. After he completed his, to us gruesome research, then cats would be sacrificed. When Ruth and Ann heard about this aspect of the study, they were distraught, yet determined to save the cats. They subscribed to the concept that “these cats had already given their lives to science; they do not have to die for science.” There had to be a way to satisfy the NIH study proposal without killing the cats. We had to present a logical, persuasive alternative test which would produce the information required.

My suggestion was that instead of mutilating the cats, we would restrict the movement of the cat’s head by having them wear a harness or a visual blindfold to prevent the cats from seeing the ground. This visual “block” would create an environment that allowed the cat to move as normally as possible but prevent them from seeing what lay in or on the ground in front of them. Comparison between normal and visually restricted movements would be a better investigative comparison than intact, normal motion versus decerebrated gaits. The acquired data would reveal a more normal adaptation of their nervous systems to their movement experiences and whether there were differences in the gait parameters. Ruth’s mathematical equations would be based on data from intact animals rather than comparing normal and unrealistically abnormal ones.

We compiled a list of comprehensive and persuasive reasons explaining why the research study should be modified. Although our reasons were very personal and animal friendly, we believed that the resultant data would provide more realistic information regarding brain control mechanisms and/or decision-making. This was, after all, the goal of the research.

After several meetings with Dr. Arbib, he agreed with our modified research proposal. We then had to convince the NIH that these procedures would allow us to collect more and better information than by using the crueler method which had originally been proposed. The NIH committee sent to evaluate our study readily agreed to our rationale and well-conceived alternatives. Ruth, Ann, and I were so thrilled although the cats appeared rather blasé about their fate. Perhaps, they were as terrified as we were but were better actors!

We proceeded to collect the movement data using equipment to modify and restrict the cat’s vision. In addition, we added an additional activity. We created a depression in the floor, which was equivalent to missing a step for a human walking down stairs. The cat would be moving horizontally and, suddenly, the ground would be gone, just like a missing step. Needless to say, being cats, their locomotive skills allowed them to quickly recover and continue the path towards their food. However, we were able to record the kinematic parameters of this disturbed motion pattern.
The data collection was now complete using normal and impaired vision, as well as a physical disruption with which the feline brain had to cope. The results revealed some underlying principles in the neural control of locomotion in cats. This information provided some interesting challenges on how the human brain may control our movement when we are walking and running. Dr. Arbib was extremely enthusiastic about the quantity and quality of the research and excited about the neural architectural concepts which he could incorporate into his own research.

The study was submitted and accepted for publication in *Advances in Behavioral Biology* in 1974. The publication is shown in

We had collected all of the data we needed and our studies had been presented and published. It was time to find homes for our 22 beautiful cats. Ruth and Ann were determined to find a loving home for each cat. They placed advertisements in the local newspaper, called friends and family members around the U.S. searching for the right home for each of the 22 feline personalities. Eventually, they were all placed in welcoming, loving homes and Ruth and Ann were able to relax.

The research mission had been successfully accomplished. Dr. Arbib had extensive research findings to puzzle over in his quest to understand the human brain architecture in contrast to feline neural structures. Ruth received her Ph.D. and moved to Philadelphia to pursue a further degree. Ann was happy with her contribution to the NIH study and returned to work on her own Ph.D. I began to enjoy the extra time for my own work on Sunday mornings. Of all the participants, perhaps the cats had the best ending to the study although they were unaware of what their fate had originally been. Maybe the idea of cozy, comfortable, and loving homes can be more than a wished for dream.

After our cat research, CBA’s work made another unusual transition. If you had asked me at that time, as a former discus thrower, a biomechanical expert in numerous industrial applications and equipment design, as well as a recent student of feline locomotion what I knew about the violin, I would have answered that I liked listening to it. However, I never imagined that our company would find an

![Figure 1. An oscilloscope display of the vertical, horizontal, and lateral components of the force exerted by the cat during the trot.](image-url)
application in the field of classical music. Although I loved classical music and we listened to the local Public Broadcasting Station in our lab, I was surprised to receive a call from the famous violinist, Paul Zukofsky. He asked if he could visit our lab so we set a date in two weeks. I confess that I was puzzled about why he wanted to come to our lab with his violin.

Two weeks later, Paul arrived in our laboratory in Amherst. He explained that he had some grant money from Bell Laboratories in New Jersey. Things began to make more sense as he described the relationship between Bell Labs and music. Bell Labs was focused on information about sounds. This included any sounds from low frequency whale communication to high pitched violin notes. Paul, as an accomplished violinist, was particularly interested in studying specific violin performances such as executing some arrangements by Paganini. Paul had found that many violinists were unable to perform certain musical compositions. He pointed out that, to date, there had been virtually no integrated studies of such a highly complex skill as violin playing. As the hours passed and we discussed the issues that he had, I realized that his questions ultimately related to the limits, correlations, and constraints on the coordination between hands and arms when playing the violin. It became apparent that the biomechanical technique of evaluating a violin performer was not that different from analyzing a Shot Putter or a Discus Thrower. Basically, quantifying motion using our kinematic techniques was applicable to most movements. Our motto: “IF IT MOVES, WE CAN MEASURE IT” was appropriate for playing the violin as well as throwing the discus.

After a day of discussions, we agreed on the details for a research study. Mr. Zukofsky was confident that Bell Labs would agree to fund the study and we arranged for him to return to Amherst to perform. We made sure that he understood all of the equipment that he would need to bring on that day so that we could acquire all of the data in one session. He needed to bring his instrument, a music stand, and the sheet music that he planned to play. In addition, to perform the most accurate biomechanical analysis, the joint centers should be exposed as much as possible. This usually resulted in the study subject
in bare feet wearing only shorts and sleeveless shirts. Needless to say, this was not the normal attire for a concert violinist. However, to achieve his research goals, Paul agreed to most of our clothing requirements. Shorts and a sleeveless shirt were acceptable, but he insisted on wearing his concert shoes! Apparently, shoes really do, make the man.

In order to perform a three-dimensional (3D) analysis at that time, we had to film from three orthogonal perspectives simultaneously. The first two views were from the front and from the side. However, we really wanted to have an overhead view for the unique movements associated with playing the violin. Therefore, we would have to film outside, since we would have to place the third camera on the roof. Since the operator of the roof camera had to be suspended out and over the violinist, we had to hire a local building contractor to arrange the support mechanism. At last, the filming arrangements were complete. Now we had to have our violinist, Paul Zukofsky.

The day of testing was a relatively normal late spring day in western Massachusetts. That is, not too cold or hot and partly cloudy. Paul would have to stand on a pedestal outside our laboratory facing the busy road and play the musical segments that his study involved. We began the filming session with his first musical selection.

Imagine the scene as it unfolded: A storefront between a paint store and a sandwich shop on a busy road. Three groups of photographers with cameras, notepads, and signs to identify each of the trial selections. One of the photographers was suspended from the roof. Most importantly was the semi-naked man playing the violin.

Before long, the cars on Route 9 began to stop and watch this bizarre tableau. Soon the local police arrived to determine what was causing the traffic jam. They were initially skeptical but I assured them that we were performing research which could not be conducted indoors since we needed the overhead camera view. Finally, I convinced them that we needed only a few more hours to complete our work and then we could go back inside our office. The policeman understood our needs but he insisted on providing two officers to control the traffic. I have often wondered what language he used to write the notes of the day regarding personnel deployments.

After we had processed the film data, the results were fascinating to us and to Paul. Violin playing is a highly developed and coordinated skill. The music is created by arm and hand movements which are delineated by precise rhythmic and timing commands more so than many other human activities. For instance, we discovered that for traditional violin playing, the arm holding the violin remains fixed and

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Paul Zukofsky's Violin Study

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steady while the arm and hand holding the bow executes all the moving action. When this restricted motion is employed, some violinists are unable to play certain portions of more complex musical scores. However, allowing the fixed arm, which supports the violin, to move in coordination with the bow hand by moving the violin back and forth at appropriate frequencies, many violinists could now play musical scores which previously had been impossible for them. Paul was enthusiastic to learn these results and could hardly wait to let Bell Labs know about these findings.

We were involved with another amazing musical study which involved an analysis of playing the harp. The wife of Dr. Bejani, one of our customers, was a World-renown harpist. The idea was to collect the EMG (electromyography) of the muscles of the arms and fingers of the harpist as she played a piece of music. The EMG signals and the sound frequencies of the harp were recorded simultaneously and stored in a computer.

The next step was for the harpist to move her fingers in the same way that she had before only this time she “performed” without the harp. That is to say, she “played” an imaginary harp. For this second “performance” the EMG was also collected. The EMG signals that were produced were aligned with the sound frequencies produced when the harp was played. By aligning the new EMG signal with previously produced music, the harpist was able to “play” the notes without the harp itself. In other words, we could let the harpist play the harp without physically touching the instrument. Merely recreating the motions with her fingers, our system was collecting the muscle action and playing the music!

We soon found ourselves in another arena appropriate for biomechanical analysis which was product liability and insurance claims. Since our biomechanical system could evaluate movement parameters with a high degree of precision, we could produce specific quantifiable results without subjective bias. This objectivity was particularly important in cases of injuries or fraud cases which were frequently influenced by inadequate or mistaken information.

Insurance companies are often the victims of false claims but have few tools at their disposal to dispute them. Several insurance companies had learned that our analysis was scientifically based rather than reliant on guesses and opinions, we were able to provide definitive information about various products and their uses. We also learned that law firms frequently were most interested in the facts rather than whether the product had performed correctly or not. In order to prepare proper legal defenses, lawyers needed accurate information.

One of our first studies involved Dow Chemical. The law firm of Corlett, Merritt, Killian, and Sikes were representing Dow Chemical and their insurance carrier, Fireman’s Fund, when they approached us. They were involved with a sad and unfortunate case involving a severely injured gymnast.

A promising high school gymnast in southern Florida was completing his regular afternoon gymnastics training session. The young man was devoted to his sport and spent many extra hours practicing old skills as well as trying to add new tricks to his routines. One particular afternoon, at the end of a rigorous training session, he wanted to try his newest floor exercise running stunt without using the support harness. At that point, he felt that he had mastered the trick and wanted to perform it before
he quit for the day. He raced across the mat executing front and back acrobatic maneuvers and then launched himself into the air for the final backward rotating somersault round off which would open up as he landed on both feet facing the opposite direction from the takeoff. Unfortunately, the young man was unable to complete the rotation and landed on his head and neck. His neck was broken and, when the lawyers visited us in Amherst, the young gymnast was in an iron lung.

“What had gone wrong and who was to blame?” was the question put to us. That question caused everyone involved to be sued: the gym owners, the coaches, and the manufactures of the mat materials. Dow Chemical had manufactured the material, ethafoam, used inside the mat. It was alleged that there had been negligence in manufacturing. We were surprised to learn that ethafoam had been originally developed by Dow specifically for the U.S. Department of Defense as packing material for shipping bombs to Vietnam. Now, it was being used for a more peaceful purpose but the question was is it the appropriate material for gymnastic mats.

We proceeded to test all of the mats supplied by Dow. They provided mats of various thicknesses from one-half inches to four inches, with and without the gymnastic outer covering, as well as all of the other gymnastic mats marketed at that time. Our research plan was two-fold: to biomechanical analyze actual gymnasts performing the stunt and to utilize our patented material test device with the force platform to evaluate the material characteristics of each mat sample.

We located a Connecticut University gymnastic team which had gymnasts of similar size and skill levels of the injured Florida gymnast. We filmed these athletes performing the same trick that the injured gymnast had tried to execute. Based on the data we obtained on these actual performances, we subjected the test mats to our computerized hydraulic material testing equipment using the force platform to record the forces.

These tests provided interesting results. The first issue concerned the forces necessary for the gymnast to successfully execute the complete rotation and land on his feet. We were able to quantify these forces and presented a table based on the gymnasts we had evaluated. Then we used those forces to impact the mat and were able to provide a table of those values as well.

We notified the law firm and the other parties involved in the suit to come to our office for a presentation of our results. At the meeting, we explained the physics involved in this specific gymnastic stunt. Gymnasts must produce an adequate amount of force downward towards the floor in order to generate sufficient forces upwards to complete the trick. If the mat is too thick, it absorbs too much of the downward force. In other words, a mat which is too thick functions as a shock absorber. Conversely, a thin, rigid surface such as a floor with a non-slip surface absorbs little of the downward force but has no shock absorbing characteristics. With the rigid surface, however, the forces downward are returned to the gymnast in an upward direction with little or no loss due to shock absorption. A perfect mat would be rigid at takeoff and thick and soft during landings. Another way to consider this concept is that “you cannot shoot a canon out of a canoe.”

We had tested gymnasts and all of the different mats. Essentially, we concluded the thickness of the mat used in Florida was appropriate for executing the trick. At the time he attempted to execute this stunt, he was unable to generate enough force to completely rotate his body. Perhaps he was too tired since it was at the end of a long, rigorous session or maybe he was slightly off balance at takeoff. These or other reasons prevented the gymnast from generating enough force to complete the turn and resulted in landing on his head and neck.

Unfortunately, there are no mats which are soft enough to land on your head and neck but which are sufficiently firm to takeoff and execute the skill. There are foam pits designed for soft landings, such as pole vault and high jump pits among others, but they are completely appropriate for gymnastic events. The foot, leg, and hip joints are designed by nature to provide shock absorption but there is no shock absorbing characteristics in the joints of the neck or the head. Had the young man landed on almost any other part of his body, in all likelihood, the damages would have been less severe.
Our analysis, thus, demonstrated that it was impossible for a substance to be both non-resilient enough to permit an individual to complete a somersault round-off trick yet resilient enough to absorb an injury of the kind experienced by the young gymnast. Dow Chemical and their insurance carrier were much more sympathetic than many corporations and insurance carriers of our more modern times appear to be. They offered an extraordinarily generous settlement to the boy and his family which would provide financial relief to them immediately rather than involvement in a protracted legal entanglement. I am pleased to report that despite the tragedy that the family had to endure at least they did not have to worry about the financial expenses.

Following the gymnastic mat project, we were hired to perform our biomechanical analysis on another case involved an injury on a trampoline. A young female athlete was practicing on the trampoline, executed a backward flip, and landed on the edge rather than the center of the trampoline. She broke her neck and the family sued the trampoline manufacturer.

The results of our biomechanical analyses revealed that people are easily able to increase their jump heights on a trampoline compared with jumping from a solid floor-like surface. Unfortunately, being able to reach greater heights does not necessarily mean that the skill to execute various stunts is as easily obtained. In other words, if someone offered you $200.00 to jump from the floor and perform a back flip, you most likely would think twice about your ability to successfully perform such a task. But if you were standing on a trampoline and were offered the same $200.00 challenge, you would more readily consider it. Because you can bounce higher and higher on a trampoline, you would believe that you could execute a backwards flip. In all likelihood, as you increased height with each bounce, you would be able to flip over backwards but would you be able to control the stunt and land on your feet?

Most people realize the risk of trying to jump backwards from the floor, but fail to realize that it is even more dangerous from an elevated height produced by jumping on a trampoline. Although it is possible to have reach a height that allowed you to perform a flip, on landing, you would impact the trampoline surface from a greater height than you would ever be able to achieve from the floor. Think about the physics involved. Landing from a jump height of two feet results in less force on the body than landing from a height of 10 feet. A person may be willing to jump two feet to the grass from the front porch but be less willing to jump out of the second-floor window. The increase in height significantly increases the risk to your body. The injury potential is augmented if you land on your head rather than on your feet.

An additional component is skill. It may look easy to “bounce” on a trampoline. However, skill and training are required to control the jump so that the landing is in the center of the trampoline rather than being thrown off balance and landing at different locations on the surface. Lacking skill can cause the jumper to fail to land in the center of the trampoline but rather on the edge as was the case in the young woman we investigated. Although trampolines can be fun and are becoming common, it is prudent to learn how to use them safely.

American football seemed to grow in popularity in many categories across age groups including elementary, middle, and high schools, semi-professional, and professional teams as well as across international boundaries. Unfortunately, football injuries also seem to increase every year despite the efforts to improve skills, coaching, sideline physical training, and protective equipment.

A liability case involving a football helmet was brought to CBA and we were asked to evaluate this helmet and their competitors’ products. We were provided films of the actual injury since one of the local television stations had televised the game. The injured athlete, a high school senior, had a severe neck fracture and was now a quadriplegic.

Sadly, the injury resulted from a type of tackle known as “spearing”. “Spearing” occurs when the player attacks the opponent with the head while keeping his shoulders and torso rigid. In any tackle, the forces generated have to go somewhere. Helmets are rigid on the outside with a foam interior but this design cannot absorb the forces generated during impact. Therefore, the forces are directed to the next
part of the chain which, in this case, would be the neck. The neck has no shock absorbing structures so the forces generated resulted in fracturing the athlete’s neck.

One solution would be to design a helmet that could absorb and dissipate the impact forces. If the helmet were softer or had a bumper, like on the front of a car, the forces would be reduced during the impact. Another solution would be to have the helmet and shoulder pads joined in some fashion to provide a method to reduce the impact forces. A spearing tackle may be illegal in today’s football but head impacts from spearing or other incidences continue to occur. Unfortunately, there still are no well-designed helmets for reducing, buffering, or deflecting forces resulting from impact.

Another one of our most high profile cases involved Johnny Carson who, at that time, was a well-known television personality. Mr. Carson contended that he suffered an injury to his neck and back as a result of falling from an exercise slant board. His contention was his fall was a direct result of the slant board malfunctioning. Mr. Carson filed for $500,000 in damages against LNR Industries and their insurance carriers. The company and their insurance carriers contacted CBA for us to evaluate the claims. Their goal was to determine whether they had a defective product and, if so, how they could correct it.

In our Amherst laboratory, we studied the description of the accident that Mr. Carson had given during his deposition. We then replicated the activity exactly as he described using a test subject the same size and weight of Mr. Carson. In addition, we had the test subject perform the exercise following the precise directions from the slant board company which accompanied each one of their products at the time of purchase. We employed high-speed cinematography to record these replicated movements and then performed our computerized biomechanical techniques.

The results of our biomechanical analysis revealed different outcomes depending on the exercise technique employed. The slant board manufacturer specifically described how the board was to be placed at the top and the bottom. In the instruction manual, the feet were to be slipped under the bar at the top of the board and then the head and body were raised or curled up towards the feet. The purpose of the slant board was to provide exercise for the abdominal region and, when the user followed the directions, it was virtually impossible for the slant board to tip.

However, the technique that Mr. Carson employed was to hold the bar at the top of the board with his hands and to raise his legs upwards and towards his head. This abdominal exercise technique was a viable alternative but with the restriction that the legs should only be lifted into a vertical position which was perpendicular to the floor. Under no conditions were the legs to be elevated higher such that the feet reached the head. When the legs were raised over the user’s head, the board became unsteady. The results of raising the legs over the head caused the board to tip and the user to fall off. Since he used the board incorrectly, by reversing the head and leg positions, Mr. Carson produced a situation, which caused the board to flip over, and he fell.

![Slant Board Analysis](image_url)
We presented our finding to the LNR Industries and the lawyers representing their insurance carrier. These findings were not received with joy by the opposing counsel. They contacted an independent engineering firm, Truesdail Laboratories to have the board analyzed. Truesdail Laboratories confirmed our results. In addition, they indicated in their report that our results were more accurate than anyone else could produce, since we had employed a dynamic analysis, whereas they were only able to execute a static analysis. Mr. Carson withdrew his suit.

At the same time we were working on the Carson slant board project, another sporting goods manufacturer, AMF, contacted us. At that time, AMF produced and sold a variety of sports products and were in the same market arena as were Spalding and Wilson Sporting Goods. In 1971, American Machine and Foundry had been renamed AMF. For many years, the company had produced a wide variety of sport and leisure equipment including Roadmaster bicycles, Harley-Davidson motorcycles, Head snow skis and tennis racquets, snowmobiles, lawn and garden equipment, Ben Hogan golf clubs, Voit inflatable balls, exercise equipment (including exercycles), motorized bicycles, mopeds, SlickCraft powerboats, Alcort sailboats (including the Sunfish and the Hilu), Hatteras Yachts, and SCUBA gear. In the 1970s, in a reference to its numerous leisure product lines, the company began a TV advertising campaign centered on the slogan "AMF, WE MAKE WEEKENDS".

The first project AMF proposed to us involved their tennis rackets. They wanted to reduce the strain at the elbow which caused tennis elbow. Their goal was to change the location of the “sweet spot” on the racket into order to reduce or eliminate rotation caused by hitting the ball at the wrong point on the racket.

What is the “sweet spot” of the tennis racket? The term “sweet spot” is commonly used to identify the center of percussion. The center of percussion is often discussed in the context of a bat, racquet, door, sword or other extended object held at one end. The sweet spot on a baseball bat is generally defined as the point at which the impact “feels” best to the batter. The center of percussion defines a place where, if the bat strikes the ball and the batter's hands are at the pivot point, the batter feels no sudden reactive force. However, since a bat is not a rigid object the vibrations produced by the impact also play a role. Also, the pivot point of the swing may not be at the place where the batter's hands are placed. Research has shown that the dominant physical mechanism in determining where the sweet spot is arises from the location of nodes in the vibrational modes of the bat not the location of the center of percussion.

The center of percussion concept can be applied to swords as well. Being flexible objects, the "sweet spot" for such cutting weapons depends not only on the center of percussion but also on the flexing and vibrational characteristics.

The center of percussion is the point on an object, in our AMF case the tennis racket, where a perpendicular impact will produce translational and rotational forces which perfectly cancel each other at some given pivot point so that the pivot will not be moving momentarily after the impulse. As with the baseball bat, the center of percussion may or may not be the sweet spot depending on the pivot point chosen. In addition, this description only works for a racket rigidly mounted on a stand. When a human holds the racket in the hand, the hand, arm, and shoulder must also be factored into the equation.

Most people think that a tennis ball should strike the racket face exactly in the center in order to hit the sweet spot. However, the racket is more than its face with regards to its sweet spot. The handle, grip, and the arm holding the racket must be considered as part of the mechanical system. Therefore, the sweet spot is more correctly located away from the geometric center of the racket face and more towards the junction of the head with the shaft of the racket.

We proposed a project to AMF to determine where the sweet spot was located in three different conditions. One condition was when the racket was rigidly fixed in a devise mounted to the force platform. A second condition was when the racket was allowed to hang from a rope. The third situation was when a human held the racket in the hand.

At that time, tennis rackets were primarily made of wood with nylon or gut used as strings. These were in the days before the technologically advanced composite materials used for frames and the equally
advanced strings compositions which are common in the modern world of tennis. In addition, most tennis stokes were flat hits which means that there was few backspins, slices, or twists. Therefore, our study examined all of the leading wood rackets and we strung them with gut and with nylon. There were no other options at that time for us to evaluate.

We tested all of the rackets and string combinations under each condition: fixed, hanging from a rope, and held by a human. Following our biomechanical analysis, we presented our results to the AMF engineers. We showed them that the sweet spot is not in the geometrical center of the racket when a ball hits the face. The actual location is closer to the hand. This meant that when a player hit a tennis ball, the racket would turn in the hand which contributed to tennis elbow injuries. We recommended some suggestions that could reduce the stress and/or remedy the situation.

One of our ideas was to increase the size of the racket head and, if possible, eliminate or severely reduce the length of the shaft. In other words, make a racket with a short-shaft handle and a large circular racket head. A second proposal was to develop a handle that allowed the shaft to turn or twist within the handle which would prevent the transmission of the forces up the arm to the elbow. When we had described the situation to him, Ann’s father invented just such a handle. He was quite an amateur inventor, or tinkerer, as he called it and had devised this prototype solution as an idea he had to solve the force or torque transmissions. We presented this device to the AMF engineers when they came to our office for our test results.

The AMF engineers were somewhat taken aback by our novel solutions. They were worried that the playing public would laugh at the big head on a short stick concept. But they accepted our results and went back to their labs to consider our findings. It transpired that there were some internal frictions within the company and the engineer, Howard Head, wanted to pursue the large head racket idea. AMF balked at this choice. Howard Head eventually left AMF and founded Prince rackets and the large head racket became today’s tennis racket standard. As of today, there are no tennis rackets on the market with a shaft turning in the handle to prevent the transference of forces from a miss hit ball up the arm to the elbow.

Another project which AMF brought to us was known as the “three-wheeled vehicle”. The device resembled a tricycle except that the rider stood up on foot-sized pedals and then guided the vehicle by turning the tall handlebars. Movement was created by shifting the weight of the rider from side-to-side much like a speed skater does. Stopping the vehicle required pushing the foot pedals supports down with the heels.

We probably had more fun with this project than any of our other ones! The staff would ride around the building, darting between people and cars, and whizzing past the obstacles we arranged in the parking lot behind the building. Luckily, we had no accidents with surprised drivers backing out of their parking spots. However, there were some near accidents on the busy road in front of our lab by rubbernecking drivers so the local police, again, visited us. They were always entertained by our current projects but insisted, in the interest of public safety, that we should ride behind the building rather than in front. We let them try this “three-wheeled vehicle” for themselves and it was entertaining to watch our uniformed officers zipping around on the paved driveway behind our office. They seemed to have as much fun as we did riding the vehicles.

Our biomechanical analyses showed that the vehicle was a very efficient device, quiet, and safe. There were no problems with tipping over such as one could experience with a two-wheeled bike and they were only as fast as human power could generate. They were especially useful on smooth flat surfaces such as linoleum floors commonly used in factories, airline terminals, and malls. AMF was pleased with our findings and left our office with dreams of adding to their weekend fun theme.

We continued to work on projects at CBA, I was busy with my computer science studies and Ann was working on her doctoral dissertation project. That is to say, ordinary life went on until one day I was visited by one of my greatest heroes, Al Oerter. The athlete whose picture had hung above my bed in Hadassim after he won his Helsinki medals in 1952 and Melbourne in 1956, who beat me in the Rome Olympics in 1960 and in the Tokyo Olympics in 1964, was visiting me in my own lab! It is impossible
to describe the admiration and awe I felt about Al and the joy and excitement must have been palpable. Al wanted my assistance to improve his discus throw so he could participate in the 1980 Olympics in Moscow at the tender age of 44. I assured him that we would do everything possible to help him accomplish this goal.

We worked intensely with Al on this project. I was elated to be working with my long-time idol and longed for him to achieve another Olympic Gold medal. We filmed him as he threw the discus and we had him execute some special tests on the force plate. Our biomechanical studies showed that, even at the age of 44, by focusing his strength and speed correctly, he could break the World Record and exceed the qualifying distance for Olympic participation.

Al, a computer engineer himself, watched himself on our computer screen as we presented the biomechanical results. He could see how much better he performed with some minor modifications in his technique. Al was such a great athlete that he could master these changes and continued to train for the next Olympics.

Unfortunately, President Carter initiated a number of actions to protest the Soviet invasion of Afghanistan. One of these actions, led by the U.S., was for nations to boycott participation in the 1980 Moscow Olympics Games. This boycott ended the Olympics dreams of many Western athletes as other nations decided not to participate. Despite this emotional setback, Al and I continued to train in anticipation of his participation in the 1984 Olympics which were to be held in Los Angeles.

By now, we had hundreds of world-class athletes coming to our lab from all over the world. Among them were two World Record Holders in the Shot, Al Feuerbach, and the discus, Mac Wilkins. We worked with these athletes as we had with Al Oerter to help improve their techniques for future competitions.
In 1976, a group from Sports Illustrated unexpectedly visited the CBA laboratory. I was teaching a class at the University at the time and knew nothing about this surprise visit. Ann came out of her office to talk with them and they explained that they wanted to do an article about my technology and me. One of the first questions Ann asked was how many days it would take for the interview process. The answer to her question was that they expected to need three to five days.

“So,” Ann said, “this would cost $25,000.”
Al Feuerbach and Mac Wilkins, Shot-Put, and Discus World Record Holders

http://arielnet.com/ref/go/1132

Sports Illustrated, SEVEN-page spread published in August 1977
http://arielnet.com/ref/go/1133
“Don’t worry you do not have to pay Sports Illustrated to do an article on you,” Kenny Moore, their representative, responded.

Perhaps I was unclear,” she answered. “I mean the cost of taking three to five days of our time and effort is $25,000.”

“What? Are you crazy? Sports Illustrated distributes millions of magazine copies all over the world. This is worth millions in free advertising,” Kenny Moore retorted.

“I am sure you are correct but, unfortunately, we are unable to invest so much time in advertising. For us, time away from our projects puts our productivity and credibility with our customers at risk. When we promise to deliver results on time, we always honor our word. If we have to take time away from our work, it costs us the amount I mentioned to you. We love Sports Illustrated and read it all the time, but at this point, we really cannot afford to invest this time in advertising. Thank you for your interest but I am sorry to have to say, ‘No’.” Ann responded. Kenny Moore and his team shook hands with her, not believing what had just happened, and left the lab.

When I returned to the lab after my class, Ann related the visit and her response. I could not believe it. “Ann, you are crazy! We probably lost millions in future projects and publicity!”

I was upset for days. During the weekend, I sat in the office glaring up at the ceiling. I could not do any work and was really depressed. On Monday morning, the telephone rang. “This is Kenny Moore from Sports Illustrated,” the voice said. “We have decided to pay you the $25,000 because we want to do this article and realize the financial hardship you would suffer by our taking your time.”
I was ecstatic and assured Kenny that he would find our laboratory, projects, and me to be fascinating. I thanked him for reconsidering us and for finding a way to resolve the financial dilemma. We set a date for them to come to the office.

I could not believe it. Ann had been correct......again.

This article provided worldwide interest and the cache of Sports Illustrated yielded an authenticity which continues today. The Sports Illustrated article was seven pages in length and outlined in detail the methods we used and some of the projects that we had completed. One aspect of the article was that Sports Illustrated interviewed some of the athletes and quoted them as to how much they appreciated our help in improving their results. It was a very positive article for us.

With these types of projects and studies, our business was firmly established. Our name, as the first and only biomechanical company, was becoming well known. We continued to work on business projects, classes, and doctoral studies and, of course, exercised every day. However, sometimes it “rains on the parade.”

http://arielnet.com/ref/go/1133
Ariel has programmed the computer to juggle with an electronic copy of an athlete. The analyst can change the angles, the timing, even the weight of the image and compute how the performance would be affected by these changes. The athlete's initial performance is the raw material that can be honed into perfection. The lessons learnt can then be applied to the original performer.

To date, the application of computerized biomechanics has been impressive. Al Oerter's case is not alone in the field of events that have been improved. Mac Wilkins, another gold medalist discus thrower has been filmed in action. The slow motion study revealed that the impetus of his throw was greatly reduced as much energy was channelled into his front leg. Dr Ariel explained that the best method for him would be to decelerate the heavy part of his anatomy — his trunk and legs — so that the lighter parts — the arms and the discus — would accelerate.

New light on bad habits

The computer analysis of Wilkins' performance revealed that he was actually about 30 per cent faster in his swing than fellow throwers who were also filmed. But he was dissipated in the end of his turn. The computer projected that with a perfectly timed summation of forces, Wilkins would be able to throw the discus 76 ft.

And putting his knowledge of his potential into practice, Wilkins went on to win the Olympic Gold medal in the event with a throw of 70.9 m.

An analysis of shot putter Terry Albritton revealed a similar problem. Albritton was bending his front leg at the knee just as he was about to release the shot. It was like trying to throw from a trampoline or shooting a cannon from a canoe' said Ariel. One month after this analysis, Albritton became the next world-record holder -- putting the shot 21.85 m.

Biomechanics has directly challenged some accepted theory and training methods. Long jumpers, for example, have always trained by rising to their toes under heavy weights, strengthening their calves for the final push off the board. But analysis has revealed that the best jumper did not point their toes until the pushing foot is already two feet off the ground. The free leg was seen to be far more important than the pushing leg. The free leg and the torso accelerate as the planted leg decelerates. When the landing leg is yanked off the ground it is no longer pushing but trying to catch up.

Ariel's study of long distance running -- generally considered to depend upon the athlete's blood-pumping efficiency -- revealed that biomechanical factors are vital. The running speed and the runner's work output depends on the stride length and frequency. Previous studies suggested that

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Chapter 10: The Learning Ivory Tower

While CBA was flourishing, I continued my affiliation at the University of Massachusetts. In addition to the classes I attended in Computer Science and the Cybernetics Departments, I was also an assistant professor in the Department of Exercise Science and Computer Sciences.

The Exercise Science Department was headed by a gruff-speaking physiologist, Dr. Harry Campney. Dr. Campney taught statistical class as well as being the head of the department. His brainchild, however, was the establishment of the first department of Exercise Science which he started at the University of Massachusetts in 1967. Dr. Campney was an educational visionary who hired professors from various disciplines which were related to human movement. Although Dr. Campney had been trained as a classical physiologist, he recognized that the future for his students would be challenged by a narrow academic concentration. Future students would need to have more broadly based academic backgrounds if they hoped to find university employment or to find work outside of the university. They would need to be proficient in at least two disciplines. To that end, Dr. Campney hired professors with strong academic credentials in biomechanics, nervous system controls and integration, and biochemistry.

I had been Dr. Campney’s student when I pursued my Master’s degree and then, again, as a Ph.D. student. He had been Ann’s mentor and served on her doctoral dissertation committee. He had always defended and guided us during of our graduate programs. Dr. Campney was the most demanding academic professor as well as the head of the Department of Exercise Science and we were lucky to have him on our side. Ann and I place special value on his contributions to our educations and to receiving our Ph.D.’s.

One of the professors whom Dr. Campney hired was Dr. Walter Kroll. Walter P. Kroll was born in Chicago, Ill. on Dec. 11, 1930. He received his undergraduate degree at Northern Illinois University and then went on to earn a master’s degree at the University of Illinois and a doctorate at Indiana University. Following academic positions at Fort Hays Kansas State College from 1959-63, and the University of Texas from 1963-67, he joined the faculty of the founders of the Department of Exercise Science (now Kinesiology) at UMass Amherst in 1967, eventually receiving the honorary appointment as the first University Commonwealth Professor.

Dr. Kroll was a pioneer and always ahead in his field. Well before computers were even available for common use, he learned computer programming and applied it to implement multivariate statistical techniques to study questions such as the role of personality in athletic performance. He was best known for his achievements in motor integration, advancing the use of oscilloscopic electromyography to study the role of the nervous system in the timing of rapid human movements. Dr. Kroll served as the Chairman of the committee for Ann’ doctoral dissertation and she was devoted to his work and his contribution to her own life’s work.

Another important professor whom Dr. Campney included in the Exercise Science Department was a biochemist, Dr. Dee Edington. Dr. Edington was trained in mathematics, kinesiology and biochemistry, received his B.S. and Ph.D. degrees from Michigan State University and completed his M.S. at Florida State University. He taught at the University of Massachusetts before moving to Michigan in 1976. During his professional life, Dr. Edington has authored or co-author more than 500
articles, presentations, and several books. Dr. Edington was the most unique of the faculty hired by Dr. Campney at the University of Massachusetts because his background was on the cellular level while the other members were examining the human body as a total composite entity.

Dr. Stanley C. Plagenhoef was the third member of the Exercise Science Department hired by Dr. Campney. Dr. Plagnehoef’s area was biomechanics of motion and he, at that time, had developed a small computer program to facilitate the calculations of the kinematic characteristics to movement.

After I completed my Ph.D., Dr. Campney, approached me about a teaching position. This was in keeping with his vision for the Exercise Science Department as a progressive and multifaceted program for students. His goal was to introduce undergraduate and graduate students to the work I was doing in biomechanics. One of his concerns was that after students graduated, they would need to find jobs. Based on his experiences as well as on the trends at that time, there were fewer academic positions in pure fields such as only Physiology or only Biomechanics. Dr. Campney was confronted with the need to educate and train students who would be sufficiently diverse to have dual academic appointments or even leave the university to find employment in business settings. He recognized that my experiences might open opportunities and he wanted me to teach classes which bridged the disciplines which was what I was doing in my life and business. I had, successfully, straddled the world of academics and of business.

Dr. Dee Edington

undergraduate and graduate students to the work I was doing in biomechanics. One of his concerns was that after students graduated, they would need to find jobs. Based on his experiences as well as on the trends at that time, there were fewer academic positions in pure fields such as only Physiology or only Biomechanics. Dr. Campney was confronted with the need to educate and train students who would be sufficiently diverse to have dual academic appointments or even leave the university to find employment in business settings. He recognized that my experiences might open opportunities and he wanted me to teach classes which bridged the disciplines which was what I was doing in my life and business. I had, successfully, straddled the world of academics and of business.

University of Massachusetts
I took this photograph of Dr. Campney with Ann in California where he retired 31 years after our studies at the University of Massachusetts

Some of my success was that I had surrounded myself with brilliant and hard workers. But a great portion of the credit goes to the fact that I had found a niche where the information I studied --- Biomechanics, Engineering, Computer Sciences --- were very much in need. People and companies wanted the benefits of what the CBA company and I provided to improve the efficiency of their products or their personal performances.

Unfortunately, everyone did not share Dr. Campney’s positive attitude and forward-thinking vision. For some peculiar reason, two of my professors in Physiology and in Biomechanics, Drs. Ricci and Plagenhoef, disagreed with Dr. Campney’s philosophies. These two professors were opposed to my academic-business connection. I had thought that the purpose of a university was to expose and teach students. Then, the students could use this knowledge and integrate it into their lives, or business, or become teachers. Drs. Ricci and Plagenhoef disagreed with my philosophy as well as that held by Dr. Campney.

Although I will never know where their animosity had its seeds, I had a surprising encounter with my advisor, Dr. Ricci. He had summoned me to his office and told me that I needed to be careful about mixing business with my schoolwork. I responded that I did not see a problem since I was supposed to be learning how to build a successful life. For me, part of that life was to build a successful business, so I was confused how this conflicted with academia. The response that Dr. Ricci provided was enigmatic at best. “Think about it,” Dr. Ricci replied.

The issue and the meeting with Dr. Ricci confused me. I was aware that some departments, Chemistry, Physics, and Food Technology to name a few, could not exist without support from external financial assistance such as grants from industry. Significant portions of the salaries of my professors in the Computer Science Department were derived from similar grant monies. I could not see how academic was contaminated by grants and subsidies from outside the university. Even if one argued that a business grant might cause a researcher to be biased in any research findings, how could I bias myself? I had my own company which provided extra monies to some of my fellow student since our research projects
could generate the finances to fund them. From that perspective, business was what helped our research center to thrive.

Furthermore, I wondered why Dr. Ricci condemned my business when Dr. Plagenhoef was doing the same thing. Dr. Plagenhoef had many outside business ventures and he merely pocketed what he earned. In addition, he used the university facilities as well as the students. There was a tongue-in-cheek joke that graduate students did the work and the professors got the money and the glory. At least at CBA, when we had students work on projects for which we were receiving payment, we paid them a reasonable amount of money for the effort they provided.

The next surprise came when Professor Ricci called Ann into his office. She had no idea why he wanted to see her, but since he was one of the older faculty members, he commanded attention especially from young, inexperienced graduate students.

“Your friend Gideon,” he said, “is playing with fire by trying to combine business with academia. Our field is to help people by providing information. We are about education, not business. Our goal is to teach people, not to make money. Gideon needs to understand this dichotomy.”

“Excuse me? What do you mean?” she responded with confused shock.

“Biomechanics is an academic study. He should not take this knowledge and use it to make money. It is an academic subject and should stay within the confines of teachers and students,” was Dr. Ricci’s answer.

Ann said, “Many people have created inventions from scientific knowledge and made money. What about the iron lung? Look at how Gideon is helping athletes and coaches and people with motor diseases such as muscular dystrophy. They need this information to help improve their lives.”

“But he is profiting from it,” Dr. Ricci responded. “We cannot have a mixture of profit with academic knowledge. It will sully and contaminate the field of education. This will be viewed as polluting the purity of knowledge and education.”

Ann sat there quietly, confused, while pondering Dr. Ricci’s statements. Were these rules written somewhere, she wondered. She believed that the purpose of knowledge was to contribute to society and that scientific discoveries were steps along that path. After all, DNA was discovered in a laboratory and that scientific information was being applied to research as well as business ventures. These thoughts were swirling in her head as she sat on the other side of Dr. Ricci’s desk.

Professor Ricci began to rearrange objects on his desk so she understood that the meeting was over. Ann stood up and left his office. This Professor, whom she had respected, was telling her that we were not doing the right thing. This was not only completely illogical but was the opposite of what we had been taught about science and learning. The foundation of knowledge was to use it and spread it to others. How could what we were doing possibly be construed as contradicting this basic tenet of education. In her heart, she knew that we were doing the right thing. She came home that afternoon and relayed the detailed conversation of her meeting with Dr. Ricci. I, too, was upset, shocked, and puzzled.

Until today, I remain confused about Dr. Ricci’s objections. Did he believe that it was wrong to benefit financially, had our academic discipline been tarnished by what I had been doing, was he jealous, or was there another reason? There was no specific reason nor obvious rationale that I could find in his objections. I just shook my head and told Ann, “The only thing to do is to continue. We will continue to do our work and our projects both at CBA and at the University and hope that Dr. Ricci’s objections will fade.”

I threw myself into work, as has always been my personality, by attending classes, coordinating CBA projects, teaching the Exercise Science classes, and involving many of these students in real-life projects associated with movement analysis. These projects enhanced the knowledge base of computer programming and applications as well as the actual problems confronting modern businesses. The students who participated in these studies were enthusiastic and derived many benefits from their involvements. Besides the learning value, they also made money and what student did not need money?
At the beginning of each new semester course, my standard entrance line was the same. I would arrive at the first class and announce, “Good morning, Ladies and Gentlemen. Welcome to the Logic of Movement class. You will all receive an ‘A’ in the class. Therefore, you do not need to attend any of the classes if you do not want to or have something else you would prefer to do. I do not care if you come here or not since I have already received my Ph.D. degree. In addition, I am not going to teach you anything; rather, you are going to teach me. In this process, you will learn more than in any course you have ever taken in your life and you will never have another course where you will have so much fun learning."

To the best of my knowledge, I do not think a single student ever dropped out of my class or missed any sessions except for colds or the flu. They were dedicated students and we produced hundreds of studies and research for companies as well as for publications. Some students participated in on-going CBA projects. Other students created their own projects using our CBA equipment.

One young man, Amraham Melamed, used the Force Plate to study handwriting. He discovered that the forces used to write an individual’s name, or signature, created a unique force pattern. The conclusion he reached was that a forger could not replicate the forces created when signing your name. It was possible to write on a piece of paper and have the name appear to be identical using a visual comparison. However, it was impossible for someone else to recreate the individual’s force pattern. A bank, for example, could utilize a specialized pen for force pattern detection and, thus, eliminate fraudulent check cashing. It could also prevent inebriated people from signing checks! At that time, people actually had to hand write checks and go inside the bank to a human teller to withdraw money. Of course, this was long before the electronic banking systems that exist in today’s world. There were no ATMs or financial transfers that could be executed on your cell phone. Of course, there were no cell phones either!

Avraham Melamed was one of the athletes in the 1972 Munich Olympics and I have shared a room with him one night before the Massacre. It was a special time for both of us to have more positive and peaceful times for study and research at the University of Massachusetts.

Avraham Melamed

Although he qualified as a swimmer, he was at the games as a coach and reporter. He was sleeping in apartment 2 and was able to escape capture because the terrorists were led by hostage Moshe Weinberg to apartments 1 and 3 where the weightlifters and wrestlers were sleeping in the hope that the stronger athletes could overpower the gunmen.

Mark Spitz and Avraham Melamed in 1968

Prior to the Munich games, Avraham Melamed had represent Israel as a swimmer at the 1964 Tokyo games and again in 1968 in Mexico City. He was a former student and swim coach at UMass Amherst and has resided in the United States for the past 40 years. Avraham Melamed currently owns his own Computer Company, Dynabyte based near his home in New York.

Avraham Melamed and the gold-medalist swimmer that we analyzed, Mark Spitz.

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When the semester ended, the students would share their research studies with their classmates. They were dedicated individuals who excited themselves and each other by what they had learned. Each of them was amazed by the discoveries that they had made as individuals and by the superior quality of the research. All of us were better informed by the studies they conducted. Fortunately, my students secured jobs when they graduated from the university. Whether this was due to the foresight and planning for diversification of Dr. Campney’s Exercise Science program or my class is irrelevant to me. That they were all able to succeed was the most important factor.

The classes I taught and my teaching techniques were unusual and revolutionary. I knew it and they knew it. I knew that I differed from the norm with my attitudes and thinking. Dr. Campney had hired me to teach precisely because I was uniquely different. But, I loved my job, the projects, the individual students, and their interesting and amazing progress. Companies came to CBA because my approach to problems was unusual and I was willing to risk alternative thought processes in order to solve a dilemma. I was a perfect example of what today is called “thinking outside of the box”. I had spent my entire life going against the trends, charting my own destiny, and searching for solutions to problems. It did not seem to me to be a flaw in my personality but rather an asset.

In fact, when Dr. Campney, had hired me as an Assistant Professor, he admitted that he preferred to hire professors from outside in order to introduce new ideas to the students. He realized, however, that I was not the typical graduate student. By establishing my own company while still a student, as well as pursuing a second degree, I was clearly different. He perceived that I already had a plethora of unique ideas and was open-minded in my approach to problems. Dr. Campney was eager for the Exercise...
Science department students to be exposed to this type of thinking and experiences. Dr. Campney expressed his considerations in a letter to the graduate school:

We are most interested in Gideon Ariel’s ability, his work, and his potential for contributing to a better understanding of how man moves. For example, I am attempting to secure a position on our faculty for Gideon for the 1974-75 academic year. However, there are a few obstacles in my way at the moment.

One of the obstacles was a lawsuit issued by Dr. Ricci against Gideon claiming that he was using University funds, technology, and ideas to develop his projects.

Due to Dr. Ricci’s allegations, the Department of Exercise Science was instructed by the Dean of the Graduate School to evaluate Gideon’s position. Their findings were:

“Based upon our elective faculty workload assignment scheme, Professor Ariel was assigned a 1-1-1 relative distribution profile among the Teaching-Research-Service categories. The assigned nature of his workload was because he was on a one-half time appointment in the Department of Exercise Science. His second half was in the Department of Computer Sciences.

In the area of teaching, Professor Ariel carried 6.0 student contact hours; his grade distributions were high; his student evaluations were superior.

In the area of research, Professor Ariel had two refereed publications and several non-refereed professional articles. His involvement with research and professional presentation was extensive. I personally heard two of his professional presentations and felt they were well received.

Despite my efforts to operate a new and innovative company, teach university graduate students, and contribute to scientific knowledge, I rubbed some professors the wrong way. Sadly, this glowing document written by Dr. Campney and indorsed by the Graduate School became useful in a completely different cause. I had needed to hire an attorney to defend myself in a suit brought by the University. The University was less than enthusiastic but were forced into it by my own professors, Drs. Ricci and Plagenhoef. My attorney, David Burres, would now have to use this report as part of our first line of defense.

One of Professor Ricci’s complaints was that I had received an unlimited grant for use of the computer mainframe at the university center. At that time, everyone at the university was allocated computer time. I was not unique in receiving time and memory allotments. Teachers, graduate and undergraduate students were assigned computer access codes and given time. The hours of use were billed in what was known as “funny money”. “Funny money” meant that the time, memory, and computing power were provided accordingly with charges enumerated by category. The financial information relative to the components was used by the computer science department for internal evaluations only. No one was ever presented with an actual invoice for the use of the University’s computer and expected to pay. Computer time was provided free to all university inhabitants in the same way that the library loaned books at no cost. An example of the “invoice” from the Computing Center is shown below:
One of Dr. Ricci’s claims in this lawsuit was that I used more than ten million dollars of the University’s computer time. Dr. Ricci knew at that time that my computer usage had not only been authorized by Dr. Wogrin, who was the head of the Computing Center, but that Dr. Wogrin was aware that I was using the computer for my own private research and company. None the less, Dr. Ricci seemed to find this use of the University’s computer to be inappropriate. He induced Dr. Plagenhoef, or perhaps vice versa, to convince officials in the University Center to sue me for this usage. In this way, the two professors had “clean hands” by making the law suit appear to have come from higher up in the University hierarchy.

The day came for the presentation of arguments in the District Court of Northampton. I was present with my attorney but the two professors who were instrumental in bringing the suit apparently could not be bothered to be present at this momentous occasion. The Judge listened to what the University attorney, who was effectively representing Drs. Ricci and Plagenhoef, had to say. Essentially, the University’s case was that I was using my biomechanical and computer knowledge for my own use.

My first witness was Dr. Conrad Wogrin who was the head and administrator of the Computer Science Department. I had taken several computer language courses from him in the Computer Science Department. He was an excellent teacher and receptive to new ideas and applications for computers. His attitude was that the computer was a new and exciting tool for students and faculty to use and would soon replace most of the pen-and-pencil situations of the past. He saw the future as a new frontier and the computer was going to be one of the primary vehicles for change.

The philosophy of Dr. Wogrin and the University Computer Center was to make this amazing tool available to any and all university “citizens” regardless of their status. Professors were usually granted more “funny money” than students, but everyone had access to the computer and its powers. Graduate students were also high on the list of people who were encouraged to use the computer.
Dr. Wogrin knew that by using the computer, I did not affect the CPU of any other users. In addition, Dr. Wogrin had frequently expressed admiration for the work I was doing and the creative ways that I was using the computer. His testimony in court as one of my witness included that he “wished all of his students were as creative with the computer as I was” and that he “would provide as much time as necessary to any clever and inventive use of the computer.”

CONRAD A. WOGRIN

emitus

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Homepage: Link

INTERESTS

Intelligent tutors, computational strategies in learning and education.

With Dr. Wogrin during my Award by the Department in 2006

My lawyer argued, as a legitimate student in the Exercise Science Department as well as my other scholastic involvements, coupled with the endorsement from Dr. Wogrin, that I was doing exactly what
a creative and scholarly individual was supposed to do. I was an excellent example of what students should be learning and performing at a university.

The Judge retired to his chambers to ponder the arguments and the evidence presented by the lawyers and witnesses. As this was not a jury trial, the Judge would evaluate the laws and testimonies and make a judgement. When the Judge returned to the courtroom, he announced his ruling: “If Dr. Ariel owes monies to the University, then the University owes monies to Isaac Newton. Case dismissed.”

Many people in the courtroom began to cheer and clap after the Judge announced his verdict. Although they were happy for me and I was relieved and thrilled by the outcome, it had seriously impacted my life to have been sued by my own professors. In spite of my vindication, I was bothered that neither Dr. Ricci nor Dr. Plagenhoef had come to court. Obviously, they had no respect for the court or for their own convictions. They were disrespectful to the system of justice, which they had used to fight their own petty battles and then they were too cowardly to accept their loss in public. They and their behavior disgusted me.

I returned to the University euphoric at having won the case and visited friends and colleagues up and down the corridor. Suddenly I saw Dr. Ricci walking nonchalantly down the hall. I walked rapidly down the hall in the same direction that he was going and fell in beside him. With an elevated voice, I told him what a coward he was and that he did not even have the guts to show up in Court. Furthermore, he was a disgrace to the university and to all humanity!

Of course, Dr. Ricci immediately filed another lawsuit against me. This one was for Sureties to Keep the Peace, which is less than disturbing the peace, but the only one his lawyer could find to file a suit against me. I was victorious in that case as well, but realized that this kind of nonsense was fun for Dr. Ricci but a waste of time for me. I resolved to stay as far away from him as I could and proceed with doing good and worthwhile things. Entertaining Dr. Ricci in the gutter was a thing of the past for me.

Despite any discomfort which I felt, the local newspapers in Amherst had found a conflict that they could print any number of articles since the story had at least two sides. The lawsuits and negative publicity provoked the University into seeking an outside evaluation of the Exercise Science Department. The goal was only slightly veiled with public statements that all the departments were to be evaluated in efforts to determine status, areas for improvements, faculty depth, and other reasons. None the less, it was a chance for people on the outside to look at the department and make independent assessments.

An independent panel of evaluators was appointed by the university to evaluate all departments on campus. However, it was interesting to discover that only one other department was subjected to an extensive external evaluation. Later, there was one other department which was merged with a larger one but the primary focus appeared to be the Exercise Science Department.
The independent evaluation of the department of Exercise Science examined a number of important criteria including teachers, students, equipment, and research projects. The school’s laboratory equipment and supplies impressed them. They indicated that the school needed to more vigorously pursue government and private funds for research support. They found most of us, including me, to be serious and competent researchers. Only two men were found sorely lacking as noted in the report, as follows:

“.... The publication record of neither Dr. Ricci nor Plagenhoef is impressive. Their research output is not at a level expected of those holding graduate faculty status. According to the information provided to the Committee, Dr. Ricci is currently not directing any Ph.D. research. Dr. Plagenhoef has directed one Ph.D. dissertation and is presently directing a second dissertation. Judging from Dr. Plagenhoef’s vita, the Committee has some concern for the quality of his research, since so little of his work has appeared in refereed journals.

.... In view of the above, the Committee has some questions regarding the graduate faculty status of Drs. Ricci and Plagenhoef. It is proposed that the departmental faculty is subjected to periodic reviews of Graduate Faculty qualifications by the Graduate School.”

After all of the attacks on me, some subtle and others more public, I was thrilled to read the report of the Graduate Program Review especially since it had been prepared by a completely independent review committee. I had learned about the report when I was called to the office of the new head of the Exercise Science department, Dr. Dee Eddington. He told me to read the report while he went to lunch. I
read the report in the deserted quite of his office and then hurried down the hall to the office to make a quick copy of the report. I left the original report on his desk with a note that it was interesting reading.

About a week later, I traveled to Kentucky to a conference, which was also attended by several other faculty members from the Exercise Science Department. While I out of town, a miracle occurred! The “Graduate Program Review” was printed in its entirety in both local newspapers. Finally, at last, it was revealed to the entire local population, both university and towns people, who were the contributors and who were the failures. The heading in one of the newspaper was: “Tenure, who is protected?” In the second newspaper, the title was “Who is Qualified?”

Ann had stayed in Amherst to attend her classes and work at CBA while I was gone. Suddenly, she received a frantic call from Dr. Eddington. He was desperate to determine if I had published the report in the newspaper. Ann told him that I was in Kentucky and could not have been the one responsible for printing the report. She assured him that she was not the one either and had not even seen a copy of the report. She concluded that there must be another individual who wanted the world to know the details printed in the report.
Despite having their professionalism questioned, these two professors continued to attack me but their attempts became subtler. Rather than focusing on their own research or academic subjects, they concentrated on finding loopholes in mine and attacking me in any way they could find. They continued to launch accusations and, fortunately for me, to lose. It was a waste of money and brainpower. The end came when we moved to California. I guess we needed an entire continent to keep us apart.

There was a poignant irony to all this. In 2006, thirty-six years later, the Department of Exercise Science, which by that time had changed their name to the Department of Kinesiology, selected me for their “Graduate Student Achievement Award.”
At the beginning of the ceremony, the Head of the Department, Dr. Joe Hamel, called me to the podium to receive this unique award. I walked briskly to the front with a joyful heart and a big smile on my face. As I stood there listening to the flattering things Joe had to say, I looked out into the audience. There were a few old teachers, Robert James, Dee Edenton, Dr. Wogrin, as well as many of my fellow graduate students, and even a few of my previous students. All of those attending the ceremony were aware of the history of my time in Amherst and the subsequent successes which I had experienced. After Joe’s commendation, I was given a chance to say a few words. I began my appreciation comments as follows:

It is an honor for me to receive this award for my accomplishment as a student in the Exercise Science Department. Unfortunately, you had to wait for two faculty members to die before you could invite me to this ceremony! However, it is a real honor for me to be present at this occasion tonight and to be given this wonderful award. I want to thank all of you, teachers, colleagues, and students who have honored me by your presence here tonight. It means a lot to me and I sincerely appreciate and thank you.

After the presentation, I was surrounded by many of my friends. They were happy at my successes in life and for the award which they all believed was late in coming. It was a special thrill to be reunited with Dr. Wogrin and for his continued joy at what I had accomplished. I will always remember his inspiration and friendship.

Despite the difficulties, which fortunately were small in number when compared with the extraordinarily large number of positive things that happened to me during the same years, I had loved my years at Amherst. I had thrived on the projects, the students, the excitement, the opportunities, the learning. I had received my doctorate, met Ann, and started a successful and flourishing business.

Yet, I was soon to discover that pettiness and jealousies were not restricted to academia, but existed everywhere. Now I would have to fight the exercise machine wars and these were as strange as they were robust.
Dr. Joe Hamel presenting the Achievement Award

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With some of my old students and new students at my Award
I previously described that one of my first projects was with the Universal Gym Equipment Company and was the inaugural use of our newly invented sonic digitizer installed in my kitchen. My work with the Universal Gym Company resulted in a beneficial relationship for both CBA and Universal. I created new designs and changed the old styles from ordinary standard exercise machines with which everyone was familiar into ones that were specifically built according to scientific principles.

Harold Zinkin, the owner, and his entire Universal staff were open to this new way of providing exercise machines that automatically adjusted to the exerciser’s body and assisted the person in each lift.
Harold had been a superb weight lifter and body builder during the days of bar bells and dumb bells on Muscle Beach, California. Harold was one of the early devotees of strength development in the armies of exercise and fitness enthusiasts who trained for many hours every day on the sunny beach of California. Although he was relatively short in stature, he was enormously tall when it came to thinking about exercise and equipment to increase strength.

One of Harold’s best friends was the legendary Jack LaLane. Many of these famous exercise fanatics and the gurus of the fitness industry believed in myths or in the latest fad without scientific evidence to support their theories regarding strength development. Even today, the designers and the so-called experts in the exercise field believe in myths or speculation as to what people need just as people at the time of Copernicus thought that the Earth was the center of the Universe.

It was not that the relationship between resistance and muscle strength was new during Harold’s days on the beach or even now. Probably as early as Milo the Greek, who lifted a baby calf every day until it was full-grown, people have lifted weights to increase their strength.

In 1948, Delorme adopted the name "progressive resistance exercise" for his method of developing muscular strength through the utilization of counter-balancing the weight of the extremity with a cable and pulley arrangement. Two gifted individuals, Thomas DeLorme and Arthur L. Watkins, MD, published landmark papers on strength training. Since the publication of their papers, thousands of physical therapy students have been introduced to DeLorme & Watkins therapeutic exercise prescription methods, termed Progressive Resistance Exercise (PRE) and their 1948 prescription of 3 sets of 10 repetitions using 50%, 75%, and 100% of a 10 RM load. Today, many physical therapists are taught and prescribe therapeutic exercise theoretically using DeLorme & Watkins 3 x 10 model.

McQueen distinguished between exercise regimes for producing muscle hypertrophy and for producing muscle power. He concluded that the number of repetitions for each set of exercise determined the different characteristics of the exercise.

Hundreds of investigations have been published about developing muscular development through resistance exercises using different techniques. These techniques include isotonic, isometric, and eccentric exercises, the Oxford technique, double and triple progressive systems, super set systems, isokinetic exercise systems, chains and barbells, springs systems, and the list continues. Each system has been supported and refuted by numerous studies. Berger performed some of the best research and he concluded that six to seven repetitions three times a week is best for developing dynamic strength. Steinhouse conducted other excellent research and he emphasized the need to increase the intensity, but not the amount of work, in order to develop maximum strength.

Throughout my own life, from a young teenager pulling against strings attached to the wall to an Olympic athlete lifting traditional weights, I have been interested in muscular development and its application to athletic events. As a master’s and doctoral student, I pursued research topics which reflected this on-going fascination with strength development. I prepared an article, titled “Resistive Training”, which was printed in Clinics in Sports Medicine.

When a person uses any resistance device, there are two types of forces applied on the body. The internal forces produced by the muscular system and the external forces produced by the resistance device. Consideration of the magnitude of the externally applied resistance cannot be the only consideration in muscular training. Rather, the magnitude, action line, direction, and point of application are all characteristics which must be considered to develop maximum muscular training. Physical educators, trainers, physical therapists, and athletes deal constantly with muscle forces, both normal and super-normal, but little is actually known about the actual magnitudes of these forces.

The human body is a system of linked segments and forces which cause rotation of the parts about their anatomic axes. Both muscle and gravitational forces are important in producing these turning effects which are fundamental to body movements in daily living and sports. Pushing, pulling, lifting, kicking,
running, and walking are all results of rotational motion. The linked segments are our rigid bones and the power to move the bones is caused by the contractions of our muscles.

To illustrate the mechanical principle governing the human muscular system, a good example is a seesaw. Nearly everyone has had the experience of going to a park and riding up and down with a friend on a seesaw. Understanding the principle of how to create the joy of going up and down is quickly derived from personal experience. If one child is heavier than the friend, the bar has to be adjusted to accommodate the differences in weight. The location of where the bar is placed or balanced is called the fulcrum. Through the trial and error of experience, children rapidly learn that their size determines how they must adjust the bar.

What children learn, without the benefit of fancy mechanical terminology, is the “Principle of Moments”. The weight of the child and the distance from the fulcrum are both important in determining the force needed to balance the other child. This principle, widely used throughout the entire field of biomechanics, is the Principle of Moments. The definition is: “the moment of a force about any point is equal to the magnitude of the force multiplied by the perpendicular distance from the action line of the force to that point.” A diagram illustrating this principle follows:

![Moment of Force Illustration](http://arielnet.com/ref/go/1143)

![Moment of Force Illustration](http://arielnet.com/ref/go/1144)

Since a moment is a force time a distance, it may be increased or decreased in either of two ways. One way is to change the magnitude of the force and the second way is to change the distance from the fulcrum. In the case of the seesaw, if two boys are of equal weight, they must sit the same distance from the fulcrum to the end of the board. If one boy plays with a child half his weight, this child must sit twice as far from the fulcrum in order to balance.

Another important consideration for all movements is the relationship between the skeleton and the muscles which are attached to each of the bones in it. The human body consists of a reciprocating arrangement of our muscles and the levers which are our bones. When we move, we change the angle that the muscle pulls on the bone. For example, holding a weight in the right hand and bending the elbow, moves the weight upwards. As the elbow bends, the muscles attached to the upper arm constantly change the amount of force needed to raise the weight upwards. The length of the lever arm and the angle of muscular attachment to the bone are offset by changes in the ability of the muscles to develop torques about the joints. Therefore, there are three factors involved in movement:

1. The length of the lever (bone)
2. The angle of muscle attachment to the bone
3. The length of the muscle itself
Some of the information about muscular activity is covered in the Red Brochure below:

![The Red Brochure](http://arielnet.com/ref/go/1145)

There is a compensatory relationship between the geometric arrangement of the lever and the physiology of muscle contraction that allows smooth bodily movements.

In addition to consideration of the human body’s internal leverage system, the levers and resistance of exercise equipment must be calculated to facilitate and optimize the increase in muscular strength. To facilitate maximum muscular involvement, the resistance must vary. To develop exercise equipment to achieve the best design, the resistance should vary according to the biomechanical data obtained under dynamic conditions.

Consider, for example, a well-known weight lifting exercises, the bench press. Using the normal barbell arrangement, the resistance varies by as much as 100 percent during the entire movement. At the beginning of the exercise, the force necessary to raise the bar is higher, while in the middle and at the end, the muscle effort will be less. To increase the muscular involvement throughout the entire exercise, the leverage system of the equipment must change. The resistance to the muscle must occur throughout the entire range of the motion in order to increase strength. To be effective, this resistance should increase or decrease according to the biomechanical data obtained under dynamic conditions for each separate exercise.

Another joint that can and should be studied because of its importance to everyone regardless of age or gender is the knee. The knee is crucial for locomotion. Just like that old song about the foot connecting to the knee joint and on up the skeletal system, anything which disrupts the normal function of the knee will affect the entire body. When a person limps due to a knee problem, the resultant forces are transmitted to other parts of the body in ways similar to those which I previously discussed for football.
and gymnastic injuries. Back and shoulder pains are commonly associated with long-term knee problems and can result in chronic complications elsewhere in the body.

In 1972, we collected data on the knee using X-Ray photography. The X-Ray gave us information on the internal structure and movement of joints, in this case the knee. The following is one analysis among many on the intra-articular forces at the knee joint during a squat exercise.

The figure presents a sample of an x-ray used to determine the knee joint model. The figure shows a person executing a squat exercise with weight. The goal for the weight lifter is to increase the muscular strength primarily in the vertical direction. In other words, to win an Olympic gold medal, the lifter must raise the barbell with more weight than the competitors. To accomplish this task, the knee joint motion must produce more force components in the vertical direction and minimize those in the horizontal direction. The horizontal forces are frequently referred to as “shear forces”.

To evaluate the forces on the knee, the most important information can be gleaned by calculating the moment arm. The moment arm, shown in the figure as “x”, is defined as the perpendicular distance from the joint center to the line of force generated by the muscle. As the knee bends, the moment arms change. The goal is to minimize the shear force component and maximize the vertical force component. Quantification of the moment arm is particularly useful for this purpose. The changes in the moment arm of the joint should be considered when designing exercise equipment.

Another vulnerable part of the body, which is routinely exposed to shearing forces, is in the lower back between the fourth and fifth lumbar vertebrae. For all of us who walk on two legs and also lift and carry packages, there is a risk of lower back pain and injury. For decades, there has been continued interest in the prevalence and etiology of lower back pain in industrial applications, injuries in the home, and sport-related problems.

Back injuries are commonly associated with the lifting of weights. Almost any weight lifting exercise, executed while standing with erect posture, is associated with great force on the vertebral column. Kotani, et al, found a high incidence of scoliosis, prolapsed disc, and other injuries to the
vertebral column and its associated structures in competitive weight lifters. The risk of degenerative and traumatic lesions of the spine is not confined to those engaged in competitive lifting since athletes in many different sports routinely incorporate weight training as part of their training routines. Young and inexperienced lifters represent another high-risk population as noted by Troup.

In a study of pressures in the trunk cavities when pulling, pushing, and lifting, Davis found that with increased stress on the vertebral column, the abdominal muscles are very active in relieving the load on the lumbar spine. Thus, the abdominal muscles counteract the shearing force to a certain extent. This factor illustrates the importance of well-developed abdominal musculature to aid in the prevention of low-back pain in weight lifting. The widespread use of the waist belt among weight lifters is not worn to support the back, as many people believe. Rather the function of the belt is to increase the strength of the abdominal muscles to resist the shearing force on the lumbar region.

In 1973, there were no exercise equipment companies familiar with biomechanical calculations or with the ability to design their products to accommodate the dynamically necessary changes. Many manufacturers may have thought about the need to improve their designs, but they did not have the data to actually build new equipment. It was, therefore, a unique situation to be approached by a major exercise
manufacturer to help them design better equipment. It was another indicator of the creative and open-mindedness of Harold Zinkin of Universal Gym. He had been an innovator during his earlier years on Muscle Beach and now he was thinking of the future by seeking biomechanical improvements in his line of exercise equipment.

We used our CBA technology to evaluate the existing Universal equipment. Following these biomechanical analyses, we designed a new system which was able to change the resistance for each separate exercise according to the dynamic needs of the person exercising. This new system was labeled “Dynamic Variable Resistance” or DVR as it became known. These exercise machines utilized an appropriate resistance lever arm in accordance with the requirements of Kinesiology and human anatomy and were based on the dynamically quantified biomechanical information. The design automatically determined the moment of force in each exercise and simultaneously considered the muscular and the dynamic forces due to the motion.

In 1974, Universal Gym introduced several DVR machines, which incorporated the biomechanical research and development which we had performed at CBA. Two of the new scientifically designed equipment were:

1. **Bench press machine.** The Universal variable resistance bench press station demonstrated an automatic loading effect enabling total muscle training throughout the range of motion because of the cam-bar arrangement.

2. **Leg press and shoulder press stations.** This new variable resistance leg and shoulder press stations optimized the resultant force in the appropriate direction and at the same time minimized the shearing force. As discussed previously, a shearing force represents the intra-articular stress on the joint. The unique development of the leg machine was to eliminate standing posture when executing the exercises. The exercise is performed while seated and the legs are exercised against a resistance applied in the horizontal direction. By providing good support for the back, the
press is executed on a seat with the motion restricted to suit the exercise and, at the same time, to minimize the shearing factor. Thus, high shear forces in the lumbar region are eliminated.

For nearly all of the newly designed Universal equipment, the total muscular performance exceeded 85 percent of maximum muscular movement involvement throughout the range of motion. This extended range of motion permitted maximum training for each muscular group involved.

After Universal Gym introduced the first few DVR machines and explained the biomechanical principles, which I had taught them, the reaction from their competitors was immediate and fierce. I realized how difficult it must have been for Galileo when the soldiers locked him out of his house for telling the World his calculations indicated that the Sun rotated around the Earth. I am not trying to compare myself to Galileo who was one of the greatest scientists of the last 600 years. Rather, that we had each done something that was correct but revolutionary for its time.

From 1974 and for years after, thousands of Universal Gym machines were sold around the globe. Universal hired CBA to send me around the World to present my research at various conferences. We both benefited from this relationship since they received publicity from a well-known biomechanist and I was able to present the CBA technology in conference settings. My personal goal was to attract companies interested in our quantification technologies that would hire us to perform work on their products. We already had a proven track record of positive results and this was a wonderful opportunity to present my company in favorable settings.

The strategy was working well until one day when, unexpectedly, an article was published in the Athletic Journal, which was one of the main fitness and exercise publications at that time. The title of this article was “Criminal Fraud or Unbelievable Stupidity” and the author was Arthur Jones. I had never heard of Arthur Jones before that article was published but he blasted into my world like the meteorite that smashed into the Yucatan peninsula 65 million years ago contributing to the end of the dinosaurs. As events evolved, Arthur Jones was prehistoric in his thinking.

I soon discovered that Arthur Jones was the owner and the founder of the Nautilus Company. Nautilus was a major commercial competitor of Universal. The article was seven pages in length and hurled many outlandish claims against both Universal and me.
Arthur Jones was allegedly a wild and eccentric character in his own right. The claim was that he always carried a gun and, according to urban legend, he had pistol-whipped people when he was provoked. He owned two 707 airplanes which he used to fly his exercise equipment units from their manufacturing base in Columbia to the U.S. for sale.

In his younger years, Arthur Jones had lived in Africa where he filmed and produced a television program called “Wild Cargo”. It was a popular show in America because it showed daring and exciting rescues of African animals which were in danger from situations such as environmental threats or poachers. After he had left Africa, he moved to a small town in Florida, Lake Helen, where he had based his Nautilus Company. He had a collection of unusual pets including snakes, spiders, quails, and a big crocodile named Jack. I always knew him to be a great animal lover. In fact, in his later years, he flew 63 baby elephants to his farm in Lake Helena from Africa where they were to have been culled. (For those who do not realize it, “cull” is a fancy way to hide the real meaning which is the “selective slaughter of wild animals”). Arthur saved these baby elephants from death.

To the best of my knowledge, Jones never finished elementary school and, most certainly, had no advanced academic education. He was what is known as “street smart” and had used his imagination and intuition to develop monstrous exercise equipment. Unfortunately, his machines were massive and, although extremely well made, they were exactly backwards for the purpose of dynamic strength development. The machines had to be used at a slow, deliberate speed. If the exerciser tried to move quickly, enormous inertia was generated which caused the weight stack to move upward rapidly. The result was that the exerciser could develop hypertrophy, but not the strength needed for dynamic athletic activities. Athletic activities require fitness training to be dynamic rather than slow and steady.

Athletic events are nearly always explosive movements. Hitting a golf ball or swinging a baseball bat involve sufficient muscle resources contracting together to hit the object as far as possible. These explosive events require muscles to contract together, in synchrony, with power rather than with a slow, regulated pattern of control. A slow controlled movement, such as painting with a brush or tracing a line with the finger, does not require a dynamic burst of muscular contraction. These two different types of movements dictate different types of training protocols. Training for slow movements will not improve batting in baseball. On the other hand, training for explosive events, such as the shot put, will not be improved with slow controlled exercise regimens. Therefore, the Nautilus equipment was fine for some activities but not for sports training.

It seemed that Arthur Jones first encountered the Universal Gym DVR machines in 1974 at a Trainer Convention in Kansas City. I did not meet him at that time but it was reported that he was extremely angry. The stories of his ranting and raving were legendary. After the show closed, Jones began his attack on me and on Universal.

In his Athletic Journal article, Jones talked about his company and all of his ventures. However, I will present the statements that are relevant to this story.

On page one, Jones stated:

Think it is about time for somebody to make some very plain statements ... and if you are involved in any aspect of coaching or physical training, then the following may well be one of the most important things you will ever read.

Universal Athletic Sales Company is guilty of outright CRIMINAL FRAUD ... or, if not, then they are certainly guilty of almost unbelievable STUPIDITY.

Additionally, ... they are guilty of libel, slander and malicious lies. As well as utterly false claims and phony documentation.
LET ME BE VERY PLAIN . . . the statements and claims now being made by Universal are not merely "over-statements" nor anything even approaching the misleading claims of some other companies in the field of exercise. INSTEAD ... they are making statements that are outright lies, quoting "experts" who do not exist. Trying to "prove" their lies on the basis of research that never occurred.

The field of exercise has been almost literally knee-deep in outright criminal fraud for the last thirty years ... the health foods, the protein supplements, the drugs, the sauna belts, the body wraps, and a long list of worthless or near-worthless equipment; all of the above listed items are of no demonstrated value . . . and the people promoting them are guilty of criminal fraud, or almost unbelievable stupidity.

YET ... hidden beneath a vast covering of worthless products and phony claims, the demonstrated benefits of proper exercise are certainly of great value. The problem has been [and the problem remains] ... just how do you separate fact from fiction? How do you know what to believe? Or not to believe?

The last was a good question but one he forgot to ask himself. He was clearly entitled to his attitudes, ideas, and concepts although I did not agree with most of them. This is a free country and you are allowed to believe whatever you want to think. Some of his complaints were probably hyperbole but, apparently, it made him feel good to expound on them. However, his personal and unjustified attacks on Universal and me were factually wrong, scientifically incorrect, and a mirror image of his own claims.

On Page 2 Jones continued:

“...Then, later, Burke told a number of people that I made threats against his life although, even later, he assured me to my face that he had NEVER made such statements to anybody; that, in fact, he had never said anything to anybody that could even be twisted into being a critical statement regarding me or my products. Ed Burke is a liar and, in due course, we will prove it in court; with a long list of witnesses that will put him in jail where he belongs ... highly respected medical doctors, coaches, trainers, people that a judge will not doubt.”

The man Jones was attacking was Ed Burke the American hammer throwing champion who had competed in the 1968 Olympics Games in Mexico City. Although he had not thrown far enough to win an Olympic medal, he remained the U.S. champion. Long after the events described here with Arthur Jones, Ed Burke resumed his training and decided to compete in the 1984 Los Angeles Olympics. He received the great honor of being elected by all of the American athletes to carry the flag as he led the United States Team into the stadium at the Los Angeles Olympic Games Opening Ceremony.

In 1974, Ed had been working for Universal for many years and I worked with him at shows presenting the Universal machines. I was aware of the fact that Jones had threatened Ed at various times and once he put a gun to Ed’s head. In addition, Jones had threatened Ed and his family so many times that Ed felt the need to move from Fresno, home of Universal, to another city. Since I spent time with both of them over the years, I can say without dispute, that Ed Burke was and is an honorable, honest person. I cannot say the same about Arthur Jones.

On Page 3, Jones continued his rant:
"A few months after that telephone conversation, Universal suddenly sprang their "HERO" onto an unsuspecting world ... the "great doctor" Gideon Ariel, according to their ads, had invented a new and totally revolutionary type of Universal Exercise machine with variable resistance. Which variable resistance, of course, was "exactly correct."?

Well the facts are that Gideon Ariel is an outright fraud ... AND, rather than provide a perfectly balanced "variable resistance," their machines DO NOT VARY AT All, remain absolutely constant in all positions. When I first saw their initial ads, concerning the new Centurion line of Universal machines that supposedly provided variable resistance, I simply could not figure out how it was supposed to VARY. Then, when I first saw the machine itself, I instantly realized that it doesn't vary, that it is exactly the same in every position. So I approached the great doctor, Gideon Ariel, and I asked him ... "How much does your leg-press force increase during the full stroke?" And he said, "The exact amount for the mean average." (Which is pure double talk nonsense.) I said, "Tell me in figures, so a dumb guy like me can understand. What percentage does it increase?"

Because ... in order to vary the resistance you must vary the torque; and in order to vary the torque you have to change either the leverage or the perpendicular force, or both ...and since both remain constant in this machine, it should be obvious to an idiot that the resistance doesn't vary. Then I offered to bet him a thousand dollars that his machine didn't vary at all, that the resistance remained absolutely constant in every position. He refused to bet."

"Later that night I offered to bet one-hundred thousand dollars against a "used doughnut" that the Universal machine didn't vary at all; this bet being offered to and refused by Chuck Coker, the President of Universal. When I first met Gideon Ariel, I didn't know him from Adam . . . but it didn't take long to check him out ... and, in any case, it was obvious at first glance that he was either an utter fool or guilty of criminal fraud. If he really believed his statements, then he was almost unbelievably stupid. And if he was aware that his statements were lies, then he was guilty of criminal fraud. Take your pick; there is no other choice, fool or fraud."

Jones was correct in saying he did not understand how the DVR functioned. He was clueless and wrong about how the mechanism functioned on the DVR machines. His ignorance and outrageous hatred were staggering. The most amazing part of the entire attack was that he was wrong about all of his scientific claims and, therefore, guilty of exactly what he was accusing others of doing or being.

At this point, I should not have been surprised to read that one of my old adversaries from the University of Massachusetts, Dr. Plagenhoef, would come back to haunt me through the distorted lens of Arthur Jones.

"Having thought so, and having discovered much what I expected to after meeting Ariel. I invited Professor Stan Plagenhoef of the University of Massachusetts to come to the Trainers convention in Kansas City for the purpose of confronting the great doctor Ariel.

Professor Plagenhoef, you see, were Gideon's former teacher ... and, at the moment, are bringing charges against Ariel for fraud, lies, false statements and false claims and similar outrages.

Then I said ... "Gideon, I want you to know that your Professor, Dr. Plagenhoef, stood up for you ... you see, Gideon, I was worried about you; I thought you are guilty of criminal fraud ... so I asked your professor if it was really possible for you to be stupid
enough to believe your own claims. And he assured me that you were ... he told me that you were so dumb that you were capable of believing almost anything.

For your part, be you coach, trainer, doctor or athlete ... it would pay you to investigate the facts; and if you have been unlucky enough to purchase a Universal machine advertised as providing "variable resistance," then you are also in a position to bring charges of fraud against Universal.”

I was not surprised that my old adversary, Dr. Plagenhoef, was attacking me even with the likes of Arthur Jones. What did shock me was that my professor, the one who had taught me Biomechanics and accused me of not knowing enough about engineering to have my own company, was unable to understand how the mechanism that I had devised for the Universal machine varied the resistance. Not liking someone is insufficient proof for misunderstanding basic physics and engineering principles.

An engineering professor of mine, Paul Tartaglia, and I had designed a sleeve mechanism which we attached to the bar. This mechanism consisted of a roller that always applied the force perpendicular to the bar. What this accomplished was that when the bar was pushed, the moment arm became longer and the resistance increased. A diagram illustrating this system is shown below:

It was understandable that Arthur Jones lacked sufficient engineering education to make the appropriate calculations to realize how the force applications were made possible by the DVR mechanism. But when Professor Plagenhoef was unable to make the correct assessment, I could only surmise that he did not want to recognize the simplicity and cleverness of the device. Either he did not calculate how the device worked or was merely blinded by hatred for me personally.

After the spectacle of the show, Harold Zinkin arranged for me to travel to Universal’s home site in Fresno, California. Based on the accusations, despite the craziness of source, we concluded that it would be a good strategy to have the machines tested by an independent professional testing equipment company. One of the leading companies for this task was Truesdail Laboratories. I was familiar with the company since they had been instrumental previously in the Johnny Carson case.

Truesdail Laboratories agreed to test the equipment and provide detailed results. Universal provided the machines for testing with the specific purpose to determine whether they varied in resistance as I had calculated. There was no question that the resistance changed. However, the primary issues were the accuracy of my calculations and the functionality of the equipment to perform as desired.

The results calculated by Truesdail’s were amazing and positively confirmed that the DVR performed as I had planned. As a scientist, I was very happy to discover that Truesdail’s results varied less than one percent from the results which I had calculated. The machines did, indeed, vary as the person exercised exactly as they had been advertised to do. Now, Universal had an independent third-party confirmation regarding their claims. Arthur Jones’s diatribe had been wrong on many levels and now Universal could proceed to prove this in a public forum. Step one was to print and circulate the Truesdail
results in a handout available at all of the trade shows. The cover of this brochure is shown below and the text is available in its entirety on the internet.

After the Truesdail results had been published, Harold Zinkin again asked me to come to Fresno as soon as possible. I flew from Amherst to Fresno where Cliff Cocker, who was Chuck Cocker’s son, met me at the airport. Cliff had served in the U.S. Marines in Vietnam and was a war hero with a chest covered with medals. On the way to Universal’s office, Cliff told me that Universal was launching an incredibly important project and that he had been selected to head this initiative. I was pleased to hear that Cliff was going to be placed in a leadership role. For the last several years, I had come to know him and was very impressed with his abilities as a planner and leader.

When we arrived at the Universal, I walked into Harold’s office and saw a large conference table surrounded by a number of individuals with serious and intense expressions on their faces. Harold Zinkin sat at the head of the conference table with one of the Universal engineers, Dennis Kiser, their sales manager, Ed Burke, and the president of Universal, Chuck Cocker. Cliff Coker, the head of research and development, and I sat down at the table and all eyes focused on Harold. I imagined that this environment must be what every campaign resembles before the combat begins.

Harold said, “Gideon, here is what the plans are for the immediate future. Universal is going to file a multimillion dollar lawsuit against the Nautilus Corporation and individually against Arthur Jones.”

Cliff continued the thought, “The claims are based on the erroneous statements Jones made in the Athletic Journal, defamation of character issues, and the physical threats Jones made at the Kansas convention.”

“What do you want me to do to help?” I asked, pleased that they were going to do something about the outrageous lies and misinformation Jones had published.

Harold leaned forward and said, “We want you to analyze the Nautilus machines. We want to know specifically and scientifically what the Nautilus machines actually do with regard to their claims of providing resistance as well as whether the other performance parameters they claim are correct. We will send an official request directing you to conduct this research.

“Of course,” I said. We can perform all of the analyses and prepare a report for you. I then suggested how we could acquire the data and, afterwards, I would perform the biomechanical analyses on the Nautilus equipment.

This project required some subterfuge. We had to take films of the machines without alerting Arthur Jones or any of his sales staff about our activities. Fortunately, Ed Burke and Cliff Coker had many contacts in the exercise and fitness world so they were able to find the Nautilus equipment and arranged for us to film the various machines.
The Green Brochure

http://arielnet.com/ref/go/1151

http://arielnet.com/ref/go/1152
After we had the film, it was business as usual, biomechanically speaking. We used the CBA equipment, personnel, and technology to evaluate how the Nautilus machines performed. After we had the data on the Nautilus, we compared them with the Universal Machines.

CBA provided a detailed, in-depth report to Universal Gym. The report included details about each Nautilus machine and a specific comparison with the appropriate Universal equipment. It was lengthy and filled with scientifically calculated biomechanical results obtained under dynamic conditions.

Following the receipt of the report from CBA, Universal prepared a large brochure to detail the findings we had made. This brochure had a bright, electric green cover and has been referred to as “The Green Brochure” even to this day. “The Green Brochure” can be read in its entirety in Link above.

The beginning pages of “The Green Brochure” identified specific pieces of equipment and presented detailed analysis regarding their strengths and limitations. Needless to say, the DVR on the Universal equipment provided more resistance throughout more of the exercise stroke. These strengths were specifically identified. For the Nautilus machines, on the contrary, the limitations were explained in detail and provided the biomechanical and engineering flaws inherent in the equipment.

In addition to quantifying the specific equipment and presenting comparisons, there was a section which addressed the “Principles and Terms” as they related to the conditioning of the human body for strength and fitness. The message presented in the section was to make it clear that any resistance, which a muscle had to overcome, would be beneficial in the development of muscular force. There were differences of opinions between the two companies regarding training principles and the relative effectiveness.

It was explained that there are two primary types of muscular contractions within the human body which are involved with athletic and normal movements: concentric and eccentric. A third type of muscular contraction, isometric, involves the generation of force by the muscles involved but there is no movement of the limbs associated with the generated forces.

Since fitness training involves limb movements, the research focus was restricted to evaluations only of concentric and eccentric motions. Concentric contractions are when the muscles pull one limb segment towards another which reduces the angle between the two segments. With concentric contractions, the muscle becomes shorter. For example, holding a weight in the hand and moving the arm so that the forearm moves upwards will reduce the internal angle at the elbow. Eccentric contractions are the opposite movements. The muscle lengthens and the angle between the segments increases in size. Holding a weight in the hand, with the weight touching the upper arm, an eccentric contraction would lower the lower arm resulting in increasing the internal angle at the elbow. Another set of terms frequently used to define concentric is “positive work” and eccentric is “negative work”.

Daily life activities and sports are blends of these two types of muscle contractions. Walking is an excellent example since it requires bending and flexing of the leg joints, the stabilization of the torso, and balance is assisted with arm motions. Exercise training can focus on many levels. Many people are merely trying to produce strength for a healthy daily life while others are attempting to win Olympic medals or achieve other maximum goals.

There were major differences between Universal and Nautilus in achieving these varying goals. The philosophy of training principles and the relative conditioning effectiveness was the ultimate goal of strength development and fitness. The manner and construction of the equipment for each, however, significantly affected the results of training.

One of the most obvious differences was the emphasis on concentric (positive force) with the Universal equipment compared to the heavier reliance on eccentric (negative force) with Nautilus. This was manifested primarily through the construction of the machines. Universal employed the DVR device, which allowed the exerciser to maximize the concentric contraction throughout most of the exercise
stroke. Nautilus advocated negative resistive training or eccentric motion and they recommended slow movements in both directions.

With regard to the Nautilus equipment, it was unknown whether the slow speed was recommended because of the belief that strength was developed most readily with this exercise technique or rather that slowness was necessary because of the equipment design. The design of the equipment of the weight stack and cam arrangement on the Nautilus equipment precluded rapid movements. If an exerciser moved quickly, the inertia due to this rapid movement resulted in the weight stack flying up in the rack. The result was that with very little initial effort, large displacement of the weights resulted. In other words, with a relative small effort at the beginning of the exercise, the weight stack would essentially “lift itself” due to inertial forces. Therefore, in order to exercise more of the musculature, the exercise action had to be slow so that the weights were moved by the person rather than by inertia.

“Negative resistance training”, that is eccentric, is simply the exertion of maximum muscular effort while lowering a weight from the extended or ending position back to its original starting point. In the previous example, when the weight in the hand was lifted up to touch the upper arm (bicep curl) this constituted the concentric portion of the exercise. Returning the weight downwards to the starting point would be the eccentric phase of the exercise. Although there is a natural muscular system of concentric-eccentric action, Nautilus placed greater emphasis on the lowering or negative phase of the movement. Furthermore, the performance which they espoused was to execute the exercise strokes, in both directions, with slow, controlled speed.

Arguments have continued, before and after that time, concerning the efficacy of concentration or eccentric contractions for athletic achievements. There appears to be no scientific basis that training in a negative or eccentric fashion will improve the strength of athletic performance. There does seem to be more bases for training all of the muscles for dynamic or explosive events.

Athletic events are primarily concerned with the development of “Functional Strength”. “Functional Strength” has been defined as the force variations in a particular displacement (direction). The first rule in any weight-training program should be to train the muscle in a positive manner to enhance the development of “Functional Strength”. The characteristics of athletic “Functional Strength” include the ability to instantaneously change the degree of: speed, force, direction, and intensity.

When exercising a muscle in a negative fashion, the motion or direction, as well as the speed of the movement is opposite to the required (positive) motion and develops a negative central pattern which may be detrimental to “Functional Strength”. Negative training over a long period of time may actually produce impaired coordination as well as a reduction in athletic ballistic efficiency (speed of the movement). There may as well be reductions in the biochemical activities within the muscle although this remains to be proven.

In other words, the athlete should be able to generate the maximum amount of force at every point of the movement rather than slowly under control. When a shot putter throws the shot, the direction is away from the athlete out into the field. Training should be a dynamic, explosive activity just as throwing the shot is. Using eccentric training, on the other hand, would be appropriate in this example, if the shot putter wanted to catch the shot. Yoga training requires slow, deliberate movements and may be enhanced with concentric, eccentric, and even isometric exercises.

The second rule for a weight-training program is to “Train to Perform”. Every athletic activity has its own unique muscular demands. For example, some activities may require greater leg strength while others require greater arm strength. In addition, they also may differ in the direction in which the force is applied. In general, a high jumper needs more leg strength to be applied vertically while a long jumper requires greater leg strength for translation in a horizontal direction. Each of these jumping events requires leg strength but the performance criteria for each event are different. Strength development must be developed appropriately in conjunction with the correct performance technique. Therefore, the ability to exert a maximum force at only one isolated joint angle, such as with an isometric contraction, would not contribute to the efficiency of either of these sporting performance.
Due to these differences, it is essential that training routines develop “Functional Strength” as well as “Train to Perform” in ways which closely simulate the desired activity. It would appear rather obvious that maximum athletic performances cannot be achieved through negative training, isometric programs, or exercising every athlete with the same fitness protocols.

The advantage that the Universal DVR equipment had was that the exercise motions more nearly reflected the anatomical and neurological system in the human. The DVR maintained a natural lifting ratio while the resistive intensity was instantaneously adjusted to accommodate the mechanical changes. The adaptive mechanism, which the DVR provided, allowed for maximum muscular efforts throughout the entire range in motion. Only Universal was superior in the ability to accurately adapt to the complete resistive needs of the exerciser’s movement and successfully employ them into a failure-proof lifting system.

Fortunately, the third-party evaluator of Truesdail’s Laboratory corroborated all of these claims. I had maintained confidence in the calculations that CBA and the Universal engineers had made and in the products that had resulted from them. It was gratifying that an external, unbiased third party had verified our calculations and designs Universal’s marketing department immediately began to distribute the “Truesdail Report”.

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Eventually the report reached Arthur Jones. Apparently, his response was rapid. When Jones got the “Green Brochure,” he begged Universal to take it out of the market place. His urgent communications to Universal reflected obvious desperation since his previous behavior was nothing short of belligerent.

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Arthur Jones’ request for Universal to take the “Green Brochure” out of circulation prompted a phone call from Harold Zinkin. He asked me to come to Fresno as soon as possible to discuss the future with regards to Arthur Jones.

The next day I was once again flying for hours across America to meet with Harold Zinkin about Arthur Jones and Nautilus. This was prior to the long lines and extensive security checks of our modern world, so most of the time was spent flying. Still, the entire Arthur Jones episode was dysfunctional, unproductive, and the opposite of uplifting. Whereas the DVR development had been a rewarding challenge, its defense against the opponent could politely be described as a major pain.

Once again, the meeting consisted of Harold Zinkin, Chuck Cocker, Cliff Cocker, and Ed Burke. This time, however, additional participants included Universal’s attorneys. We sat around Harold Zinkin’s large conference table and there was the sense of great victory among the Universal staff. The primary focus of the discussion concerned Arthur Jones’ sudden proposal to settle the legal battle between the two companies. He had expressed his willingness to compensate for damages and pay legal fees.

The next afternoon, the meeting was with Arthur Jones in Harold’s office. The initial discussion was limited to Harold and me with Arthur Jones. The two attorneys, one for Universal and one for Nautilus, waited outside the room. I have no doubt that the lawyers were concerned and perplexed about what they must have envisioned as shenanigans going on behind the closed office door.

I sat quietly at the table without saying a word. I had no need to speak, as yet, while the presidents of the respective companies hammered out some of the large details. After a long discussion and finger pointing by both Harold Zinkin and Arthur Jones, they arrived at a tentative agreement. I listened to their proposal as it developed and, when they asked how I felt about the terms, I agreed with most of them.

The proposed out-of-court settlement consisted of the following steps:
1. Arthur Jones would publish a retraction immediately to his statement in the Athletic Journal. The retraction was to appear in that same journal and in several other mutually agreed upon media sources.

2. Arthur Jones would pay cash to me (I prefer not to mention the amount, but it was substantial).

3. Payment to Universal would be separate from Arthur Jones’ payment to me.

4. In addition to the cash payment, Arthur would pay me an additional $200,000 in installments each month and were to be referred to as “consultation fees” for movie making. This reflected Arthur Jones’ plan to produce some fitness movies in which I would appear as one of the guests.

I was displeased with the movie option since the relationship between Arthur Jones and me had been quite contentious. However, Harold convinced me that it would be good for both companies and, to the outside world; it would look as if the “War” between Universal and Nautilus had ended. Reluctantly, I agreed, but only because of my deeply felt respect for Harold.

At one point during the conversation, I asked Harold about what would happen to Ed, Cliff, and Chuck who had been attacked by Arthur Jones, as well. Harold answered that the damages specified in the agreement were to cover only him and me. He would work with Ed, Cliff, and Chuck from within his Universal compensation. Because of the confidentiality of the settlement, this is the first time I am revealing some of the terms of the agreement.

Unfortunately, peace and quiet lasted a relatively short time. Within two years, another incident occurred with Jones which started a new legal battle with him. He, predictably, stopped sending the required payment to me and the wasteful time spent traveling to Lake Helen, Florida mercifully ended. That episode was relatively short and, actually, I was only a sideshow in Arthur Jones’ on-going problems with the IRS.

The wars between Universal and Nautilus as well as between Arthur Jones and me were finally finished. Corporations and individuals often try to destroy innovative people who have new ideas. These attacks frequently result because their own ideas are no longer relevant or because they prefer to avoid
competition. I felt vindicated that the DVR, which my staff and I had proposed for Universal’s exercise equipment, had been proven to be scientifically accurate and correct. The biomechanical motion analysis system had produced accurate data. Science and knowledge always win, but sometimes it takes time. The entire Nautilus experience poisoned my attitude and I was more guarded about in ventures in the future.

Arthur Jones' retraction
Chapter 12: The Olympic Connection

Through my work, I have met many great athletes. Three of the greatest ones were Al Oerter, winner of four consecutive Olympic Gold medals in the discus throw; Bill Toomey, the Gold medalist in the decathlon in Mexico City; and Russ Hodge, 1964 Olympic competitor and the world record holder in the decathlon in 1966. Interestingly, Russ and his mother, Alice Arden Hodge, is the only mother-son Olympians in American history.

In the early 1970s, Bill Toomey was the head Track and Field coach at the University of California at Irvine (UCI). He invited me to UCI to demonstrate my methods of athletic evaluation based on the system he had seen me use with the Olympic throwers at Dartmouth College training camp. We became really good friends and Bill visited me a number of times in Amherst. We even had a number of joint business involvements.

Russ Hodge traveled to Amherst to meet me and learn about the biomechanical system I was using. Since CBA had received magazine and television coverage in addition to my presentations around the world at conferences, Russ was curious to see for himself.

It was in one of these meetings with Bill Toomey and Russ Hodge that the idea of an Olympic Training Center was born. I often described my 1972 visit to the East German Olympic training facilities in Leipzig. Usually, I would become animated in the descriptions of how the United States lagged behind the East Germans and other Soviet bloc countries, in their athletic training. I complained that the United States relied strictly on DNA to win events. There was so much talent in the U.S., but no one optimized the athletes’ abilities but rather left them alone to do their best. With far fewer people, the East Germans focused their combined efforts to harness science and nutrition into their training.

For hours we discussed the future of sports in the United States. Bill and Russ both realized the advantages of the technology that I had to offer. So, Bill asked: “What are we going to do to make a Training Center come about? We need to approach the United States Olympic Committee’s director, Colonel Miller. If we proposed it as a Sports Medicine Center for the U.S. Olympians, perhaps he would be persuaded. It would really be helpful if we can find a physician to join us.”

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**Bill Toomey**
http://arielnet.com/ref/go/1154

**Al Oerter**
http://arielnet.com/ref/go/1156
http://arielnet.com/ref/go/1157
It just so happened I knew a doctor who had been an Olympic athlete. I had met him in Israel in 1957 when I competed in the Maccabean Games. These games are held every 4 years as a Jewish Olympics and Jews from all over the world travel to Israel to compete in this meet. In 1957, I was still in high school at Hadassim but competed in the youth class and won the discus throw. The then-famous American, Gary Jay Gubner, who lived in New York, won the shot put event. A medical student won the 400-meter race by the name of Irwin Dardik. We met during the social events of the Maccabean Games and engaged in general conversations about sports and Israel.

I was surprised to discover that both Russ and Bill were also acquainted with Irwin Dardik. In these early years of the 1970s, Dr. Dardik was a famous cardiovascular surgeon. In fact, he had been nominated, with his brother Herbert, and Ibrahim Ibrahim, for a Nobel Prize in medicine. As a cardiovascular surgeon, Dr. Dardik had searched for coronary bypass grafts that were sufficiently long, without holes, and compatible with human beings. Through his medical experiences, he knew that following the birth of a baby; the umbilical cord was thrown away. This was a perfect solution to his dilemma. The umbilical cord was long enough to serve as a graft, there were no holes or valves, and it had been road-tested, so to speak, for nine months. What Dr. Dardik and his team had to invent was a technique to delete or nullify the human identification so that the recipient could use it as an implant without causing rejection. They had successfully developed such a technique and, hence, the Nobel Prize nomination.

Although Dr. Dardik was a brilliant and successful medical doctor, he was still very much an athlete in his heart. He had wanted to compete in the 1956 Olympics in Melbourne in the 400-meter dash. Unfortunately, he failed to qualify for the American team and planned to try for the 1960 Rome Olympic Games. He entered medical school and this ended his dream of competing in the Olympics. "In those days, you couldn't just leave medical school for something like running in the Olympics," he used to say. So instead of achieving glory as a quarter-miler, he achieved fame as a vascular surgeon. But, as they say, "You can take the boy out of the city but you cannot take the city out of the boy." In spite of his joy and success as a physician, Dr. Dardik never lost his love for running, nor his dream about the Olympic Games.

We decided that the best way to convince him was to show him the technology that we already used for athletes in our Amherst office. Dr. Dardik was sufficiently intrigued about what we wanted to present that he was more than willing to come at his first convenient date. Dr. Dardik was a tall, handsome man with an inquisitive and creative mind. I gave him a full presentation of what we were doing, and Al Oerter told him how much the scientific methods had helped him to throw much better, even at an older age.

"When I was in 42, sports scientist Gideon Ariel determined that I could throw 75 meters without any problem, if I just maintained the acceleration that I began with in the actual throw. In 1984, at the age of 47, I went even further using his technology. I was working with him and it was very hot and I started to get more and more angry because of camera problems that day. I pushed harder and harder for every throw and started landing the discus on the hill and then on the other side. They tried to measure it and found that it was 217 feet to the base of the hill, which was 15 feet high, and finally measured my throw to be around 245 feet long!"
Dr. Dardik was very enthusiastic about the idea of better training for the U.S. athletes and he liked the technology, which CBA had been using to analyze people, products, and their interactions. All of us were committed to the health of athletes in addition to the opportunity to help them improve their athletic skills. Dr. Dardik also foresaw medicine as being preventive, before many others did, and so he liked the idea of a center where everyone was working toward optimum health. We shared the ideal that positive-health related ideas developed in the Training Centers would flow to the general public. These goals were in addition to helping the U.S. athletes achieve Olympic victories.

After a long day of sharing ideas and considering many alternatives on how to proceed, the decision was made to approach Colonel Miller with our ideas. Dr. Dardik and I contacted Colonel Miller and, based on the credibility and successes in our respective fields of expertise, he agreed to meet us in New York City. At that time, the home office of the United States Olympic Committee (U.S.O.C) was in New York.

Shortly after our meeting in Amherst, on a sunny day, Dr. Dardik and I met Colonel Miller at the Algonquin Hotel in Manhattan. Colonel Miller was a tall, handsome athletic man, of military bearing, but warm and upbeat. He listened intently to our vision for success for the American athletes and the plan we proposed to accomplish the task.

Once again I described the scientific focus that the East Germans used for training in their Leipzig Center, as well as their other more secret locations. Although the United States is a huge country in size and population compared to the East Germans, they were far superior to the Americans in the support and preparation given to their athletes. The East Germans had decided to make athletic success a national
priority and then set the plan into motion. We, on the other hand, only gave attention to our American athletes when they paraded into the stadium during the Opening Ceremonies. During the intervening four years, the American athlete was left in the wilderness, with regard to support.

In addition to what I had seen in Leipzig, I explained the wide variety of options that we could and should provide to our own athletes. I presented our vision for a U.S.O.C Training Center that would rival anything that the Eastern bloc countries had. Our ideas were based on quantification of the sport and the athletes in conjunction with proper training, coaching, fitness, and nutrition but we would excel without the use of any performance-enhancing drugs. These goals could best be achieved in a focused, supported living and training environment, such as the Olympic Training Center idea that we were proposing. It seemed to me that I had spent a lot of time on this Olympic training soapbox, but maybe this time someone would hear my plea and be able to do something to affect it.

As the meeting progressed, Colonel Miller became increasingly excited about the idea. He was as frustrated as we were about the continuous defeat of American athletes by, seemingly, everyone. He told us that the statistics showed that the United States had dropped from first place to third place in the overall medal standings. Colonel Miller wanted the United States to be strong and successful. This desire was more than just part of his job. Success grew and developed from a deep sense of honor and loyalty, which he felt for the United States.

But Colonel Miller also had to be practical so he posed many of the obvious questions, such as where to establish the first center and how will it be funded? He pointed out that even a good idea costs
money and, in addition, there had to be organizational infrastructure to operate the Center. These were legitimate questions. The first order of business, however, had to be the willingness to recognize the need and to accept the challenge. If and when the decision was made to proceed, the questions and solutions could be addressed with a dedicated organizational will to accomplish them.

Colonel Miller agreed with our ideals and goals. He was as determined as we were to provide more and better opportunities to the American athletes. As the Head of U.S.O.C, he was obviously the best man and in the right place to get things done. He appointed Dr. Dardik as the Chairman of Sports Medicine Committee and I became the Chairman of Sports Science, which included physiology and biomechanics.

Colonel Miller’s task was to organize the structure and funding for the U.S.O.C Center, which would be put in place, as soon as an appropriate site was selected.

I immediately began thinking and organizing about the Sports Science Committee. How should it be organized and who should direct the separate areas. Another critical factor was to coordinate each area and focus on the primary task, which was to help the athletes. It needed to be emphasized repeatedly that this was not to be perceived as a university study project, but rather a joint project for all the disciplines to help the athletes excel in their sports.

For the biomechanics portion of Sports Science, my personal extensive experience as an athlete, a coach, and a biomechanist was immediately applicable. To begin working with athletes immediately, despite the lack of a U.S.O.C Training Center, I thought that we could use the existing CBA facility in Amherst to analyze the athletes. After a permanent site was established, we could move the biomechanical quantification abilities there. It would obviously be more efficient to have all of the Sports Science departments in the same place and at the location where the athletes lived and trained.

Initially each athlete would be filmed in his/her event. If possible, the film would be during actual competition since this was the most realistic representation of the performance. The subsequent biomechanical analysis would include a comprehensive report for the athlete with a specifically prescribed training program for performance improvement. Also, corrections could be given, where appropriate, and computerized optimization programs would allow the athlete to estimate the performance potential. Other recommendations could be applied such as comments regarding specific fitness routines for that sport or athlete, physiological testing schedules, as well as anything that appeared to be reasonable for improvement.

The biomechanical analysis would include comparisons to world-class athletes in that sport. This would provide both the athlete and the coach with comparative information. Hopefully, the athlete would be inspired to attain the same or similar technique results, as well as having a performance target. After all, what athlete does not want to achieve what the Gold Medal winner or World Record Holder was able to surpass.

The athlete’s coach would receive a separate report with special considerations for that individual. Seminars would be held at the training centers to address the athletes and the coaches on the findings in their particular sport. In addition, seminars for coaches would be provided to facilitate inclusion of the scientific method of analysis into their coaching procedures.

I sent these proposals to Dr. Dardik and Colonel Miller and continued working on other projects while I waited for their responses. Ironically, during the interim, I was conducting research on ski boots. In order to collect the data on ski boots for the Salomon Corporation, we had to go to Squaw Valley, California, which had been the site of the 1960 Winter Olympics. Squaw Valley is a beautiful area with a wide valley bound by mountains. In the summer, the meadows and slopes were covered with green and abundant wild flowers made the valley into a wonderland of nature at its best. During the winter, the valley became a sparkling white winter wonderland with brightly colorful skiers everywhere.

During some of the ski boot tests, I had the chance to meet the owner of Squaw Valley, Alexander Cushing. His manager, Mr. Black a South African, had been quite helpful to us with filming the skiers in Squaw Valley. While we were having lunch one day, I suddenly had the inspiration to ask him about the
potential of Squaw Valley becoming a location for an Olympic Training Center. He listened to my ideas and surprised me by responding that he would discuss the matter with Mr. Cushing.

I called Dr. Dardik and told him about my conversation with Mr. Black. We were both very excited about this promising lead. I gave the phone number to Dr. Dardik and he immediately called Mr. Cushing. A meeting was arranged and then things progressed rapidly.

After a few meetings in New York with Colonel Miller and a visit to Amherst to my Laboratory, the dream materialized. An official Olympic Training Center in Squaw Valley was established for the availability, coaching, training, and living for athletes on a permanent, year-round basis.

There were dormitories for more than 300 athletes and the spacious dining room facilities were open 24 hours per day. Billiard and Ping-Pong tables, as well as a small outdoor swimming pool, were in almost constant use. A soft drink machine dispensed free beverages, such as water and electrolyte drinks. “It’s quite a bit like a mini Olympic Village, without the tremendous pressure of the Games,” said Whiting, the camp director.

Director Whiting was a 50-year-old retired Army colonel who had previously been in charge of the Modern Pentathlon training camp in San Antonio.

The strategy was for athletes to come to Squaw Valley for two-to-three week sessions periodically during the year. This would allow them time to maintain their ordinary lives and, presumably, work schedule. For those athletes who needed a permanent base for living and training, they could stay full-time at the Squaw Valley Camp. The flexibility of schedules was achievable with a permanent base of operation, which the Squaw Valley facility afforded us. This allowed the athletes to be analyzed during their residency using the biomechanical technology provided through CBA along with the exercise physiology tests. The physiology department was under the direction of Dr. Fritz Hagerman.

Since the Squaw Valley Center had previously focused primarily on ski related events, they had only minimal weight training equipment. For World caliber athletes, the exercise facility needed a major overhaul, as well as many and varied exercise equipment. I contacted Harold Zinkin, my old friend at Universal Gym. I described the situation as it currently existed and told him that this was an opportunity for Universal to contribute to American athletes. In addition, it would be a feather in their advertising cap to be able to claim that their equipment was being used at the official U.S.A. Olympic Training Center where top athletes trained on Universal Gym exercise equipment. Harold immediately said, “Agreed”. Under the supervision of Ed Burke, who was both an employee of Universal and also the former
American record holder in the hammer throw, the Squaw Valley Olympic Training Center possessed one of the most sophisticated Exercise Training Rooms in the world.

Now Colonel Miller, Dr. Dardik, and I eagerly contacted everyone that we could to find funding, equipment donations, or any type of corporate sponsorships. We talked with people that we knew personally and followed every lead in an effort to create the best training facility for the American athletes.

Fortunately, there was more patriotic fervor in the population at large after some of the most recent drubbings that the U.S. teams had experienced. This attitude was something that many corporations could use to their advantage in advertising, so we were successful in getting almost any necessary equipment. Companies like Universal, Yager, Cybex, and others donated their best equipment to the Center. It was a wonderful confluence of interests with athletes benefitting from the equipment and the companies being able to advertise that the best American athletes at the U.S.O.C Training Center were using their products.

Dr. Dardik, with his Gold Medal in Medical Achievement, gave tremendous credibility and confidence to our concept, my contributions in biomechanics, and Colonel Miller as Head of the U.S.O.C was in constant demand for interviews. We tried to use every forum available to spread the word. Our goals were to attract the athletes to train at the Center and to garner support from individuals and corporations. We wanted the entire world to know what our vision was and how we hoped to achieve it.

As we had planned, one of the Olympic Sports Medicine Committee’s major roles was to analyze and study the body as it related to the sporting event performances, which were contested, in the Olympic Games. One of the purposes of the Training Center was to bring together various experts from all over the country with different areas of expertise and pool their resources. The concept was to gather, process, and use as much information from many different areas. The synthesized information would be provided to the athletes, coaches, and trainers to maximize training and performance. Also, the center would be used as an educational institute with medical and scientific people continually rotated through Squaw Valley. They would bring knowledge into the center and, in
turn, return to their home institutions with the new knowledge they had acquired. I was specifically assigned to the area of Biomechanics and Dr. Fritz Hagerman was assigned to the area of physiology.

After a few months of successful operation with various teams that came to the Training Center and staff hired to run the camp, Dr. Dardik was assigned to choose his Sports Medicine Committee. At the first meeting of the Sports Sciences Committee under the chairmanship of Dr. Dardik, I was appointed to be in charge of Biomechanics. The other six-committee members included: Tenley Albright, Allan Rayn, Tony Daly, Dave Costill, Alan Singer, Leroy Walker, and Don Hanley. Each of the individuals represented different athletic organizations related to sports and athletes.

One of the first decisions of the new U.S. Sports Medicine Committee made was for the U.S.O.C to open three regional training centers by the end of 1977. Squaw Valley, California was the first center with other sites being considered in the East and Midwest. The regional training centers would be self-sufficient units that would be able to accommodate a number of sports simultaneously. Training facilities, room and board, staffing and the necessary services would be under the control of the U.S.O.C. Several specific targets for development and training were established at this initial meeting. They included:

1. Athletes would be selected from all levels of ability (elite, junior, novice, and introductory level) and they would be screened at the pilot project level for participation in a training center.
2. Activities that would be included in the training center concept were: short-term intensive training of athletes who were members of teams readying for competition, clinics with practical experience opportunities for athletes, coaches, judges, and officials, specialized development camps for athletes, competition (both domestic and foreign) for athletes training at the site.

3. The regional training centers would be the hub of gathering and disseminating information related to the newly introduced U.S.O.C Sports Medicine Program. The Sports Medicine Concept would include studies, research, and programs in exercise physiology, biomechanics and kinesiology, nutrition, sports psychology, and medical services (orthopedic and internal medicine). Studies and research at the regional centers would provide factual information concerning the use of Bee Pollen, anabolic steroids, blood doping, and other elements that had been purported to have beneficial effects on performance. The Sports Medicine Program would also have the responsibility to correlate the information gathered from various research programs and determine its effects on preventing athletic injuries as well as its effect on preventing diseases common to the American public. The Medical staff would inform the athletic and medical community about their findings concerning training, diet, methods of preventing athletic injuries, and effects of training on preventing diseases. It would be clearly stated that any and all pharmacological elements were never permitted.

For the first year, the U.S.O.C Training Center in Squaw Valley operated with impressive success. As the official Chairman of Biomechanics for the United States Sports Medicine Committee, my assignment was enormous: to biomechanically analyze every sport and every athlete who came to the training center. I conducted hundreds of studies for many teams and athletes. Since there were no computers at Squaw Valley, I used all of the equipment in our CBA facility in Amherst to analyze the athletes. The high-speed film was taken at the Training Center and then it would be flown to Amherst for analysis. In Amherst, we expedited the work so that the analysis was rapidly processed and the reports

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were taken back to Squaw Valley for the coaches to present to their athletes. One important requirement was that the athletes and coaches would receive the reports before leaving the Center. Following a presentation of the biomechanical results, a seminar was conducted with each team to discuss the results and to design the training program based on the quantified results. This process of evaluation, analysis, and planning was to be repeated every few months.

One of the first studies was to analyze the Women’s Basketball team. In addition, my team and I analyzed various team sports such as volleyball, baseball, soccer and others. We also analyzed individual sports in Track and Field, including events such as the shot put, hammer throwing, and javelin. Several studies were performed for the cyclists, as well as for canoe, scull, and kayak rowers.

Before the remarkable surge by the East German and other Soviet bloc countries, the U.S. was dominant in most of the Track and Field events. Just the natural American athletic talent available was enough to win Gold at the Games. But with the advent of focused training, nutritional and pharmacological enhancements by the Eastern countries, the U.S. fell behind. As I had told Dr. Dardik and Colonel Miller, unless we develop our athletes with skills, technique improvements, and nutritional guidance, we will continue to lose to these other countries. With the U.S.O.C Training Centers finally a reality, we had the chance to recover our greatness.

One of the areas that the U.S. had enjoyed success previously included performance in the hammer throw. For many years, the United States held the World Records in the hammer throw because of Hal Connolly. As the last American to win the Olympic gold, at the 1956 Melbourne Australia Games, Harold Connolly had dedicated his life to the event. It was his goal to see America once again among the world’s best in this event. Hal Connolly’s athletic career was amazing. He transformed himself from a young handicapped child outside of Boston to becoming a household name around
the world. He devoted his career to helping young athletes in Track and Field events including his two sons, who were also successful hammer throwers.

In the intervening years since Connolly’s 1956 Olympic victory, however, the American hammer throwers had failed to produce distances comparable to those of their Soviet and Eastern bloc counterparts. At the 1976 Montreal Olympic Games, no American exceeded the qualifying standard of 226 feet, while the Soviet Union had more than twenty-five athletes capable of heaving the hammer that distance. One reason for this discrepancy was the use of scientific analysis by the U.S.SR and the application of Newtonian physics. As I had repeatedly told everyone who would listen, and perhaps many who instantly became deaf, these approaches were the cornerstones of modern Eastern and Soviet bloc sports groups. Now, at last, we were going to apply the same approach.

One of the methods the U.S.O.C Training Center system could employ was to work with athletes and coaches by conducting educational and analytical sessions. These training sessions, as well as arranging competitive settings for many of the Track and Field events, were techniques that would give support to the athletes in both technical skills and make them aware of the newly developed, positive attitude of the Olympic Committee.

In August 1978, the U.S. Olympic Committee for a hammer-throwing clinic invited a group of national class American hammer throwers to Houston, Texas. Attending the clinic were some of the best American throwers currently competing in the hammer throwing event: Ed Arcaro, Emmitt Berry, Andy Bessette, John McArdle, Dave McKenzie, Midles, Perkins, Satchwell, and Silvario. Comparison of these athletes was made with those of the top six finishers in the preceding 1976 Montreal Olympics. The Olympic athletes analyzed in order of finish, beginning with the gold medalist, were: Yuriy Syedikh (Russian), Aleksey Spiridonov (Russian), Anatoliy Bondarchuk (Russian), Karl-Hans Riehm (West Germany), Walter Schmidt (West Germany), and Jochen Sachse (East Germany). For the purpose of comparison, the lone American thrower, Larry Hart, finished fifteenth among the twenty finalists. Clearly, the U.S. had a challenging task to try to regain our competitive credentials.

At the Houston clinic, all of the CBA equipment was used to film the athletes and send the information back to the Amherst office. The biomechanical portion of the study focused on comparing the single support phase of the third turn and release between the Olympic competitors with those of the athletes at the U.S.O.C Houston clinic. Another important question considered in this study was the hip-shoulder relationship during the turns. The cinematographically approach to this problem involved consideration of segment length. A third focus was to perform separate digitization of the implement itself (the hammer head). This process allowed for the determination of the instantaneous linear velocity, acceleration, and angle of release.
The results were predictable, as well as unfortunate for the American athletes. Compared with the Olympians, the American throwers were slower in completing each turn in every rotation. However, several clinic throwers achieved as much acceleration in the transition from the second to the third turn as did the world-class throwers.

All of the Olympic athletes spent more time in the double support phase of the first and second turns than in the single support phase. The Gold medalist, Syedikh, demonstrated a double support phase longer than his single support phase in the last turn and during release. He was able to achieve this extended double support phase by placing his right foot in a toe-to-heel relationship with his left foot, while the other throwers placed their feet adjacent to each other as shown in the diagram.

The foot placement and the deeply flexed knees, also allowed the Gold medalist to establish and maintain a positive center of gravity in the direction of the throw. This positioning improved his balance and his throwing technique and contributed to his increased velocity of the hammer at release. Continued movement of the athlete's center of gravity in the direction of the throw, as evidenced by the Olympic competitors, is an extremely important component of throwing technique. If the body-hammer system moves forward early in the throwing sequence, it can ultimately reach a higher horizontal velocity.

The shorter throws of the American athletes reflected the relatively low velocities during the turns and low linear velocities of the hammer during the delivery phase. Somewhat unexpected, however, were their frequently high turning accelerations and consistently high linear accelerations of the hammer during delivery.

However, the extended double support phase exhibited by the Olympic athletes, most notably by Syedikh, probably contributed to the acceleration of the hammer. The longer both feet are on the ground, the more that force can be applied to accelerate the turning body.

The tangential velocity of the hammerhead is a product of its angular velocity and the effective radius of its path. Thus, it is important that the radius is as large as possible. Syedikh's lean toward the hammerhead, counterbalanced by deep flexion of the left leg and toe-to-heel placement of the right foot, maximizes the effective radius of the hammer's path. Most of the other throwers lean away from both the hammer and the direction of the throw.

These are merely short descriptive comments, which were included in the longer report to the athletes, coaches, and the Olympic committee. The CBA staff collected the data and processed the information before sending the detailed analysis of every athlete attending the Houston Clinic. The athletes and the coaches were able to ask questions and confirm the details about their individual performances, in addition to comparing their throws with the Olympic finalists.

Another group of athletes who attended the Houston, Texas Clinic, in addition to the hammer throwers, were the shot putters. In 1972 and 1976, American shot putters had failed to perform as well as their Eastern European counterparts. Beginning in 1948 and continuing through 1968, the American shot
putters had dominated. They had swept the medals for nearly 20 years until 1972 when the results placed Poland on the top pedestal. In fact, in the 1976 Olympic Games, it was perhaps the first time that no American was present on the winners' stand for any medal.

Attending the clinic were some of the best American throwers in the event, including Al Feuerbach, who finished in 4th place in the Montreal Games. Other throwers participating in the clinic were Peter Shmock, Dave Laut, and ten additional athletes. Comparison of the throws of these athletes was made with those of the top six finishers in the 1976 Montreal Olympics in the same manner as the biomechanical analysis performed on the hammer throwers.

The biomechanical analysis revealed that the most important factor in shot putting is the velocity of the shot at release. This factor was found to be more important than either the height or the angle of release.

The biomechanical study also incorporated the use of a force platform. This equipment was particularly useful in determining the forces applied to each leg during the shot put action. The most striking result of the force platform analysis was the discovery of the roles of the rear push-off leg and the front breaking leg. In the push-off phase, there was only a small horizontal force on the rear leg, while the vertical force reached approximately 560 pounds. This indicated that the rear leg provided a lifting force, but little pushing force in the direction of the throw.

Another characteristic, which differentiated the U.S. athletes from the Olympic competitors, was the pattern of the vertical center of gravity. In most cases the clinic throwers raised the body prematurely during the gliding and transitional phases.

The acceleration curves showed that the clinic throwers had less dynamic strength relative to their Olympic counterparts. We recommended specific exercises, which would most efficiently contribute to their throwing techniques. The athletes and coaches were excited to receive the information they gleaned at the Clinic and all enthusiastically requested future training sessions.

The following figures represent the best European shot putters at the time. These computer-generated stick figures were made with the computer technology available in 1976. It is ironic that biomechanical analysis and subsequent graphic representations executed on a million-dollar mainframe in 1976 can now be processed on a 100-dollar computer, an iPad, or even on the new smart phones. However, a reminder is that what can be shown or analyzed with biomechanical processes are based on actual human performances. The computerization can assist the person to be better, but only the athlete can perform.

Analysis of Mechanical Techniques
http://arielnet.com/ref/go/1164

One last example of the Biomechanical Committee’s work with Olympic athletes was with the javelin throwers. During the era between the Mycenaean Times and the Roman Empire, the javelin was a commonly used offensive weapon. Being lighter than the spear, the javelin would be thrown rather than thrust and thus allowed long distance attacks against one’s enemy. Athletes, however, used javelins that
were much lighter than military ones because the idea of the event was to demonstrate distance rather than penetration.

The javelin throw has a particularly strong tradition in the Nordic nations of Europe. Of the 69 Olympic medals that have been awarded in the men's javelin, 32 have gone to competitors from Norway, Sweden, or Finland. Finland is the only nation to have ever swept the medals at a currently recognized official Olympics and has done so twice in 1920 and 1932. One of the world records of the past, was thrown by the American, Al Cantello (1959). Not since 1971 had any American javelin competitor exceeded 91 meters and only a handful have even thrown as far as 85 meters. America is a nation of throwers, but it is the land of baseball pitchers and football quarterbacks. However, the small European countries, such as Finland and Hungary have excelled in some of the other areas of throwing, such as the javelin, and have dominated the Olympic winners stand. In addition to these differences in attitudes towards sports, American javelin throwers did not conform to the typical physique pattern found in their European counterparts. As a whole, Americans were larger and stronger. Regardless of the physical differences between the American and European javelin throwers, skill, technique, and strength in the plane of motion affect the final ballistic motions of hand and javelin. Our biomechanical task was to discover the best technique for the athletes we had.

Unlike other throwing events, the javelin competition allows the athlete to build speed over a considerable distance. In addition to the core and upper body strength necessary to deliver the implement, javelin throwers benefit from the agility and athleticism typically associated with running and jumping events. Thus, the athletes share more physical characteristics with sprinters than with other, larger athletes involved with throwing the hammer and shot.
Traditional **free-weight training** was standard fare for javelin throwers. **Metal-rod exercises** and **resistance band exercises** have been employed to train a similar action to the javelin throw to increase power and intensity. The extensive training focused on flexibility and **loading** the arm-shoulder areas to develop strength. Without proper strength and flexibility, throwers can become extremely injury prone, especially in the shoulder and elbow. **Core stability** can help in the transference of physical power and force from the ground through the body to the javelin. **Stretching and sprint training** are used to enhance the speed of the athlete at the point of release, and subsequently, the speed of the javelin. At release, a javelin can reach speeds approaching 70 mph.

In August 1978, the U.S. Olympic Committee for a javelin-throwing clinic invited a group of national class American throwers to Houston, Texas. Attending the clinic were some of the best American throwers currently competing in this event: Jace Derwin, Tom Petranoff, Bill Schmidt, and Bob Roggy. Comparisons, of the throws of these athletes, were made with those of the six top finishers in the 1976 Montreal Olympics. The Olympic athletes were analyzed in their order of finish, beginning with the gold medalist: Miklos Nemeth (Hungary), Hannu Siitonen (Finland), Gheorghe Megelea (Romania), Piotr Bielczyk (Poland), Sam Colson (U.S.A.), and Vasyl Yershov (Russia).

Biomechanical procedures were followed with the javelin throwers, as had been applied in the other two field events of discus and hammer. Following the computer processing of the data, the information was sent from Amherst to Houston, to present to the athletes and coaches.

One area of interest was to compare the center of gravity locations of the two groups. The American throwers decreased the velocities of their centers of gravity during the throw more rapidly than any of the finalists in Montreal. The Olympic finalists averaged a 43 percent decrease in velocity from the time of rear foot impact during the release step phase, until the moment that the javelin was actually released. The Houston clinic throwers, however, averaged a 55 percent decrease in velocity for this same phase of the throw.

A second aspect of the study was the javelin itself. Measuring the angle of attack positions of the thrower’s javelin revealed unexpected results. The relationship to the throwing plane to the angle of attack differed markedly between the two groups. The Olympic throwers averaged 30 degrees out of the plane. Only Tom Petranoff, at the Houston camp, rotated his javelin more than 20 degrees out of the plane; Bob Roggy and Jace Derwin were at approximately 15 degrees; and Bill Schmidt, the straight-line thrower, at zero degrees.

A third factor was the velocity of the javelin. It would be expected that the velocities of the Olympic throwers would be greater than the Houston throwers and this expectation was verified. All the velocities produced by the Olympians at the moment of release were greater than the Houston throwers.

The source of the difference between the two groups was found to be in the method or style of delivery. The Houston throwers produced a constant velocity from the time they initiated the throw until the release and, therefore, no acceleration of the javelin was produced. The Olympic athletes, however, achieved tremendous accelerations. The two distinct styles of throwing can be likened to spiking a
volleyball (American) or throwing it (Olympians). In all the cases listed above, as well for every analysis we did, we suggested exercises to remedy the differences.

Our analysis yielded fantastic results. In a matter of a few months, all of the athletes improved their results in all events that we analyzed. Our successes were very significant and the athletes and coaches were more than pleased with the procedures and practices that were now being provided by the U.S.O.C.

However, despite our successful operations at Squaw Valley and other camps, such as those in Houston, the training center was becoming too small. The Squaw Valley Training Center’s living accommodations could not handle the number of athletes who wanted to attend, the dining room struggled to serve all of them in a timely fashion, and the location was prohibitively far for the athletes living on the East Coast. Thus, the U.S. Olympic Committee began looking for a more suitable site.

As things transpired, Colonel Miller learned that the U.S. Air Force Academy in Colorado Springs was moving to another location. However, when the Air Force left the Colorado Springs site, the necessary facilities for a better Training Camp than Squaw Valley would become available. It sounded too good to be true.

Colonel Miller, Dr. Dardik, and I traveled to Colorado Springs to tour the facilities. We could see that there was plenty of room to support the existing Training Camp and plenty of room to expand. We all agreed that this was a good place to move and grow. Thus the Olympic Complex, former home of ENT Air Force Base and the headquarters of the North American Defense Command, officially became the U.S.O.C administrative headquarters in July 1978. In fact, that Colorado Springs site continues to exist and provides housing, dining, recreational facilities and other services for as many as 557 coaches and athletes at one time at the complex.

The first job we had was to move the laboratories from Squaw Valley to the new location. Committees and various leaders in the field gathered together to plan the move and select the proper staff. These included administrators, coaches and scientists to begin the operation. It was a grand operation, but soon the entire Training Camp was up and running at its new home on the slopes leading up to the beautiful Rocky Mountains.

Dr. Dardik continued as the Chairman of Sports Medicine and I was appointed for a full quadrennial of 4 years as the Chairman of Biomechanics. My appointment was extended during several different quadrennial periods until after the conclusion of the Olympic Games in Los Angeles of 1984. It required a tremendous commitment and extensive amounts of work but, having been an Olympian, I felt that it was worth all of the extra effort for the athletes. At least they had an advocate who had been there and understood what they were experiencing.

Our Biomechanics Committee was swamped with as many biomechanical projects as we could possibly handle, but we lacked enough proper equipment. For one thing, we needed an on-site computer to run the analysis. It was inefficient to collect the data in one place, ship it to the CBA laboratory in Amherst, and then return the results to Colorado Springs. We needed a very powerful computer at Colorado Springs, but the big question was how were we going to get it with a budget of zero funds?

Suddenly, one day while I was driving on Route 9 from the office to my little house, I had an inspiration. At that time, CBA used a Data General Nova-3 Computer in our laboratory in Amherst. The Data General Nova-3 was a mini-computer that, ultimately, served as an interim step between the massive mainframe computers, like Honeywell and Control Data, and the soon to be introduced desk-top computers of IBM. At that time, the two main competitors in the mini-computer market were Digital Equipment Company (DEC) and Data General.
During these early days of mini-computers, I took courses at the Data General headquarters in Worcester, Massachusetts, which was located on Route 9. I drove back and forth on the same Route 9 between our office in Amherst and Data General located fifty miles eastward toward Boston twice a week. In those days, computers were such a new phenomenon and there was, among many other things to learn, a complicated toggle switch procedure, just to power up the system. Times have changed greatly since those early computer days! Since I traveled to Worcester for the classes, I had become very familiar with the personnel and the hardware. I also learned that Data General was planning to introduce a new computer called Eclipse.

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UNITED STATES OLYMPIC COMMITTEE
Olympic House
57 Park Avenue, New York, N.Y., 10016 • Tel. (212) 586-1656 • Cable: "AMOlympic"

VIII Pan American Games, San Juan, Puerto Rico, August 4 & 10, 1979
XIII Olympic Winter Games, Lake Placid, U.S.A., February 13-24, 1980
Games of the XXII Olympiad, Moscow, U.S.S.R., July 19-August 3, 1980

January 3, 1978

Dr. Gideon Ariel
316 College Street
Amherst, Massachusetts 01002

Dear Dr. Ariel:

This is in reference to appointments of the United States Olympic Sports Medicine Committee for the 1977-1980 quadrennial. After consulting with Irving Bardik, M.D., Chairman of the Sports Medicine Committee, I will recommend to the United States Olympic Committee Executive Board your appointment to this Committee.

While your appointment cannot be ratified until the next USOC Executive Board meeting, due to the importance of the functions of this committee, I am authorizing that it commence its initial planning as expeditiously as possible.

Careful consideration was given to issuing appointments to elected representatives of recognized sports medicine and scientific organizations. It was determined that due to the number of organizations involved, the committee would become unwieldy should appointments be made in this manner. Therefore, uniquely capable individuals who are affiliated with organizations that have demonstrated an interest in developing a Sports Medicine Program for the amateur athletes of the United States were selected to this committee.

Provision has been made in organizational structure of the USOC Sports Medicine Program for participation of sports medical and scientific organization in this most important national effort. The USOC solicits this support should any organization desire to participate.

Members of the Sports Medicine Committee can expect to meet approximately three times a year. The initial meeting will be held January 27, 1978 at Squaw Valley. Enclosed for your use is a form indicating acceptance of this appointment. Please return this form no later than January 9, 1978.

Enclosed for your information is the USOC Sports Medicine Organizational Chart and a list of recommended appointments to the committee. Should you have any questions, please feel free to contact me.

Sincerely,

[Signature]

R.E.: 1r
Enc.
Now man and machine join on the sports field to boost physical output

By DANIEL RUBY
TRABUCO CANYON, CALIF.

"Explode."
The heavyset man yelled in my ear as I strained to jolt the bar upward. But it was much heavier near the top of its travel than it had been at first. I lost momentum.

"Try again," he said disapprovingly. But my second bench press—and third—proved just as feeble.

A color graph appeared on the screen, displaying a shortage of foot pounds where I'd need them most for heaving an iron ball. "You'll never make it as a shot-putter, my friend," said Gideon Ariel, a one-time Olympic shot-putter himself and inventor of the computerized weight machine that had just defeated me.

Ariel's exercise machine, which is programmed to offer variable resistance to match the physical demands of the sport being trained for, is just one of the electronic devices he uses at the Coto Research Center to quantify the forces and stresses generated in athletics. Sophisticated computers, digitizing pens and hardware, high-speed cameras, force plates, and infrared detectors are the instruments that turn an already first-class sports complex—tennis courts, running track, gym, swimming pools, equestrian grounds—into the world's premier laboratory for the study of biomechanics—the science that relates the physics of motion to human anatomy.

The basis for Ariel's work is that old con man's truth: The hand is quicker than the eye. So are the feet, head, and every other part of an athlete's body. Only by slowing down the motion on film or videotape can anyone really tell what happens when a racket hits a ball or a foot meets a track.

Thigh bone's connected . . .

Of course, the use of film alone is nothing new to sport. What is new—and is becoming a powerful tool in recognizing talent, training athletes, treating their injuries, and designing their equipment—is the use of computer technology to quantify the velocities, accelerations, and angles generated in athletic performance.

"It's basic physics," Ariel said, using as an example his work with four-time Olympic discus champion Al Oerter. "We know the forces that the discus to go so far it must leave the hand at a certain velocity and a certain angle. So we work backward. For the discus to have that velocity, then the hand must have that velocity. For that to happen, the forearm must be moving so, then the upper arm, the torso, and so on down to the feet. We created a computer model of the optimum throw and then tried to teach the athlete to do that."

At age 43, after working with Ariel, Oerter threw 27 feet farther than his best gold-medal performance. Now he is training for a comeback at the 1984 Olympics.

The interdependence of body parts is true of all sports. Ariel's co-researcher at Coto, psychologist and tennis guru Vic Braden, uses the analogy of a whip. "Power supply comes from efficiently transferring shock from one body segment to another and finally into the implement or ball." Or as Ariel likes to say: "You can't shoot a cannon from a canoe."

Ariel himself once shot canons—or tried to. Competing for his native Israel in the 1960 and '64 Olympics, his best shot put landed far short of the gold. But if he lacked natural ability with 16-pound shots, he had it to spare for work with computers. He came to the U.S. and received his doctorate in computer science, then set about ap-

http://arielnet.com/ref/go/1170
One day after class, I decided that I would make a bold and unique proposal to the President of the company, Mr. Edson De Castro. I did not ask anyone nor had I made an appointment. I just went to his office on the third floor and knocked on the door. A secretary or administrative assistant opened the door and I asked her if I could see Mr. De Castro. She looked at me as if I were crazy.

“Do you have an appointment?” she asked me.

“No, unfortunately, I do not have an appointment. My company uses Data General Computers and I am here to take the classes that Data General provides people and companies like me. But the reason I need to see Mr. De Castro is, as a representative of the athletes of America. The United States Olympic athletes need his help. I am the Chairman of Biomechanics for the United States Olympic Committee and I believe with all my heart and mind that Data General and America can make a good, rewarding relationship.”

She told me to wait for a minute and quietly shut the door. Several moments later, she came back and invited me into what turned out to be Mr. De Castro’s office. He was the chief engineer who had envisioned the Eclipse and it was to be a great performer for them. He was a fantastic engineer and pushed for many of his own ideas. Some of his concepts included support for virtual memory and multitasking, which were suitable for the small office environment, like CBA’s. Not only was the Data General system fast, but also the new Eclipse was even packaged differently so that it looked like a tall, sleek, blue refrigerator standing next to our sophisticated digitizer.

Mr. De Castro gestured for me to sit and asked me what he could do for me.

Although my heart was pounding and I was sure that he could hear it thundering, I began, “Mr. De Castro, I use your computer, the Nova-3, in my own company, Computerized Biomechanical Analysis, Inc. or CBA. We conduct studies for many companies on their products and are currently heavily involved with the United States Olympic Committee. We conduct studies on the U.S. athletes and recently we moved our Training Center from Squaw Valley to Colorado Springs. Currently, CBA has to do all of the computer work at our office in Amherst, but this is extremely time-consuming and inefficient for the athletes waiting in Colorado Springs for their results. It would be much more efficient if we had a computer on-site in Colorado. Obviously, the best computer possible, in my opinion, is the Data General and the new Eclipse would be perfect. I will install our own proprietary software for the biomechanical analysis for free, if you will give them the computer.” I finished talking and politely waited for his response.

He sat quietly for a few minutes and then asked for some contact information. He jotted my phone number and address and said that his staff would contact me. I thanked him very much and left. I assumed that nothing would happen, but after all, “nothing ventured, nothing gained”.

The next day I received a call from Mr. Howard Steiner, the Public Relations Manager of Data General. He told me that he had read the article in Sports Illustrated and would like to visit me at the CBA office. We set the meeting and two days later Mr. Steiner walked into our office. We gave him an extensive presentation of what we did, how we conducted the projects, and what our results were like. Clearly, he was very impressed by what he saw in our CBA laboratory. He asked me if it was okay to call Colonel Miller at the U.S. Olympic Committee for more details of our plans. By that time, I already had talked with Colonel Miller and he was waiting for the call. The call took place and Colonel Miller must have been convincing because Data General sent him the following letter on the next page:
May 7, 1979
Colonel F. Don Miller
Executive Director
Dear Colonel Miller:

Thank you for taking time out from your busy schedule to meet with us last week. We are very pleased and enthusiastic about your response to our concerns about the planned implementation of the Data General Computer System.

We believe that your decision to make Gideon Ariel responsible for the implementation of the S/250 Computer system insures that it will be operational in the shortest amount of time.

I have received your executed copies of the Data General field service and program license agreement. I have been in touch with our field service organization and it will be handling this installation on a priority basis.

It's my understanding that the installation of air conditioning equipment will begin because the computer room was measured last week at 30 degrees F. Given the substantial heat dissipation from the computer and related peripheral equipment the installation of air conditioning equipment will be essential to the reliable operation of the equipment.

With the time required for this preparatory work as well as the development work going on at Dr. Ariel's laboratory, the System will be operational in Colorado Springs by approximately July 15.

We would like the U.S.O.C to announce our donation on June 4 in New York; City in conjunction with the National Computer Conferences. Also, we would like very much for you to participate with us in making this announcement at the 21 Club of The Four Seasons. In July, we then could follow this up with a press tour of the laboratory. If this proposal is agreeable to you, I would like to immediately begin planning with your staff.

Data General announced the news regarding the donation and the publicity tour in their quarterly newsletter. It was actually a good arrangement for everyone involved. Data General would be able to generate news stories about the donation to the U.S.O.C, rather than relegating it to an advertising segment. The U.S.O.C was able to use the publicity to stimulate excitement about the athletes and their activities, as well as promoting the need for additional equipment. The Olympic Committee could only authorize the use of the Olympic rings, but everyone wanted to display them on their products. For this reason, we were optimistic that there would be many new and useful donations in the near future. For CBA, it was a wonderful opportunity to describe our services in forums around Europe and the U.S. Data General covered the travel and publicity expenses, and we garnered new projects for CBA.

Now the United States Olympic Training Center would receive a very powerful computer. But, as they say, there is no free lunch and this computer donation came with strings attached. I would have to travel to European and American cities to tell the Data General-Olympic story.

The introduction of the Eclipse S/250 occurred at the National Computer Show in New York City in 1979. Al Oerter and I were present, in addition to the Data General publicity staff, at this event. Al and I demonstrated how the computer helped the American athletes in their quest for Gold at the Olympics. In Tracy Kidder's book The Soul of a New Machine, he described the race for the construction of the best
The donation of the Data General computer to the U.S.O.C immediately made exciting news headlines. The Data General marketing machine was nothing short of miraculous. They arranged for the introduction of the donation to be made by Colonel Miller and me on NBC’s Today Show with Tom Brokaw.

To make a spectacular publicity event, I convinced Data General, NBC, and Tom Brokaw that we should conduct a biomechanical analysis on Tom Brokaw. We would perform a biomechanical comparison between the styles of running of Tom Brokaw and Bill Rodgers, who was the American record holder in the marathon. Track and Field News ranked Bill Rodgers as Number One in the world in the marathon in 1975, 1977, and 1979. Of the 59 marathons which Rodgers ran, 28 were run under 2 hours, and 15 minutes. In all, he won 22 marathons in his career. He came to be referred to by sportswriters and others as Boston Billy, because of his many successes in the Boston Marathon. We set a filming date for the two athletes to race on the running path through Central Park in New York City.

The day of the race could not have been more perfect for running and filming. It was a crisp spring day with a brisk breeze blowing and the sun shining brightly. In their appropriate running gear, Tom and Bill sped past the cameras as fast as they could run. Ann and I were able to film numerous simultaneous sequences from the two cameras, so that we could produce three-dimensional results. Suddenly, some horses cantered past with their riders clearly enjoying the spectacle. With another one of my inspirations, I asked the riders if we could film them to compare equine with human gaits. With a great deal of laughter, the men and the horses chased each other on the running trails, while we filmed the events. I believe it goes without saying that this was the first time that the head and star of the Today Show had ever been

http://arielnet.com/ref/go/1171
Biomechanics in the service of athletes

by Françoise Coffrant,
Director of the periodicals “Aro” and “Arc International”

The Medical Commission of the International Olympic Committee has informed all delegations and athletes who are going to take part in the Olympic Games in Moscow that the “anti-doping” tests will be particularly strict. Everything must be done to discourage the use of doping substances.

The American delegation for its part has acquired a highly perfected data processing plant designed to improve the performance of athletes during training. Colonel Miller, who is in charge of this plant, stated last September that he was also relying on his country’s technology to prepare the Games.

To improve performances without doping is the task set himself by Gideon Ariel, a former athlete and now professor at the University of Massachusetts, who has been studying the human body with the help of computers for about ten years now.

Helped by the company which markets the instruments, he has recently agreed to supervise the training sessions specially prepared for the United States Olympic Committee.

Gideon Ariel, born at Tel Aviv in 1940, is far from unknown in sports circles. He was a member of the Israeli Olympic team at the 1960 Games in Rome as well as the 1964 Games in Tokyo, throwing the discus in which he is still holder of the record in Israel.

After his military service in Israel, he was scholarship to Wyoming University. He then attended courses at the University of Massachusetts where he obtained a doctorate in data processing. Having become an American citizen and a professor, he founded a biomechanical analysis company at Amherst in Massachusetts.

This company, CBA—Computerized Biomechanical Analysis—the first research company specialising in this type of study, was created for the specific purpose of improving top-level athletic performances. Encouraged by the results, CBA has during the last few years widened its field of research to include industrial products, sports equipment, safety precautions at places of work.

In actual fact computerised biomechanical analysis existed before Ariel: it will be remembered that the Swedish scientist Ing Fredricson studied the movements of a horse for 10 years and discovered that the hindquarters were submitted to almost dangerous strains on racetracks that were a general rule too hard in the straight section.

http://arielnet.com/ref/go/1172
Howard Steiner, Tom Brokaw, Bill Rogers, Gideon, and Ann

Interview with Tom Brokaw
It was an amazing time to appear with Colonel Miller on the Today Show. Colonel Miller was able to publicly thank Data General, and explain what a wonderful donation it was for the Olympic athletes. I was able to describe the biomechanical techniques, which would be performed, on the new Olympic system by using the biomechanical analysis we had performed on Tom, Bill and the horses. Mr. Brokaw was enthusiastic about the donation and seemed to enjoy the comparisons made. Mr. Brokaw and I crossed paths several times after this initial event and he has always amazed me with his humor and the depth of his insight into situations.

The Data General Eclipse S/250 was quickly installed in the specially designed biomechanics laboratory at the Colorado Springs Training Center. I arranged to have one of my former University of Massachusetts undergraduate students, Rocco Petitto, come to work under my direction at the Center. Mr. Petitto had executed hundreds of biomechanical projects on athletes during the previous three years, while he completed his undergraduate degree. He was extremely talented and overly qualified for the position. There were so many athletes and Coaches at the Center; however, Mr. Petitto was busy all day, every day.
(Scan QR Code for more information: “How Data General Computers Are Helping Our Athletes Level Mount Olympus”)

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http://arielnet.com/ref/go/1175
Since Data General had announced their donation to the world, it was easier to approach and convince other companies to make contributions to the U.S.O.C. One of many was from Megatek Corporation. They manufactured a graphic terminal that could calculate 3D coordinates provided by our CBA software. The results of the interaction of our software and their hardware allowed visual presentation of the motions of the athlete in 3-dimensions on the screen. The processor on the system was so fast that the athletes appeared to move in a rapid and normal manner. It allowed athletes and coaches to examine the performances of stick figure forms. The ability to study how the body moved, without the distractions of clothes or background scenery, was extremely useful as a coaching and learning technique.

Data General wanted the U.S.O.C computer donation to have as much publicity as possible and quickly arranged events. Since the Colorado Springs biomechanics lab could function with Mr. Petitto coordinating the athletes and conducting the research, it was unnecessary for me to be there for as many days as previously required. The same held for CBA since Ann and the staff could conduct all of the research needs that we had at that time. This allowed me the time to fulfill my obligation to Data General of presenting the biomechanical uses and to convey the excitement of working with the Olympic competitors.

From June through the end of August, 1979 I appeared on television shows up and down the Eastern Coast of America, as well as several national programs including National Geographic and The Human Body. There were radio and newspaper interviews across the country. I was even sent on a European city tour, which began in England, then in Sweden, Germany, Italy, and France. Fortunately, Data General had excellent publicity staffs in the U.S. and in Europe, so I only had to make my presentation repeatedly. There were so many days of presentations and questions that I frequently had no recollection of what city I was in at that moment. But it was all worth the effort.

Needless to say, those presentations were also fantastic for my own company. With each presentation, I was able to introduce myself and the services of CBA to a wider audience than I would otherwise have been able to reach. I really had not planned this symbiotic relationship, since I sincerely had wanted to find a way for the Colorado Springs Biomechanics Laboratory to have an affordable computer. I never thought of myself as a marketing genius. But the advertisement of my system by a third party, at their expense, was nearly a dream come true. CBA had managed to get all this exposure for free. Some of the newspaper coverage is shown below: (Scan QR Code for more information: “The Man Behind the Computer of the U.S. Olympic Sports Medicine”).

http://arielnet.com/ref/go/1171
During the time that the U.S.O.C was relocating from Squaw Valley to Colorado Springs, CBA was heavily involved in the analysis and improvement of shoe designs. We studied many different sports and the interrelationship between the body, feet, shoes, and surfaces. The sports ranged from basketball, baseball, archery, cycling, and all of the track and field events. This hefty amount of research resulted in extensive meetings with the designers, engineers, and the company directors to evaluate our results and create new and better footwear. As we sat around the CBA conference room table one day, I had another one of my crazy ideas!

“How would your company like to put the Olympic rings on all of your shoes?” I asked the head of sales.

“Of course, we would be ecstatic to use the Olympic rings, but it is impossible for us to get them,” he replied.

“How much would you be willing to pay, per shoe pair, for the rings?” I answered.

After a short thoughtful pause, he responded, “I would estimate one dollar per pair would be a fair amount, since we would have to adjust many other overhead considerations. The fee would basically be similar to royalty or franchise fee. However, we have no way to obtain permission to use the Olympic rings,” he continued.

My answer was a big smile. I knew that I would only need to persuade Colonel Miller and I believed that the dollar figure might be sufficiently large enough to do just that. This company had the exclusive license for importing shoes from South Korea. In the 1970s almost all shoes, particularly sporting shoes, were made in Korea. Thus, millions of imported shoes, at one dollar per pair, would be a fantastic way to support the biomechanics and other scientific laboratories at Colorado Springs. With such a healthy influx of capital funds, Colonel Miller would not have to devise some difficult cost cutting in order to support the Center. In addition, as had Data General, the shoe company could benefit from the enhanced publicity of helping America’s athletes.

The contract was signed in short order with both the U.S.O.C and the shoe company happy with the results. The monies were used to expand and improve the Biomechanics Center, to hire some additional personnel to assist Mr. Petitto, and purchase some necessary hardware.

Everything seemed to be perfect, but there must be an axiom somewhere, that “rain should fall on the parade.” No one knew that all my work with the U.S.O.C was completely voluntary. Ann and the entire CBA staff had worked on Olympic projects for years without compensation. Larry Graham, our partner in the company, supported this free support, since he was as patriotic and compassionate of the American athletes as we were. The companies that had donated their equipment generated the only payment CBA or I ever received. However, jealousy is an evil beast.

Because of my very visible role in the Olympic effort, some of the geniuses at various universities began an ugly rumor suggesting that there must be a conflict of interest. For example, the head of the biomechanics department at Penn State, Richard Nelson, complained to the U.S.O.C that it was a conflict of interest that Gideon Ariel was the Chairman of Biomechanics for the Olympic Committee, while owning and operating his private company. A Professor at UCLA, Bob Gregor, who coincidentally was Nelson’s student, made the same claim. Not surprisingly, other University scientists joined the clamor. My attorneys and the lawyers for the U.S.O.C informed me that there was absolutely no conflict of interest. Many people who volunteered directly to the Olympic Committee and to all of the hundreds of individual sporting programs also earned their livings apart from their philanthropic work. Without dedicated entrepreneurs, there would not be an American Olympic program because the organization existed only because of the volunteers and the donated monies. I was told to ignore the criticism, but it was a painful experience and the bitterness continues even after all these years. It seemed so unfair for the people who did nothing to help the U.S. athletes to mount nasty, spurious attacks.

The biomechanics laboratory at Colorado Springs now had some additional staff members to compliment Mr. Petitto. Since I was only a volunteer and could not be present all the time since I ran my own company, Colonel Miller, Dr. Dardik, and I hired Dr. Chuck Dillman from the University of Illinois.
At that time, Dr. Dillman was a well-known biomechanist and he would be the Director of the Biomechanics laboratory under my direction. We felt that a few students from various Universities could be found to work beside Mr. Petitto and under the guidance of Dr. Dillman.

The U.S.O.C Training Center, with my directions to Dr. Dillman and Mr. Petitto, began to produce many important projects, which helped the American athletes improve their skills. By providing a location where they could live, eat, train, and hone their skills, the level of competitiveness was raised significantly. Since the U.S. athletes were now engaged against stronger and more focused competitors from other state-sponsored programs, we had to try to use and discover, every edge we had available to us. Hopefully, the Colorado Springs Training Center would be able to continue to find funding, build databases and laboratories, as well as continue to utilize the biomechanical strengths, which we had established.

The U.S.O.C continued to receive news coverage from the major television and print media. Some of the stories and graphic materials of a few of the sports covered are illustrated on the next page:
Analyzing Al Oerter

Dan Rather reporting on the U.S. Olympic Training Center

Hammer Throwing

Sprint Start

Triple Jump (World Record Performance)
http://arielnet.com/ref/go/1176
APAS System in Action

http://arielnet.com/ref/go/1177
The 1980 Summer Olympic Games in Moscow were the first to be staged in a communist nation. The United States and 63 other countries boycotted the 1980 Olympic Games, as a protest against the Soviet invasion of Afghanistan. Unfortunately, this decision not to compete was based on political rather than sporting reasons. It was unfortunate that this political decision interfered with the hopes and dreams of so many athletes throughout the World of sports. It seemed a contradiction of the Olympic spirit, which was to lay down arms, cease hostilities, and meet in the sporting area for athletic competition. Decision makers more powerful than anyone in sports, however, decided otherwise and the Moscow Olympics proceeded without the U.S. and many of her allies.

The next Olympics were held in Los Angeles in 1984. Needless to say, seventeen countries chose not to compete at the Los Angeles Games, including fourteen in a Soviet-led boycott. Although the Western power athletes were able to compete in an Olympic Game venue, there was disappointment that it was not the noble world affair that all the competitors hoped to enjoy. Nonetheless, the U.S. won a record 83 Gold medals, which broke the previous record of 78 from the 1904 Summer Games. But this was fewer medals than the previous overall record. Surprisingly, Romanian, China, and Yugoslavia— at the time, ruled by communist governments—decided to compete and finished second, fourth, and ninth in the medal standings.

At the conclusion of the 1984 Los Angeles summer Olympic Games, the end of my second quadrennial term was approaching. My initial appointment had started in 1977 in Squaw Valley and continued to Colorado Springs. My second quadrennial term began in 1980 to overcome the difficulties associated with our non-participation in the Moscow Games. In 1980, Colonel Miller decided that Dr. Dardik and I would continue for an additional quadrennial term. It meant another four years of effort for me but, as usual, I wanted to do all that I could to help these American athletes perform to the best of their abilities.
A dream that had initially seemed to be impossible had been achieved beyond the greatest hope and expectation. A dream that began with Bill Tommey, Russ Hudge and myself in my small office in Amherst, Massachusetts. Then finding the indefatigable Dr. Dardik and linking with Colonel Miller, we had established the most advanced sports training center imaginable. I could happily hang up my hat now and move on with enormous pride in our accomplishments.

Olympic Certificate
Despite the tragic events in Munich, which weighed on my heart, I could not stop thinking about what I had seen during my visit to the East German Olympic training facility in Leipzig. Perhaps it was merely a protective thought process to focus on a positive future rather than the terrible past, but I was determined to find a way to create a system where we could train American athletes and attain higher performance levels for competition against the East Germans and the other Soviet bloc countries. Those countries used a communistic system as the foundation and operational protocol to conduct their programs. The administrators, coaches, and athletes operated under a regimen of total discipline directed from the top down to the athletes. The philosophy of complete devotion to the State, governed the people and their system.

In the United States of America, the land of freedom and capitalism, the people would never tolerate such a system. You could never take the children away from their parents and give them to the State. No American parent would allow his or her young children to be housed and trained in a special State program. In addition, Americans athletes are too free in their attitudes and mental perceptions to train in a method with military-type discipline, without flexibility, or in the shadow of “don’t ask, just do it” directions.

In the Western World, our freedom is jealously guarded. What system, then, could work for us? I knew that better technology would help and, in fact, I had already demonstrated the efficacy of my biomechanical motion analysis technique. Not only was it effective within the American system, but also I had already discovered in Leipzig that they thought the motion analysis technique was good! However, just having the ability to analyze athletes biomechanically was insufficient for producing Olympic quality athletes. They needed an entire support structure of housing, food, training facilities, and coaching, in addition to the scientific contributions, such as physiological and biomechanical techniques.

One area that the East Germans and Russians also utilized was a pharmacological agent to augment performances. The U.S. would not engage in these areas for many reasons, not the least of which was the illegality and safety issues involved. In addition, it would be an anathema to the Olympic idea of healthiness, the optimization of human performance, as well as human and national dignity, to be tainted with drug use. Application of technology and technique improvement could achieve the desired performance goals without having to rely on pharmacology.

Another significant disadvantage that Western athletes faced was financial. All Olympic athletes had to be considered amateur, in order to compete in the Games. State sponsored programs, such as the East Germans provided, were not considered to be violating this restriction since the athletes were not paid to be there. Apparently, Olympic officials did not evaluate free food and lodging, in addition to financial support for their parents, as payment and, therefore, they were able to participate in the Games as amateurs.

Unfortunately, the same situation of State-sponsored athletic camps was impossible, at that time, in the United States and other Western countries. The rules governing amateurism dictated that athletes could not be paid to perform their sport. Just as college basketball players are not supposed to receive money to play, these student athletes must leave the university setting and play professionally in order to be compensated. It was the same situation with all Olympic sports: no money for playing. Needless to say, the U.S. athletes were hard pressed to support themselves while pursuing their sport. Many were unable to pay for the mentoring and coaching they needed to excel and often they had to sacrifice their educational goals to find time to work to support them while they trained. All too frequently, athletic goals had to be abandoned, in order to support their lives or remain in school.

In this atmosphere, Bill Toomey, Russ Hodge, and I had met in Amherst to try to derive a solution to this Western versus East bloc conundrum. The result, with Dr. Dardik and Colonel Miller, were the Olympic Training Centers first in Squaw Valley, California and then in Colorado Springs, Colorado. Because of personal situations, however, many of the athletes could not live and train in Colorado Springs.
at the Training Center. Whether the problems stemmed from obligations to school, family, or other reasons, these Olympians needed work to support themselves, which did not violate their amateur status in addition to having time and their ability to practice their event.

I pondered the situation while I exercised, drove the car, and when I was supposed to be sleeping. Suddenly one day I had an idea, maybe crazy, but, at least, a possible solution. What if we started a nationwide chain of exercise clubs, with the United States Olympic Committee (U.S.O.C) official endorsement, staffed by Olympic athletes? The athletes would be paid to work with individuals on their own private exercise regimens and the Olympians would be paid for their work. At the same time, they would be able to use the exercise facilities for their own sports training while they earned money to support their existence. This system would not violate their amateur status.

I immediately called Dr. Dardik, who was extremely enthusiastic about my proposal. In addition, he was involved with the patients suffering from juvenile diabetes, as well as their parents and some related individuals trying to help those afflicted children. The preliminary evidence suggested that children who were active, meaning engaged in strenuous daily exercise programs, were able to reduce and, in some cases eliminate, the number of drugs they needed to control their disease. Dr. Dardik’s idea was to combine the efforts against juvenile diabetes with the need for suitable employment for the Olympic athletes. Thus, we could provide an environment for the public to become more fitness minded, while at the same time, helping Olympic athletes support themselves.

As the two of us expanded the concept, a shape emerged. We would start a corporation, which we called Scientific Life Systems (SLS). This corporation would create fitness centers in every city that we could find in the United States, where there was sufficient interest in the public and enough athletes willing to participate. The athletes would be hired as trainers in the Centers and the men, women, and children of the general public would be thrilled to become members of a gym/health center that provided one-on-one sessions with Olympians. In addition, because Olympic athletes are usually stellar examples of good health, young people frequently idolize them. We believed they would inspire children and their parents to train with these Olympians and improve their own health as they exercised.

Dr. Dardik and I believed that this was a perfect solution to many problems. First, SLS would provide legitimate work for the Olympic athletes, which would not violate their amateur status. Second, the general public would have opportunities to improve their health and well-being in well-run clubs staffed by awe-inspiring athletes. A third goal was to send ten percent of the revenues to the U.S.O.C to help offset the costs of maintaining and improving the Training Center especially the Biomechanics and Sports Medicine laboratories. We planned to obtain usage of the Olympic rings, since we were helping Olympic athletes and were sending money to the U.S.O.C, which would benefit all of the sports. Paying monies to the U.S.O.C for the use of the rings was nothing new. I had previously forged an alliance between the shoe company and the U.S.O.C for the opportunity to have the rings on the shoes, as had many other companies for their products, including McDonalds and Coke.

In the back of my mind, I believed that there were additional components that could be included in the SLS Corporation. I had many product ideas, such as the air shoe concept, my computerized exercise machine, as well as the service aspect in areas of product development and liability testing. But I had to start with my idealized training centers as a starting point.

Now that Dr. Dardik and I had our idea to support the athletes, as well as encouraging the general public to exercise, the next step was to secure the endorsement and backing of the U.S.O.C. We would have to involve the Olympic Committee so we could use the rings and work with us in staffing the national centers with available athletes who were interested in this arrangement.

The current president of the U.S.O.C was William Simon and he was actively engaged in the workings of the Committee. Mr. Simon had served as Deputy Secretary of the Treasury from 1973 to 1974 and was the Secretary of the Treasury from 1974 until 1977. He had been the Chairman of the Economic Policy Board, the Federal Energy Office, and the East-West Foreign Trade Board. In addition
to his presidency of the U.S.O.C, he was a Senior Advisor to Booz, Allen, and Hamilton, Inc. and to Blyth Eastman Dillon and Co., Inc. He was an extremely busy man, to say the least.

I had met Mr. Simon in Lake Placid when the Winter Olympics were held there in 1976. In one of our subsequent meetings, Mr. Simon gave me an autographed copy of his book, A Time for Truth. The subject of Mr. Simon’s book referred to the political system. From my perspective as a former athlete, a member of the Sports Medicine Committee, and as a supporter of the Olympic athletes, I decided to propose my idea to him as a “time for truth” for a national training system which would benefit the U.S.O.C, the general public, and the Olympic athletes.

I decided to write to Mr. Simon and propose my fitness club/Olympic athlete merger idea. I included as extensive a proposal as possible with many reports and articles as background support. Obviously, I included the large contributions to the Training Center, which I had secured, from Data General and other manufacturers in addition to many of the biomechanical studies, which we had done for the athletes. I also outlined the SLS exercise club idea which was designed so that the athletes were able to earn a living, train for their event, and, in addition, to raise funds for the U.S.O.C. I worked a long time on the proposal and incorporated a critique of the existing Olympic Training Center system at the time. In addition, I included many of the projects and studies, which we had conducted for many of the companies that had hired CBA and me.

In response to my proposal, I received the following letter from Mr. Simon:

Dear Gideon:

Thank you for the recent letter updating me on the Sports Medicine program. I apologize for this belated response, but my schedule has kept me out of the office more than in, recently.

I appreciate your forwarding this material to me and I am sympathetic to your concerns regarding the current state of the sports medicine program. As you and Irv know, both Don Miller and I feel strongly that this program can provide a singularly outstanding benefit to our athletes in their preparation for ’84 and we are committed to finding the best and most immediate ways to apply it to the existing programs of the U.S.O.C.

I will be in touch with you once I have had the chance to take a closer look at the package you have sent to me and can respond in more detail.
I was thrilled to learn that Mr. Simon liked my idea. Now the next step was to meet, and try to discover the best path forward. We arranged for Dr. Dardik and me to meet in New York City in Mr. Simon’s office. Also attending the meeting was one of Mr. Simon’s friends and colleague, Mr. William Casey.

This was the same William Casey who had been involved with the World War II spy agency, the Office of Strategic Services (OSS) and was awarded the Bronze Star Medal for meritorious achievement in coordinating French resistance forces in support of the D-Day invasion of Normandy. After serving as associate general counsel at the European headquarters of the Marshall Plan, Mr. Casey returned to the U.S. where he practiced law before becoming the chairman of the Securities and Exchange Commission from 1971 to 1973 during the Nixon administration. From 1981 to 1987, President Ronald Reagan named Mr. Casey to the post of Director of the CIA, where Stansfield Turner dubbed him, the “Resurrection of Wild Bill”. This reference was to Bill Donovan, the brilliant and eccentric head of the OSS whom Casey had greatly admired. It is an understatement to say that William Casey was a remarkable man and, as I discovered, a very interesting character to know. I was thrilled when Mr. Casey gave me a copy of his book about the American Revolution, Where and How the War Was Fought.

Mr. Casey’s war was on the battlefield and in the world of sleuthing and intrigue. His expertise was beating the enemies with bullets. Where to aim, however, was frequently based on intelligence about what the opponent was planning at the war table, which he and his team of spies had obtained. My war was on the athletic field. In my venue, it was possible to spy on your competitors and learn how to beat them with talent and technology. In Mr. Casey’s war, you could lose your life. In my athletic combat, using my system, the worse that could happen to you was to lose an Olympic Medal.
During this initial New York City meeting, Mr. Simon, Mr. Casey, Dr. Dardik, and I decided to embrace the idea and form the Scientific Life System Corporation. It was one of those exciting meetings where everyone becomes enthusiastic and bubbles with ideas. I would not characterize Mr. Casey as actually bubbling, but he was very interested and participated actively. We left the meeting with specific assignments for each of us. Dr. Dardik and I were to develop the program for the fitness clubs, Mr. Casey’s task was to formally create the SLS corporation, and Mr. Simon was to fly to California to meet Mr. Victor Palmieri, who was the head of the Penn Central Railroad, which oversaw Coto de Caza and my new research center there (details about this center will be discussed in a later chapter).

Mr. Simon flew to California on other business, but was able to meet Mr. Palmieri as well. They discussed a variety of arrangements for the Coto Research Center (my new California-CBA venture) and the development of the SLS corporations with respect to the Penn Central interest. Mr. Simon returned to New York to report many of the topics he had discussed with Mr. Palmieri.

A subsequent letter to all of us from Mr. Casey summarized the developments as of early 1977. The letter follows:

Dr. Gideon Ariel Dr. Irving Dardik
Hon. William E. Simon

As agreed at our meeting on December 23rd, I have formed a Delaware corporation named Scientific Life Systems, Inc. with 1,000 shares authorized. Here are some things we might try to crystallize further when we visit Amherst on Saturday:

1. In order to complete the organization of the corporation we will have to determine how the $100,000 which Simon and Casey would invest and the two businesses to be transferred to the corporation should be reflected in the 25% equity interest which we talked about on the 23rd. Should any notes be issued in the capitalization, should the corporation elect under subchapter S with a view toward making it possible for the investors to deduct R and D expenditures on their individual tax returns, etc. In order to make those decisions we should have recent financial statements of each of the businesses being transferred to the corporation and a projection of its operations for the current year.

2. In order to present a tangible proposal to Palmieri as soon as possible we should work out a pro forma balance sheet and a set of projections for a physical fitness center on the scale which we think would be appropriate at Palmieri's development. We also have to formulate what kind of a combination of ownership interest, management compensation, franchise fee and equipment price or rental we should get for developing, supporting and managing that kind of a center.

3. Since a good part of the new money will be going into developing equipment, we should have a patent opinion. I have talked to Greason about this. He tells me he has not yet obtained the information he asked Gideon for some time ago. I think it would be a good idea to bring him along on Saturday so that he can get a first-hand impression of the equipment concepts.

So SLS began with the four of us and a cash investment of $50,000.00 each from Mr. Casey and Mr. Simon. We opened a pilot fitness center, in Englewood, New Jersey. The Center was equipped with the latest variable resistance exercise equipment and staffed by dedicated and intelligent United
States Olympic athletes, offering individualized fitness-training programs to suit the needs of its members. Young, old, fit or unfit could work with their athletic heroes in 30-minute training sessions.

Dr. Dardik, as a cardiovascular physician, and I, as a former athlete and devote to exercise and fitness, was concerned about the well-being of all people. We saw these centers as a way of improving the general health of people throughout the country, by using preventative medicine and fitness programs.

The Center also was dedicated to serving people with specialized medical problems, who could not find suitable fitness regimens elsewhere. One of Dr. Dardik’s main concerns was a diabetic child. He was aware that diabetes patients are prone to cardiovascular complications that are the most common cause of their early death. One of the most effective ways of forestalling this is by a lifetime habit of exercise designed to maintain the circulatory system in peak tone. Historically, this has been the most neglected aspect of diabetic treatment, principally because of the unavailability of suitable training programs. This struggle is compounded by the difficulty of motivating young diabetic patients, who discourage easily, feels different and, therefore, self-conscious, and are too readily allowed to slip into the attitudes of illness. When working with juvenile diabetics, we found that they responded with enthusiasm and renewed self-confidence to the presence and influence of Olympic athletes.

We also saw the benefits of courting businesses so as to improve the health, as well as the level of on-the-job performance of executives and their employees. Our centers could help correct specific physical problems that arise from white-collar jobs, such as lower back problems, which afflict many office workers.

Physically handicapped and paraplegic patients were another group whose survival and quality of life are especially dependent on a commitment to physical conditioning. We therefore developed special programs for such patients concentrating on body strength and cardiovascular conditioning.

The rationale for the Centers was to help Americans regardless of the age of physical condition. But the advantages for the Olympic athletes were equal as important. These nationwide training centers were an opportunity to maintain their amateur status, while engaging in a rewarding and useful career and enjoying the friendship of a congenial community of athletes. It was an opportunity to train without financial sacrifice.

There were many benefits that would flow to the U.S.O.C including the hoped for enhancement of the performances of these Olympic athletes working at the Centers. In addition, it would increase the U.S.O.C’s ability to discover new athletic talent, with outreach programs where Olympic athletes would provide training guidance in community schools and youth centers. Perhaps one of the most important factors for the U.S.O.C would be the direct revenues which would flow to the U.S.O.C from the SLS program Centers.

We now had two centers in operation. One was located in New Jersey and the other one was situated in Washington, D.C. Mr. Jack Cahill directed the Washington, D.C., center. He was an attorney that we had known and worked with in the past. We had more requests for membership than we could accommodate. Olympic athletes from different events were hired to staff these two Centers. They were practicing for their events and, at the same time, coached young children and conducted fitness programs for the adults. It was a fantastic success, functionally and economically.

We had plans to enhance the U.S.O.C/SLS fitness programs and centers. We wanted to make a better-defined nationally oriented corporate executive program, as well as our general public and community programs. We also wanted to include within our Center’s options, the ability to secure routine physical examinations, as well as, cardiac stress training, exercise, and nutrition programs that were computerized. We also planned, at some point, to offer a biomechanical analysis of tennis, golf swings, and performances in other sports.

A third division would be related to my work in the development and manufacture of computerized exercise equipment. These systems could be used not only in training centers, but also in hospitals and rehabilitation clinics for specialized work, such as injury rehabilitation, cardiac rehabilitation, and the like. Although only two CES units were currently available, I had a number of
designs and applications for different fitness needs on the drawing board. I was waiting for the money and opportunity to develop the next unit.

During the process of implementing this extraordinary program, we enjoyed the enthusiastic support of Colonel Miller who continued as the director of the Olympic Committee. He saw the tremendous opportunity for both the athletes, who needed financial support, and the flow of revenues to help the U.S.O.C with its other programs and Centers.

We arranged for Mr. Casey to come to our CBA office in Amherst to observe how we collected and processed biomechanical data, as well as to demonstrate the developing computerized exercise machine (CES). Since I was working feverishly to prepare for his arrival, Ann went to the airport in Hartford, Connecticut, to drive Mr. Casey to our office. Accompanying Mr. Casey was a young man from South Africa, Mr. Manfred Stein. Mr. Casey was true to form with his gruff demeanor and he growled during most of the trip. Fortunately, he napped intermittently during the drive, so there were the pauses between the growling. Ann, who was in awe of Mr. Casey’s WWII exploits, was perplexed by his behavior, but chalked it up to the quirks of a remarkable man.

After they had arrived at our CBA office in Amherst, we presented all of the various biomechanical technologies, as well as the early prototype of the CES. Both Mr. Stein and Mr. Casey were impressed with our capabilities, as well as the many potential products and services we could provide.

One of the projects we were working on when Mr. Casey came to Amherst was the Dow Chemical case. He watched how we analyzed movements of gymnasts, tested the mats provided, and related the head injury of a severely traumatized gymnast to the response characteristics of the mats which allegedly caused or contributed to the injury. Mr. Casey immediately noticed the potential for our technology in the area of Workers’ Compensation. We had already done a little in this area, but Mr. Casey wanted to make it a significant factor in SLS.

Mr. Casey subsequently developed a marketing plan to accomplish this feat of product testing and forensic biomechanical quantification. He saw a future with all product advertising for sports equipment would have a “CBA approved” rating on it, in the same way that electronics have “UL” on each device.

In addition, CBA was in the unique position to test the nature of serious injuries. For example, he cited a New York Times' article on April 6, 1978, which indicated that artificially surfaced football fields may be the cause of pronounced increases in the foot, ankle and knee injuries. This was a situation that CBA could have settled with research results to demonstrate the answers.

In the products liability area, CBA had already undertaken two types of cases: materials and non-materials cases. The Johnny Carson slant board case (previously discussed) fell under the latter category, while the Dow case primarily tested the actual materials involved. We had other projects under both of these categories and we showed the final reports to Mr. Casey.

Mr. Casey and Mr. Simon understood that CBA and I were on to something potentially huge, if handled correctly. Their vision was accurate. Product liability was having a devastating effect on many industries because of the increasing number of court suits, excessive court awards, and spiraling insurance premiums. Product liability cases, even today, the number exceeds four million and the average settlement of a product liability case is in excess of $300,000.

According to the U.S. Commerce Department, the industries hardest hit by product liability are those involved in the manufacture of machinery, sporting and health equipment, toys, motor vehicles, medical equipment, tobacco, and drugs. Of every liability dollar spent by these industries, 56% of it goes to legal fees and costs. This expenditure on product liability and litigation in the U.S. rose from $2 billion in 1955 to $15.4 billion in 1976. Presently, the expenditure is in the $100 billion range. (Exact figure needs to be verified by the U.S. Dept. of Commerce.)

By 1977, a number of companies had employed CBA to analyze their products and evaluate, from a biomechanical point of view, their liability. The Dow Chemical Company, as a result of the
gymnastics-neck injury case, had contracted us to determine impact analysis on all their foam products. In addition, the Riddell Corporation, a leading manufacturer of football helmets in the country, had contracted CBA for a study analyzing the design liability of football helmets.

As Mr. Casey and Mr. Simon began exploring in greater details the entire workers’ compensation area, they realized the gigantic need in this market. The products, personnel involved, and research potential was nearly almost impossible to gauge with regard to potential studies and/or derived income. To date, these claims exceed $30 billion per year and there has been no precise system to measure degrees of disability. As a result, insurance companies have resorted to general formulas to determine the amount of workers’ compensation.

Using biomechanical analysis, the actual degree of a worker’s disability can be measured, within a small margin of error. This margin of error can be eliminated if the worker is tested biomechanically before an accident has occurred. The worker's performance can be recorded and used as a standard if an accident occurs. The comparison of a worker's pre- and post-accident movements will determine the extent of the injury. Thus, through the biomechanical application, a system can be established that will consistently determine the extent of the injury and the amounts for compensation for the worker. The result would be substantial savings for any company that pays sizeable compensation fees. This analysis system would have a similar attraction for insurance carriers, who are consistently impacted with accident claims.

The entire products liability and workers’ compensation business, in Mr. Simon and Mr. Casey’s eyes, could evolve ultimately into long-term, multi-million dollar agreements with insurance carriers. This was highly desirable to me, too, since CBA required an income stream to provide corporate stability. Project-by-project income was less reliable because of the limited life of the contract.

Mr. Simon and Mr. Casey saw the overall market in excess of $100 billion, but this was admittedly speculation. Even without specifying a particular dollar figure, the financial incentive they foresaw a plethora of companies who would be interested in Product Liability testing. This list could include many of the notables on the insurance scene at the time, including Aetna Casualty and Surety Company, Liberty Mutual Insurance Company, Fireman's Fund Insurance Company, Travelers Insurance Company, and many others. There appeared to be a positive and productive future with incredible business opportunities that would benefit CBA and the insurance companies in addition to SLS.

Another potential product was the Computerized Exercise System (CES), which our staff and I at CBA had invented. (An entire chapter is devoted to this device.) I had demonstrated the equipment to Mr. Casey and Mr. Stein during their visit in Amherst. Subsequently, Ann and I drove to Mr. Simon’s home in New Jersey to show him what and how the system worked. We had invented a small computer to control a stepper motor and an angular device to regulate a hydraulic valve/pack, which we also had invented. Every component in the system was unique and patentable. We demonstrated the uniqueness of this exercise machine and the computer that controlled it with the expectation that they would also recognize the tremendous potential for making money, as well as help develop fitness. Since our invention was the first, small compact computer, we also believed that it could be manufactured and marketed as a home the computer, which everyone could own and operate.

Both Mr. Simon and Mr. Casey were impressed and took the design to Booze Allen, which was probably the most prestigious technology-consulting firm in the world. Mr. Simon was working with them at the time, so we anticipated a quick response. However, we certainly did not expect the answer we received. Booze Allen reported, “The American public will never buy a computer to have in their home.” I guess that Steve Jobs and Steve Wozniak were lucky that they introduced their Apple idea to the Homebrew Computer Club and could not afford to show their prototype to Booze Allen!!

I think all of us believed that SLS could develop and market this fantastic product, but Mr. Simon and Mr. Casey were older and more conservative than I was, at that time. I suspect, in retrospect, that they were willing to move forward in the other areas, which showed obvious financial potentials and kept this CES on the backburner, for the present.
The other situation, with Coto de Caza, turned out to be another aborted project for SLS. Since I had not been able to be in California when Mr. Simon initially met Mr. Palmieri, I do not know exactly what was said and how the discussion evolved. However, during my next visit to California, Mr. Palmieri explained his perspective about the venture. He wanted my staff and me, and all of our biomechanical system in Coto de Caza, but he was not interested in including the additional layer of SLS. He felt that it was too early in our relationship to make such a dramatic increase in the dimensions of the Coto de Caza biomechanical research concept. The goal for Penn Central was to sell the real estate and we could help them achieve that goal through the work and publicity that we generated. The SLS structure was more elaborate and Mr. Palmieri felt that this should be maintained outside of a formal, interlocking relationship.

Mr. Simon and Mr. Casey accepted the rationale presented by Mr. Palmieri. We all decided to focus on the SLS centers that were currently operating in New Jersey and Washington, D.C., and keep these other potentials for future consideration.

Our Olympic fitness program was operating very successfully. We had hired Olympic athletes who happily coached young children, as well as working to improve the fitness of the general population. We were exploring other cities, since there were a number of athletes who were seeking financial help, but were geographically restricted to their hometowns. Then, out of nowhere a bomb exploded.

On November 20, 1981, newspapers around the world printed an article by Jack Anderson primarily attacking Mr. Casey. The headline read, “CIA head Casey rented Olympic Label for a Body Boutique.” This was another attack by Mr. Anderson who is regarded by many as the “Father of Investigative Journalism.” The article was not Mr. Anderson’s first attack against Mr. Casey but, unfortunately for SLS, it came at an unfortunate time. Mr. Anderson wrote, “Another hobgoblin had appeared from out of Bill Casey’s corporate past.” He continued, “This is just the latest in a succession of tawdry discoveries” and “I’ve reported on his involvement in other questionable business deals.”

The article continued to name ex-Treasury Secretary William Simon, as well as Dr. Dardik and me as participants in the venture. The implications were that the U.S.O.C and the athletes were being duped and taken advantage of by the dishonest machinations of each and all of us. The article continued with innuendoes and allegations about mismanagement and a variety of other suggested problems. What a shock it was to me to read this attack article!!

I had endured my own “trial by fire” if that is what one would call scurrilous newspaper articles. The most difficult part is that once something appears in the newspaper, the victim is always trying to catch up to clear their name and reputation. Sometimes what is printed is true, but frequently, as was this Jack Anderson attack, the information was badly distorted and misrepresented the facts. It was true that we were using the Olympic rings, but the U.S.O.C was receiving money for this usage. It was correct that Olympic athletes were working in the fitness centers, but they were paid well for their efforts. It was not correct that Dr. Dardik and I were on the Olympic payroll. In fact, we rarely requested reimbursement for flights to Colorado Springs. But the smears, suggestions of impropriety, the resurrection of supposed past evils committed by Mr. Casey, and the knowledge that this was only the beginning of a long series of battles caused all four of us to reconsider the future of SLS.

The article was printed in a local New Jersey newspaper and is shown on the next page.

We each had our individual, as well as collective (meaning SLS) selves to consider. At the time, Dr. Dardik and I had heard rumors that Mr. Simon was pondering his chances, should he decided to run for president of the U.S.A.. Dr. Dardik was a well-respected medical doctor who did not want to have the adverse publicity and lies to taint his reputation. I was still in the early developmental steps with CBA and the new venture in California. It would be a needless time consuming effort to have to engage in
trying to win a fight with someone who possessed unlimited and unconstrained access to the public via his own newspaper. It would be like trying to fight a grizzly bear because, even if you win, you are usually so badly wounded, what price is a victory? Despite the distorted and inaccurate information in these articles, we decide that SLS would have to be abandoned.

From my perspective, the scandal caused by the lies, misrepresentations, and innuendoes printed under Mr. Anderson’s byline, appeared to be normal for him. He thrived on attacking public individuals and, in some cases these attacks may have been justified. However, Mr. Anderson’s attack on SLS appeared to spring from his personal and special animus against Mr. Casey. The underlining theme for SLS was to help athletes, the U.S.O.C, and improve the fitness levels among the general public. Mr. Anderson, who was bent on destroying individuals regardless of whether his facts and premise were correct, ignored this theme.

My background was filled with fights and struggles. My own professors and Mr. Arthur Jones had publically attacked me. I had overcome many difficulties to survive in a foreign land, where I had not known the language. I would not have backed down from this fight. However, Dr. Dardik was worried about his medical practice and Mr. Simon was considering whether to run for the presidency of the country. Mr. Casey was the most vulnerable, since Mr. Anderson was apparently on a quest to destroy Mr. Casey.

Thus, the end came to SLS. It had been a great idea, which was tarnished by jealousy of unproductive and misinformed people. However, the destruction of a good idea provided me with more time and energy to direct towards the continuing development of my own company.

My company, CBA, and the new Coto Research Center (which I will discuss soon) were flourishing. Our business ventures expanded and I continued working with the American athletes to improve their performances with biomechanical analysis. With the end of Scientific Life Systems, I turned more of my attention to these other ventures.

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Chapter 14: The Ariel Computerized Exercise (Machine) System - CES

I have discussed previously my association with the Universal Gym Exercise Company. I was involved with them for about eight years and helped to design the most advanced exercise system of the time. However, the designs were for equipment constructed of metal with Cams to provide resistance that varied throughout the exercise movement. This was an appropriate type of exercise equipment for a gym, school, or athletic setting, which could be used by many people continuously all day long. Many of the people who trained on this type of equipment were young and, frequently, insensitive or uncaring about the wear and tear on the systems. For this reason, the equipment had to be rugged and able to sustain the stress and abuse of the exercising public. The Universal Gym equipment was designed specifically for this marketplace and the type of exercise users who, in general, were indelicate when working out on the equipment.

For its time and place in the world of exercise, the Universal Gym equipment, which employed the dynamic variable resistance (DVR) system, was the best training device available. However, there were some limitations even for this advanced system. For one thing, the Cam provided only a fixed pattern of adjustment. However, if you wanted to change the form of the exercise, you were unable to make any alteration. You could not swap different cam shapes into and out of the equipment if you wanted to follow a different movement path. Another limitation was the inability to accelerate at the end of the exercise movement. You could not because of the rigid and inflexibility in the hardware. If you wanted an isometric contraction at the midpoint of the exercise, it was impossible for the cam to provide this option.

The Universal DVR machines were fantastic in the 1970s and are still providing superb exercise into the 21st Century. But I was sure there could be better and smarter machines, which could provide improved exercise benefits. I had not found any, but in my mind, I was confident that I could create something that would fill the void. I concluded that I would have to invent something. Ever the optimist and with dogged determination, I pondered and considered a number of ideas that might work.
One possibility would be to use air in closed cylinders to provide resistance. However, there were problems with using air:

1. The amount of pressure could not be regulated or calibrated
2. The system would have to be pressurized at all times
3. Pressurizing the system would require electrical connections
4. Air can only be compressed

What if there were leaks in the cylinders or the pressurized lines, which delivered the air? What would happen during an electrical failure? How would you provide for each movement direction? Since air cannot be stretched, there would have been two cylinders for an exercise, such as a bicep extension-flexion exercise.

I reconsidered another proven system to provide exercise that provided increased and decreased forces throughout the exercise movement. These were stretchy devices like the ones I had developed during my brief time at Indiana University in Bloomington, Indiana. When I was a student and the assistant track coach at Indiana University, I had taken several different lengths of surgical tubing from the medical school, attached handles at one end and fixed the other end to the wall. These simple tubes were unbelievably fantastic for three-dimensional joint movements and the more the tube was stretched, the greater the resistance to the muscle. In addition, they were light and easily portable. Unfortunately, they could not be calibrated, so the person exercising had no idea how much force he or she was exerting.

One day during my regular exercise routine, I was raising and lowering a barbell in a bicep curl. It was very easy to lift the weight at the beginning of the exercise, when my arm was down with the barbell in my hand. However, as I bent my elbow the weight was increasingly more difficult to lift, until after I had passed the halfway point with my elbow at ninety degrees. As I continued the curl, the weight again seemed easier to lift the hand and weight approached my shoulder. The same problem occurred in reverse as I lowered the barbell.

I concluded that what I really needed was a little magic genie to add and remove weight from a bar, such as a barbell, while the exercise was in progress. I imagined that there was a little magic genie, which could add weight, incrementally, when it was easy for me and remove weights when I struggled to raise the bar. In other words, the genie could add or remove some of the load during the exercise so that the load adjustments would be fine-tuned to the person performing the exercise. My, eureka moment occurred, as I realized that I needed the exercise device to adjust to the person, rather than the person having to adjust to the equipment.

These thoughts whirled around in my head. I had long ago recognized the limitations of the traditional equipment. I had perceived a way to improve on exercising. Now I had to find a way to make the equipment smart enough to adapt to the individual. This would take more time and brainpower to solve. I had to find a solution to adjust to the continuous changes between levers (bones) and the load so that exercise is optimized, as well as a method for regulating and recording these adjustments. I needed to invent a system with a brain.

At that time, all of the existing resistive training equipment was merely a tool, which lacked intelligence. The equipment was unaware that a subject was performing an exercise on it. The human brain can sense touch, see objects in motion, determine smells, tastes, and sounds and act according to the sensory inputs. No exercise hardware could function like a human because none had brains. How could I give an exercise device this thinking capability?

My initial thinking led me to the consideration of the human body’s use of closed loop feedback and sensory capabilities. This neurological and muscular system provides people with the ability to execute large and fine motor skills. Much of the control was at a subconscious level such as breathing, walking across the room, and chewing food. Other tasks necessitated great cerebral attention such as running down a runway for the pole vault in Track and Field or manipulating the dials on an electronic device. These capabilities did not exist on any fitness training equipment.
However, as I pondered the idea of an exercise machine that could have a brain and closed loop feedback abilities, I naturally turned to the newly developing world of computers. With the advent of miniaturized electronics in computers, perhaps it would be possible to connect an exercise device to the computer's artificial intelligence. If I could find a way to combine hardware and computerized software, then the equipment could adjust and adapt to the exerciser. At last, this would be the ultimate exercise device. Now, the task was to create this smart exercise system.

I thought about what currently existed among the many exercise devices available. I rejected air, springs, and stretchy surgical tubing, since they were difficult to control. I remembered a small hydraulic exercise system that we had in our Amherst office, which was a prototype for a Universal Gym Equipment product. Ed Burke, the American Olympian hammer thrower, and I worked on this machine year before, at Universal. That project had been cancelled long ago, but the hardware was in the back of our office.

Ann and I pulled the cobweb-covered machine into the middle of the room. We cleaned it off and then examined the structure and component parts. The exercise bar and handles were fixed to a small post. Also attached to the post was a small hydraulic cylinder with a small handle for opening and closing the valve. We turned the handle to open the hydraulic cylinder valve and then moved the bar up and down. The movement was relatively smooth and it was easy to move the valve control dial. However, when I closed the valve on the cylinder, as the bar was raised or lower, it was more difficult to move the bar.

“This is perfect for beginning the exercise machine with a brain!” I exclaimed in a surprised and happy manner, while Ann smiled in her understandingly, supportive way. Hydraulic cylinders have valves that can be regulated. In addition, the materials are easy and inexpensive to acquire and the oil can be anything from hydraulic fluid to maple syrup! The oil can be contained, cylinders valves can be regulated, and these components can be controlled by computer software. My brain was on fire with ideas. I felt as though there were fireworks exploding out into the room around me, but as I looked around the office, everyone was working quietly and normally.
I was always enthusiastic about ideas, so naturally I wanted the World to know about this concept. In 1975, I submitted an abstract for the “Computerized Dynamic Resistive Exercise” which I subsequently presented in 1976 at the International Conference of the Montreal Olympics in Canada. Now, we had to transform this idea into a tangible system.

I called the entire staff to consider my ideas with regard to actually implementing them. At that time, we had a programmer, Alan Blitzblau, who was a genius with software programs. Independently, Ann and I had met Alan when he was working in the computer science department. We each had sought his help at the computer center and had become quite friendly. Ann uses to pay Alan by baking pecan pies, since she did not have enough money to actually pay for his help. The three of us frequently had
lunch together at a local sandwich shop where Alan and I would play one of the first video games, Pacman!! After we moved our CBA office from Dartmouth College to Amherst and then grew large enough to need a full-time, in-house programmer, we hired Alan.

Alan and Ann thought the idea of programming a computer to control an exercise machine was fantastic and clearly a problem that we could solve together. Alan had worked with two students in the engineering department, Justin Millium and Peter Smart, who had complementary talents with regard to electronic controls and computer systems. He located them and brought them to our office. Alan was confident that Peter, Justin, and himself, would be able to program the computer, hardwire any components onto computer control boards, and interface all of these separate devices so that they could operate successfully.

At that time, the only computers commonly available were the mainframe computers, such as the Honeywell at Dartmouth College and Control Data at the University of Massachusetts. The systems were powerful and could handle many users at a time, but with sizes that filled hundreds of feet of floor space, they were inappropriate for our needs.

Our world of computers was about to explode into a whole new and vast experience. In one of our first meetings with Peter and Justin, we were introduced to a whole new world of electronics. Peter and Justin described a single chip microprocessor, which had been introduced in November 1971 by a company called Intel. This revolutionary microprocessor was the size of a little fingernail, yet could deliver the same computing power as the first electronic computer built in 1946, which filled an entire room. 1971, the Intel 4004 processor held 2300 transistors and was produced on two-inch wafers, compared to the 12-inch wafers commonly used in today’s products. The Intel 4004 microprocessor was unique in that it was one of the smallest microprocessor designs that ever went into commercial production. After the invention of integrated circuits revolutionized computer design, the next step was to make things smaller and the Intel 4004 chip moved the integrated circuit down another step by placing all the parts that allowed the computer to think, i.e. central processing unit, memory, input and output
controls, on one small chip. Fortunately, for CBA and my quest for an exercise machine with brains, this Intel microprocessor was a miracle solution for our needs. We needed computing power that did not fill half of a university building and this little tiny electronic wafer seemed to be exactly what was required.

![Intel 4004, The First Designed Microcomputer in 1974](image)

Alan explained that Justin was knowledgeable in the assembly language required to program the Intel chip. Alan and Justin would be able to design the flow of information between the various components and the microprocessor. Peter’s contribution was the ability to design and build the circuits to connect all of the interfacing components of the exercise machine’s brain, sensors, and control devices.

![Justin Milliu and Peter Smart](image)

**Gideon Ariel** Wow!!! My guys...peter and you. We did allot together Our "box" was one of the first pc in the world ...gideon December 24, 2011 at 11:55am · Like

**Justin Milliu** Yes, the "box" was the first PCI BTW, in the instrument trailer for the radiotelescope was a microprocessor-based data acquisition system using the MC6800 microprocessor, same as "the box." December 24, 2011 at 12:19pm · Like
Justin and Peter designed for me the first Personal Computer before Apple or Atari and way before the IBM Personal Computer. Here is correspondence between Justin and myself, recently on Facebook:

We also were lucky that Justin and Peter knew a professor at the university that they believed could be an asset to the project. Ann and I decided that it was a good idea to meet the fellow and perhaps good things could result. We told them to have him come to the office. A day or two later, we observed a skinny fellow with a huge head of hair and a beard staring up at the sign above our office door. The behavior of staring at our sign with a puzzled expression was quite common. However, this man had more of a hippy appearance than we ordinarily observed. Imagine our surprise, when the fellow opened the door and introduced himself as Justin and Peter’s professor. He introduced himself as Dr. Jeremy Wise. Wow, now we had smart and wise in our office!

Dr. Wise had received his baccalaureate degree in physics from Cornell and his Ph.D. in high-energy physics from the University of Massachusetts. Dr. Wise had a quiet, confident demeanor, but more importantly he had unbelievably pertinent knowledge for CBA. Initially, I was extremely impressed with his credentials, but pondered how we could successful utilize his talents. I inquired about his computer programming skills and received a modest response. I suggested that he program the stock market. He answered merely to inquire what and how much I wanted such as daily or weekly listings, all of the stocks or only what I owned, and similar questions. After we had discussed the details, I assured him that I would pay for his hours and then he left the office. I looked at Ann and we both shrugged our shoulders. Neither of us was very optimistic that we would see him again. At that time, in the 1970s, there were no computerized programs within or outside of the stock exchanges. The task we had assigned to Dr. Wise was not only a huge, but was completely unheard of at that time.
Imagine our surprise, when Dr. Wise returned in two days apologizing for the delay. He had taught his class the preceding day, so he had needed an extra day to complete the programming. He had a computer printout of the data and the program to scan into our Data General NOVA-3 computer. Within half an hour, he had loaded, demonstrated, and explained the entire stock management package that he had programmed. We were so impressed with Dr. Wise’s talents we hired him on the spot despite the fact that we did not, as yet, know what tasks to assign to him! That was a significantly momentous day for CBA. Dr. Wise has been our programmer, colleague, and friend since that day and, hopefully, for into the distant future.

The tasks for the other staff members were set. Gideon and Ann had to find the best hydraulic cylinder and transducer, while the software men proceeded with their parts. Alan and Justin began almost immediately to design the software flow charts. Peter watched their work until he had sufficient information to begin his hardware designs.

During the time that all of the computerization, board building, and discovering Dr. Wise was swirling, Ann and I had set ourselves the task to learn more about hydraulic systems. We had found a hydraulic expert at the University engineering department. The professor explained that hydraulic machines use liquid fluid power to do simple work. He had described how a huge earth digging machine could serve as an example. In that type of machine, hydraulic fluid is transmitted throughout the equipment to various hydraulic motors and cylinders which become pressurized according to the resistance present. The fluid is controlled directly or automatically by control valves and is distributed through hoses and tubes.
The advantage of hydraulic machinery is that a large amount of power can be transferred through small tubes and flexible hoses. In other words, hydraulic machinery utilizes a pressurized liquid (hydraulic fluid) as the powering medium.

The professor explained that the only way to measure force in a hydraulic cylinder was to utilize a transducer to measure the pressure inside the cylinder. Because oil cannot be compressed, the transducer can measure the forces. The pressure transducer can be located outside of the cylinder in a manner that the oil flow passes through it, in pipes from the top to the bottom of the cylinder itself. This arrangement would allow the pressure to be measured with a transducer set at a high testing rate. The higher the measurement rate, the more frequently the control valve could be opened or closed.

The first hydraulic control valve which we tried to adapt to our exercise machine was a screw type. This type of valve has to turn to open and close the opening, through which the oil flows. The valve performed well under slow controlled bar speeds, but it was not fast enough for rapid changes. The amount of time needed to spin to the most extreme positions was too extreme which caused the movement to be jerky rather than smooth. Another problem was that the pressure did not change in a linear fashion. This lack of linearity made it difficult to control. We realized that we needed a different type of valve, which could respond more quickly.

Ann and I returned to our friendly and helpful professors for help. His next suggestion was to try a hydraulic spool valve, as perhaps being more appropriate for our specific needs. A hydraulic spool valve is a cylinder inside a sealed case. It usually has valves leading to the pump and the tank on one side and valves leading to one or more hydraulic devices on the other side. Pressure can flow into the valve from the pump into the hydraulic devices or drain out.
of them back into a hydraulic storage tank. A controller moves the valve back and forth in its case to slide the spools into different positions. The position of the rotor will only allow the hydraulic fluid to flow in one direction to perform a specific task.

Hydraulic spool valves can be used in many different ways to perform many different functions. One of the most common uses is to drive a pressurized hydraulic piston. The piston is sealed in a cylinder with a valve on either end, both leading to the spool valve. When the spool valve is set in the push position, fluid flows from the pump into the bottom of the cylinder, while the fluid in the top of the cylinder is allowed to flow out into the hydraulic tank. This pushes the piston out. When the valve is set in the pull position, fluid flows into the top of the cylinder and out of the bottom causing the piston to pull back into the cylinder. This seemed to be the ideal solution for our specific needs.

At that time, I was enrolled in the computer sciences department at the University of Massachusetts pressuring a second Ph.D. degree. One of my professors was Dr. Wogrin. He was also the department head of Computer Sciences. In his class covering computer hardware, one of the requirements was to have a project. I asked Dr. Wogrin if I could work on my idea of Computerized Exercise Equipment and design the Hydraulic mechanism that will be controlled by the computer. He agreed. Here is the result of this effort.

The exercise machine would have a bar with the handles at one end for the person to push or pull. The other end of the bar would be connected to the piston in the sealed hydraulic cylinder. The spool valve, under computer control, would be adjusted to open or close as required by the pressure generated by the person exercising according to the designated computer program. From that point until the oil was returned to the accumulator, it could be controlled simply with the use of various check valves.

The control mechanism for our spool valve was a stepper motor. Peter had located the first of its kind, stepper motor from Eastern Devices. This was a newly developed device that was digitally controlled, whereas all of the previous hydraulic motors had operated under analog control. Although it was easy for large mainframe computers to control analog devices, it was very complicated to regulate
and control an analog motor with the existing microelectronics. The digital stepper motor was a digital electric motor, which moves a known finite distance with each pulse of electrical power applied.

Stepper motors effectively have multiple, toothed electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, such as a microcontroller. To make the motor shaft turn, first, one electromagnet is given power, which makes the gear’s teeth magnetically attracted to the electromagnet’s teeth. When the gear’s teeth are aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one. From that point, the process is repeated. Each of those slight rotations is called a step, with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

Thus, movement of the spool valve could be easily controlled by electronic signals from a stepper motor. Peter and Justin were easily able to control the individual steps of the motor, which allowed precise control of the spool valve. The microprocessor software could control the valve and motor so that the exercise bar could provide a person exercising with a smooth bar reaction when pushed or pulled.

The valve and stepper motor operated digitally and could be controlled by the electronics. The next problem to solve was to convert the analog data generated by both the force transducer and the pressure transducer into digital data.

My thoughts were that we needed to have two separate inputs: force and position. We could obtain pressure from a transducer located within the hydraulic system and the bar position could be provided by an angular transducer on the bar itself. Electronic circuitry would receive the data from each of the transducers. The problem to overcome was that the signals from each of the transducers were analog rather than digital. In order for the software that Peter and Justin were creating to process and control the system, the transducer signals would have to be converted from analog to digital. At that point, the brain could process them, and that information was then sent to the stepper motor control system to open or close the valve.
This is analogous to the sensory-motor feedback loops within the human body and that was the way I described the system to our two engineers. Consider, for example, drinking water from a cup. The hand and arm must lift the cup to the mouth. The position of the arm must be constantly monitored for position and to control the action. The amount of strength provided by the muscles must be evaluated and regulated so that there is enough force to lift the cup, but not so much that the cup is smashed into the mouth. There are continuous interactions between the arm/hand position and the lifting force in order for a person to drink water from a cup. The human brain must measure and regulate these actions continuously. This feedback loop system of direction, measurement, and control of the human body was what we were trying to duplicate in the CES. Fortunately, Peter and Justin were brilliant hardware and software engineers, so they were able to understand my ideas and explanations, and then were able to create the product I envisioned.

Peter and Justin concluded that they would have to build their own computer to control the spooler value, as well as the pressure and force transducers. They worked on the project for a year with many problems along the way. Every transducer, microchip, resistor, amplifier, filter, rectifier, voltage regulator, diode, semi-conductor, and other electronic parts had to be individually integrated and hand soldered by them onto boards. The result was what we called the Blue Box and was our own microcomputer. Our microcomputer predated Apple but, at that time, we were focused on building a computer brain to control our exercise machine. If we had pursued it as a computer for the home and small office, who knows what would have happened to our company and us!

The exercise machine’s brain would need to continuously know the magnitude of the hydraulic pressure inside the cylinder. With this information, the computer would have to rapidly adjust the pressure by regulating the valve. In addition, rapid and precise bar position would have to be received and processed.
With data from the various transducers, everything needed to operate the exercise machine was available for the program to process. There were several limitations that we would have to overcome to make the equipment practical and producible. One thing we needed was a miniature device, which could convert analog to digital data for the computer. The device the exercise machine needed had to be small and fast. Although huge mainframe computers could perform this task, they were entirely too large and much too expensive for our needs.

The Blue Box could do everything necessary to operate the equipment. The user could exercise and actually read a small screen, which provided instructions and feedback while the person followed a workout program. But the Blue Box was filled with components, which required intensive time to wire and was, therefore, impractical for production numbers. In addition, we all recognized that the functionality of our creation was inelegant in appearance.

While Peter and Justin continued to develop and refine the Blue Box, I searched for a solution for the analog to digital conversion. I decided to attend an electronic conference in Chicago, where I strolled up and down the aisles of displays, and perused the numerous and varied devices presented. There seemed to be miles of rows packed with booths. At one of the booths, there was a display of computer games, which were running on Atari computers. The original Atari company was founded in 1972 by Nolan Bushnell and Ted Dabney. It was a pioneer in arcade games, home video game consoles, and home computers. The company’s products, such as Pong, helped define the computer entertainment industry from the 1970s to the mid-1980s.

I watched, with fascination, as one of the fellows in the booth controlled a submarine on a screen where he fired computerized torpedoes at some unseen enemy. The fellow was manipulating a joystick to control the movements of the submarine and to aim the firing mechanism at the target. I realized immediately that he was controlling the digital signal on the screen with the analog interface of the joystick. I introduced myself and the fellow told me that his name was Dennis Kitz.

Mr. Kitz was using the Atari computer to operate the games, which he had stored on computer cassettes. I described
to Mr. Kitz what I needed and inquired whether he thought that his analog to the digital device could be adapted for use on our exercise device. He was relatively confident that he could make the necessary modifications, but that he would come to our Amherst office to see everything first hand.

One sunny day, Mr. Dennis Kitz rode his big, black Harley Davidson motorcycle up to our office and parked in front, to the amazement of a group of passing elementary school children. There were quite a number of “ooohs” and “ahhs,” as the children walked by on their way to school. Perhaps, they were also amazed by Mr. Kitz’s large presence, as well. Dennis was approximately six feet three inches, hefty build, with a big black beard. I suspect that the school children thought that Paul Bunyan, the mythical lumberjack, had appeared in real life. Actually, Dennis was large in the statue, but had a quiet demeanor.

We showed Dennis what we had developed to this point. We demonstrated the Blue Box Microcomputer, the valves we were trying to control, and described the ultimate goal. He said he would try to design and build an analog to a digital device that we could use, and then roared off on his motorcycle.

Dennis returned to our office a few weeks later with a mechanism which Justin and Peter were able to interface with our Blue Box Microcomputer.

The device was able to read the signals from the hydraulic force and position transducers. Then, these analog signals were converted into digital form, enabling the computer to process the data. From this point forward, the Blue Box could drive the system using digital signaling.

The small analog to a digital device that Dennis Kitz built for us was a significant advancement in the miniaturization process that we would have to aim for in the future if we were to develop a viable, marketable product. We were able to take the designed board to a manufacturer who could mass-produce it. Now the next step was to find a suitable computer. It would have to be small and fast, but we had some options, which were now being actively marketed.

We had several candidates to consider for computers to replace the Blue Box. At the time, CBA had in-house computer capabilities, to replace our dependence on the University’s mainframes, with a Data General NOVA computer. Data General had introduced the NOVA line, in 1969. It was packaged into a single rack mount case and had enough power to do most simple computing tasks. Our business was one of the many science laboratories around the world, which purchased the more than 50,000 units sold. We were able to perform all of our CBA biomechanical work on the NOVA and it appeared to be
an excellent interim step to use for the exercise machine’s *brain*. Ideally, we would need something smaller in the future, but it was more versatile than the *Blue Box*, for the time being. We continued to search for the perfect small computer.

![Exercise Machine with the Data General micro-NOVA](http://arielnet.com/ref/go/1188)

Now that we had a manufacturer for the hydraulic pack unit, we continued our search for a manufacturer for the frame. Joe and Frank Capelli explained that, while they could make the frame and the pack, we might be more efficiently served by going directly to a Connecticut company who already manufactured the spool valve they were using. Perhaps this company could make everything at one site. This was a gracious suggestion, since they were relinquishing their opportunity to make money manufacturing our system. However, they felt that this alternative option was better for us.

We visited the Connecticut company, which the Capelli brothers had recommended. They were able to manufacture the frame and the entire hydraulic assembly for a reasonable price. We were pleased with the arrangement and immediately worked on integrating our computerized electronics with the frame-
hydraulic pack. As soon as our first system was tested and ready, we were able to demonstrate it. By this point, our negotiations with Wilson Sporting Goods were nearly completed.

We were extremely lucky that during our time of innovation and invention on the CES, the computer industry was sharing a revolution as well. Although we were satisfied with the performance and reliability of the Data General micro-NOVA, the size and price tag were significant problems for use with our CES. We continued to search for a suitable alternative.

Simultaneously with our search for a smaller, less expensive computer, we continued to work on programming the micro-NOVA because that was the system that Wilson Sporting Goods preferred. We had discussed the computer situation with Mr. Cooksey during his visit. However, Wilson Sporting Goods was more comfortable using a known, well-established company rather than trying to adapt a hobby-type computer. Therefore, we continued to develop the software for the CES on the micro-NOVA.

We were able to reach a fantastic agreement with Wilson Sporting Goods in 1979. The basic plan was that they would manufacture and sell the CES and CBA would receive royalties on the sales, in addition to continuing consulting fees to help develop and advance the CES. They were also prepared to obtain patents on the CES and its various components, which would protect all of our investments of time, money, and intellectual concepts.

(Scan QR Code in the Patent for more information: “The Computerized Exercise Machine Patents”)

Wilson planned to take the manufacturing task to their Chicago facility so they were able to satisfy the initial purchases from the Connecticut Company and then conclude that relationship.

The arrangement with Wilson Sporting Goods seemed to be a dream and we were sometimes surprised to pinch ourselves awake and discover that it was a reality. Their plan included manufacturing the CES in their Chicago facility. We were so excited by their commitment to CBA and the development of the CES. Wilson was as enthusiastic as we were and had chosen to name the CES as the “Wilson Ariel 4000”. They intended to subcontract some of the components, such as the hydraulic pack assembly and the frame portions. They would purchase those components in sufficient quantities, as well as the micro-NOVA, to allow large discounts from the different subcontractors. Then the final CES product could be sold for a reasonable and competitive price. The Wilson plan was multi-level since they were planning
to initially target the higher priced medical market, including physical therapy. The next tier would be corporate fitness programs and larger university athletic programs. Eventually, they expected larger, less expensive retail market for sports enthusiasts.

(Scan QR Code on the right for more information: “The Wilson Brochure”)

I had many ideas for adapting and designing the CES for specific purposes. For example, Ann and I were developing a prototype, drawer-sized CES for NASA to use on the Space shuttle. This CES exercise device was developed to address two separate, but possibly related, subjects. The first obvious consideration

One of the 19 Patents issued for the Ariel Computerized Exercise Machine

http://arielnet.com/ref/go/1193

The Ariel Computerized Exercise Machine

http://arielnet.com/ref/go/1194
was to assist the astronauts in maintaining their muscular strength while in the microgravity space missions. One serious problem that their astronauts encountered was the inability to walk and move about when they returned to Earth. Time was required for them to recover their muscular strength.

The Wilson-Ariel Computerized Machines running on Micronova Mini Computer

http://arielnnet.com/ref/go/1195
A second and the more serious problem was that the NASA astronauts suffered from osteoporosis during even short duration space missions. The most common disease affecting bones, osteoporosis, literally meaning porous bones, results in the loss of bone mass, rendering bones brittle and more susceptible to fractures. Here on Earth, this condition afflicts both men and women, although it tends to be a problem that plagues more women than men. In addition, Earth-bound osteoporosis affects women more severely than men, especially after menopause.

Exposure to the microgravity environment of space causes astronauts to lose calcium from their bones. This loss occurs because the absence of Earth’s gravity disrupts the process of bone maintenance in its major function of supporting body weight. Exercise creates forces that stimulate bone development. Bones are composite structures, made up of bone matrix and mineral deposits that fill out the matrix.

It had been reported that astronauts in space could lose as much as two percent of bone mass per month, which is several times more than is lost by patients with osteoporosis. Bone cell formation depends largely on the effects of weight, both through gravity and exercise. When weight is suppressed, bones undergo a process of demineralization accompanied by a loss of calcium to the blood.

Normally, the breakdown of old bone mass (resorption) and the formation of new bone mass (growth) occur constantly, in a balanced cycle called remodeling. Bone cells called osteoblasts make new bone, and cells called osteoclasts break down old bone mass. In the weight-bearing parts of the skeleton, exposure to microgravity depresses the activity of bone-forming cells (osteoblasts) and may or may not stimulate bone-resorbing cells (osteoclasts). The remodeling process becomes unbalanced and the result is a localized loss of bone mass. Research also has shown that calcium is distributed differently throughout the skeleton in microgravity and in Earth-based space flight models, such as bed rest.

Discoveries made in the course of space biomedical research on bone are already contributing to a better understanding of osteoporosis and the treatment of bone mass loss on Earth as well as in space. The single most important contribution that NASA research has made to the understanding of bone deterioration in osteoporosis is the heightened awareness of the importance of gravity, activity, and biomechanics. In other words, there is a significant mechanical basis in the biological activity in bone remodeling.

Mechanical forces, that is, the action of energy on the matter, appear to coordinate bone-shaping processes. The standard theory of bone remodeling is that the body translates mechanical force into biochemical signals that drive the basic processes of bone formation. Aging, especially in postmenopausal women and exposure to microgravity, uncouples bone destruction and formation. When this uncoupling occurs, formation lags behind the bone restoration and the result is bone loss.

Researchers are not yet certain whether bone resorption speeds up or the bone formation slows down, though recent experimentation in space indicates that microgravity might somehow affect both processes. Progress in developing methods of preventing or treating disuse atrophy and osteoporosis depends on better understanding the mechanisms that cause the problem. Determining how the body translates mechanical loading (physical stress or force) into the signals that control bone structure, may reveal how aging, inactivity, and space flight uncouple bone formation and resorption. Only in the absence of gravity can we determine the influence of weight and stress on bone dynamics.

By studying what mechanisms translates mechanical stress on bones into biochemical signals that stimulate bone formation and resorption, space life scientists may be able to determine how to maintain bone mass. Researchers do not yet know exactly what type and amount of exercise, hormones, or drugs might prevent bone loss or promote bone formation. However, some combination of sex hormones and/or growth hormones and exercise seems to be the key to preventing bone mass loss associated with chronological aging and post-menopausal hormone changes on Earth.

We believed that the CES could be programmed to address this specific issue. By utilizing the “force” option, we believed that the system would promote greater stress at the bone-muscle connections. We envisioned that the feet could be held in shoes attached to the floor of the shuttle module. Then various exercises, for example a squat exercise, would require muscular forces thus produced stress on
the bones as well as strengthening the muscles. By generating stress on the bones, perhaps the body would have to replace rather than remove calcium from the bones. The goal would be to stimulate the development and replacement of the bones through exercise. We believed that this would a better stimulus for healthy muscle-bone growth and development rather than having to rely on drugs.

Our hope was that the modified CES would assist in the prevention of Space-induced osteoporosis. Furthermore, the proposed CES for the NASA shuttle missions could subsequently be adapted for hospital and home use.

![Ann and I working with NASA to integrate the CES with the Astronauts training](image1.jpg)

![First Prototype of the NASA machine](image2.jpg)
Our proposal for NASA on the development of the special CES for NASA is covered in the QR Codes. *(Scan QR Code below for more information: “The Computerized Resistive Exercise Dynamometer”)*

This proposal resulted in NASA work with ADI to develop the NASA machine as shown below.

Floating in the KC-135 in zero gravity

http://arielnet.com/ref/go/906

Zero Gravity Training

http://arielnet.com/ref/go/1196

http://arielnet.com/ref/go/1197

The head of Biomechanics expresses the success of the program with NASA on the CES for NASA, Dr. Mike Greenisen.
Dear Dr. Ariel:

Thank you for delivering the second generation Resistive Exercise Dynamometer RED. This is a remarkable design with the potential for an enormous positive impact on how astronauts exercise in space. The potential for modifying the RED such that it becomes a stair stepper or a rower is especially ingenious. Please extend my congratulations to Mr. Phill Harmon and his staff for a truly superb effort!

In addition, the potential use of the RED as a dynamometer to measure skeletal muscle performance during space flight missions will be a major technological breakthrough. This option will provide NASA the capability to monitor skeletal muscle strength changes while on orbit. Knowledge of these changes will be a major enhancement that will enable appropriate space flight exercise countermeasures to maintain muscle performance.

Sincerely,
Michael C. Greenisen, Ph.D.
Manager, Exercise Countermeasures Project
Michael C. Greenisen is the manager of NASA’s Exercise Countermeasures Project, where he is responsible for the physiological functions of the astronaut crews for both space shuttle missions and the International Space Station. NASA also recently selected Michael as the Increment Scientist on a pending Space Station Expedition Flight. His experiences also include work with the Russian Space Program, and studies to determine effects of space flight on the skeletal muscle fibers. He is now involved in the planning for the pending Mars missions. In 1996, NASA awarded Michael its Award of Merit for his work, “Formulating space medicine for human exploration of space.” In addition to his work with NASA, Michael is an adjunct professor at the University of Florida, visiting professor at Caledonian University in Scotland, and an associate member of the Mechanical Engineering Department at McGill University in Quebec. Michael is a National Research Council Advisor and a retired Lieutenant Colonel from the Army Reserve.

Although our initial contact with Wilson Sporting Goods had been Mr. Cooksey, we were disappointed when he told us that he was being reassigned to a new project. His primary job was to find new and exciting products and we had been one of these stimulating projects. Our new contact was Mr. Bill Morrisroe, one of the Senior Vice Presidents, and Mr. Richard Smith, the corporate council from PepsiCo to Wilson. They were instrumental in concluding the relationship with the manufacturing in Connecticut, cementing the arrangement with Data General, and providing the law firm for the CES patents.

Mr. Morrisroe assigned Mr. Lou Tabickman as the general manager for an entirely new division within Wilson, Fitness Systems. They hired about 20 people to continue the CES development in conjunction with CBA’s continuing cooperation and contributions. The development stages included immediate improvements in the software; work with their designated electronics manufacturer to develop plug-in hardware boards, and improved stepper motor drive boards, as well as more attractive external framing for the CES. This would enhance the external appearance of the machine as well as significantly improving the internal hardware and computer software.

Wilson had made it clear that they were planning to develop, manufacture, and market the most sophisticated exercise machine that had ever been created. Their plan was to create a first class system and avoid any suggestion that this was merely a hobby device. In addition to the generous licensing agreement, Wilson also included a consulting agreement to maintain the development ideas and to smooth any production difficulties. We were more financially secure than we had been when we merely conducted single company service contracts. This was clearly a fantastic path for our immediate future. Although the financial benefits were greater than we had expected, we were all devoted to the CES project. The CES was our child and we were totally enmeshed in the care and rearing of our offspring.

The early time of our relationship with Wilson Sporting Goods to develop and refine the design as well as patenting as
many components as possible was quite stimulating and enjoyable. Everyone at CBA was enthusiastic about the project and eagerly participated in each task that Wilson assigned. The patent work was quite specific and demanding but we were able to provide dated documentations and purchase invoices to substantiate all of our claims. It was tedious work but fulfilling. The technical details involved with the hydraulic pack required many hours and great effort in order to perfect the final version.

During the time between 1978 and 1981, we were also involved with opening a laboratory in Coto de Caza, California. This required quite a number of transcontinental trips with many of them routed through Chicago. Once we had the facility in California available, it would provide an additional location for demonstrating the CES.

The fellow that Wilson had placed as the manager of the fitness systems division seemed to be exerting great effort to impress both his superior managers and me. He was responsible for hiring the twenty people in Chicago, which included engineers, office staff, and even sales personnel. Since I had never worked in a large corporate entity, it seemed a strange organization to me. I assumed that the development steps would be in logical order. First, the product would be perfected, then manufacturing procedures would be implemented, and, lastly, marketing and sales activities would commence. Under Lou Tabickman’s guidance, all of these steps were activated simultaneously.

About once a month, Lou and I met. He had some habits that really irritated me but I tried not to encourage his annoying behavior by ignoring many of the things he did. I never knew if he did things to annoy me on purpose or whether this was just his character. Unfortunately, it did not make any difference since we had several clashes.

Despite my discomfort with Lou, the CES project continued to develop with excellent results. The law firm, which Wilson had hired, solved all of the necessary contractual obligations for hardware, such as computers, stepper motor boards, and other electronic components in addition to obtaining several patents on the CES. The frame and hydraulic pack assembly were improved in external appearance and some beautifully designed logos were developed.

We demonstrated the equipment at several national shows and Wilson’s marketing genius produced fantastic results. They were able to have the CES presented on television and in the print media as news rather than as advertising. The uniqueness of an exercise machine with a brain was exciting and truly news worth to local stations. I was so proud of this accomplishment and more than happy to describe it to anyone who would listen. I do not mean that I was bragging or egotistical in my outlook; I truly believed, then and now, that the CES was unique and effective for fitness and training.

The most destructive encounter with Lou occurred at a fitness trade show in Las Vegas, Nevada. I was enthusiastic in my demonstrations of the machine and was in the Wilson booth from the beginning to the close of the exhibits every day. Suddenly, one of my first, pre-Wilson customers approached me with an angry expression on his face.

“Why didn’t you tell us that you have a small home unit?” he demanded.

“What are you talking about?” was my flabbergasted response.

“Upstairs on the 14th floor, Mr. Tabickman and the other Wilson representative have a cocktail party and are demonstrating a new, small home CES unit,” he answered.

I was speechless and the look on my face must have convinced him that I was unaware of the CES unit or the party that he had just described. “Show me,” I told him.

We rode up in the elevator and I followed him to the room. After he knocked and the door was opened, I walked right it as though I have been invited. It was exactly the way it had been described, with tables of food and a small, Wilson-labeled home CES unit in the center of the floor.

I walked quickly over to Lou, who was standing next to the unit and demanded to know what was going on and why I had not been informed. Lou’s response was that I did not have to know everything, since he was in charge.

My response was, “Yes, I do have to know everything since this CES is my invention.” I pivoted and walked out of the room.
I returned to the Wilson booth in the main exhibit hall and began to pack my briefcase. Just then, Ann arrived from the airport having flown in from Massachusetts. I told her that we were leaving and, despite the shocked look on her face, she turned to me and we left.

We took the next flight back to Amherst. The first thing in the morning, I gathered the Amherst office staff. After describing the preceding few days and the encounter with Mr. Tabickman, I announced that we were on our own now. We were going to develop the “Ariel Computerized Exercise Machine” and it was going to be completely controlled by a microcomputer, such as the Radio Shack, and we were no longer going to utilize the Data General computer. Furthermore, I set a deadline for one month from that moment when we would demonstrate this finished product to the President of Wilson Sporting Goods in our office.

My insistence, that we employ a microcomputer, stemmed from the belief that smaller, faster, and more flexible computers would constitute the future. The large mainframes and even the mini computers currently available were going to be utilized by large corporations who needed to process huge quantities of data. Our need was for smaller, faster, and nimble computer capabilities. We had previously developed the Blue Box, but it was too labor-intensive for us to mass-produce. I insisted that the CES would have to operate on the best available microcomputer.

A microcomputer is a computer with a microprocessor as its central processing unit (CPU). It includes a microprocessor, memory, and input/output (I/O) facilities. Such computers are physically small compared to mainframes and minicomputers, such as the microNOVA. Many microcomputers (when equipped with a keyboard and screen for input and output) are also personal computers (in the generic sense). The Commodore 64 was one of the most popular microcomputers of its era and was the best-selling model of home computer of all time.

The abbreviation micro was common during the 1970s and 1980s, but has now fallen out of common usage. It is most commonly associated with the first wave of all-in-one 8-bit home computers and small business microcomputers (such as the Apple II, Commodore 64, BBC Micro, and TRS 80). The period from about 1971 to 1976 is sometimes called the first generation of microcomputers. These machines were for primarily for engineering development and hobbyist personal use. The MITS Altair played an instrumental role in sparking significant hobbyist interest, which itself eventually led to the founding and success of many well-known personal computer hardware and software companies, such as Microsoft and Apple Computer. Although the Altair itself was only a mild commercial success, it helped spark a huge industry.

By 1977, the introduction of the second generation, known as home computers, made microcomputers considerably easier to use than their predecessors. Previously, these earlier versions often demanded thorough familiarity with practical electronics in order to make them operational. The ability to connect to a monitor (screen) or TV set allowed visual manipulation of text and numbers. The BASIC language, which was easier to learn and use than raw machine language, became a standard
feature. These features were already common in minicomputers, with which many hobbyists were familiar. In 1979, the launch of the VisiCalc spreadsheet (initially for the Apple II) first turned the microcomputer from a hobby for computer enthusiasts into a business tool.

The TRS-80 was Tandy Corporation’s desktop microcomputer model line, sold through Tandy’s Radio Shack stores in the late 1970s and early 1980s, and was one of the earliest mass-produced personal computers. The first units, ordered unseen, were delivered in November 1977. Among the notable features of the original TRS-80 included its:

(1) Full-stroke QWERTY keyboard
(2) Small size
(3) Its floating point BASIC programming language
(4) An included monitor
(5) Starting price of $600

By 1979, the TRS-80 had the largest available selection of software in the microcomputer market. This included FORTH which was the language we had selected to control the stepper motor for our CES equipment.

Radio Shack marketed the TRS-80, affectionately nicknamed CoCo, as a home computer in 1980. It was one of the earliest of the first generation of computers marketed for home use in English-speaking markets. The original version of the Color Computer shipped in a large silver-gray case with a calculator-like Chiclet Keyboard and was available in several memory sizes. We opted to use the 16K memory size. Versions with at least 16K of memory installed shipped with standard Microsoft Color Basic or (optionally) Extended Color Basic. It used a regular TV for display and TV-out was the only available connection to a display device.

For years, we had been working on both software and hardware developments for the CES as parallel efforts. For example, with each change in the valve configuration, we usually needed to adapt the software to control it. We were searching for a microcomputer with enough processing speed, controllability features, and for the right price. We tried a number of different companies and, eventually, focused our efforts on the Radio Shack TRS-80, which used the Motorola 6809 chip.

The Motorola 6809 chip was introduced in 1978 and was a major advancement over its predecessors. Among the significant enhancements were the use of two 8-bit accumulators into a single 16-bit register, two 16-bit index registers, and two 16-bit stack pointers. In addition to these technical enhancements, for our specific purposes, the 6809 was a faster and more easily controlled chip to handle our increasing more sophisticated programs.
After Radio Shack introduced a floppy drive in 1978, we were able to develop our own console. Our CES console had the Radio Shack TRS-80 nested within the frame exposing only the keyboard and beside it was two double-density floppy disk drives.

First used to store data in 1962, magnetic disks initially provided supplemental memory in high-speed computer systems. They were considered ideal for this type of retrieval because a user could access information non-sequentially. The principle of magnetic recording is fairly simple. The magnetic recording (writing) and playback (reading) are carried out by a computer’s disk drive, whose function corresponds broadly to that of an audio record player. Data transferred from the computer to the floppy disk is relayed in the form of a binary code and received in the form of magnetic pulses, while the disk in turn, conveys magnetic patterns that the computer receives as a binary code. This code uses only 1’s and 0’s, which the disk represents as single magnetic pulses and the absences of pulses, respectively. Binary code is used because it most effectively utilizes the natural two-state characteristics of electricity and magnetism.

To record information on a disk, a magnetic head contacts the disk’s recording surface and magnetically imprints data onto it, translating the computer’s binary codes into the disk’s magnetic pulses. Once a magnetic pattern, consisting of many pulses and absences has been recorded, the disk retains the encoded information, just like a permanent magnet. Retrieving information from the disk involves the opposite process. The magnetic head senses the magnetic pattern on the disk’s recorded surface and converts it back into an electronic binary code. The computer then reads this information, using it to perform calculations or translating it into letters and figures for display on the monitor.

Floppy disks, which were smaller and more flexible portable versions of the earlier magnetic disks, were introduced during the 1970s. Although they were unable to store as many data as larger more conventional disk drives and the data could not be retrieved as easily, floppy disks have become extremely popular in situations where flexibility, low cost, and ease of use, are important. The term ‘floppy disk’ appeared in print as early as 1970. The first floppy drives used 8-inch floppy disks, but was replaced by the 5-¼ inch model. The size, according to one story, was that the size was the smallest diskette that would not fit in your pocket. The reason was that putting the diskette in a pocket was a near guarantee that it would bend. Another consideration was that a 5-¼ inch drive would fit in the PCs of that day.

The floppy disk seems so simple and primitive today, but it changed everything since it was an enormous improvement on the unfriendliness and complications, in addition to cost, of the larger systems of the day. Until the late 1970s, the personal computer owners, themselves, wrote most software applications for tasks such as word processing and accounting. But with the floppy disk and transportable diskettes, companies could write programs, write them on the disks, and sell them through the mail or in stores. Now it became possible to have a software industry. At this point, everyone who owned a computer that used floppies could share programs and data with each other. Basically, the floppy disk converted microcomputers into personal computers. As time passed, smaller diskettes of 3.5 inch were introduced of sturdier construction and longer duration of use.

Regardless of size, a floppy disk was a storage medium and was composed of a disk of thin and flexible magnetic storage medium, sealed in a rectangular plastic carrier lined with fabric that removes dust particles. They were read and written on by a floppy disk drive (FDD).
In addition to utilizing floppy disks to operate the CES, we created a unique invention that was borne out of necessity. At that time, diskettes were read only by the disk drive head located above the diskette. The problem with this system was that the diskettes, which were made of a thin plastic material, were easily worn through with a surprisingly short lifespan. We even had some program diskettes that were porous when held up to the light.

Dr. Wise invented a unique program which allowed the computer to read and write on both the top and the bottom of the diskette. This provided mirror backup for the program. His program instructed the computer to find the correct track on the opposite side, if a track on one side was damaged or unreadable. This read-write option for the top and bottom of the diskette was so unique, that it was patented by IBM long after we had developed our program. Some of the patents describe this process as the Recursive Method for protecting data.

At that time, so many things in the developing computer world were needed, but unavailable. This innovation associated with our CES system to read the diskette from the top and from the bottom was essential to lengthen the lifetime of each diskette. We created our own solution without realizing the patentable uniqueness of it, and IBM patented it years later.

Our plan for the CES was to use the drives to operate the entire CES system with floppy drives. We intended to turn the computer on, or boot as it was known at the time, operate the CES program, and save the generated exercise data. The entire system could be housed in a console we designed. Only the computer’s keyboard was exposed as were the openings for the floppy disk drives at the front of the console. The console design was similar to a simple desk. The remaining computer and floppy drive components were hidden within the console and, on the top of the console, was a color television which served as the display device. There was sufficient space on the top of this desk-like console to arrange backup diskettes, manuals, or other materials.

Alan and Jeremy were working long hours to finish the new computer programs to control the CES. I was putting pressure on them to have it completed before the visit to Amherst by the president of Wilson. Ann was working seemingly longer hours to maintain the other projects that CBA was working on for other companies. It was an extremely hectic time for all of us.

Approximately three weeks after my confrontation with Mr. Tabickman in Las Vegas was the meeting with Wilson. They walked through our office door in order of importance with Mr. Beebe, the president, followed by one of his vice presidents, Mr. Malcolm Caldlish, and lastly, Mr. Tabickman. Ann and I met them in our front office as cordial as possible.

Mr. Beebe had replaced Mr. Calley with whom we had enjoyed a fantastic relationship. Mr. Beebe was younger than Mr. Calley and projected a calm, thoughtful demeanor. Our previous interactions with him had been pleasant with no changes in our interactions. We were slightly apprehensive since we believed that the CES was a fantastic product with an extremely lucrative future, but we had no idea what poison had been spread behind our backs.
We led all of them into our large development room which was adjacent to our motion analysis laboratory. We had set our CES unit in the middle of the floor covered by a blue drape. After we had been all arranged, Ann pulled off the drape to reveal the new, smaller CES unit with its own console. The console, with the computer, disk drives, and television was less than half the size of the current Data General microNOVA that the CES was using in Chicago.

I proudly turned on the power and started the computer. The picture on the display screen read “Ariel Computerized Exercise Machine” and a voice announced:

“I am the Ariel Computerized Exercise Machine. Although I used to cost $45,000 dollars, now I only cost $5000. Let me show you how I work.”

I proceeded to demonstrate all of the functions that the CES could perform. We had duplicated all of the actions that the large microNOVA based CES could execute but was at a greatly reduced price. After the demonstration, we requested a private meeting with Mr. Beebe.

We adjourned to our conference room and Mr. Beebe asked what should be the next step. Our suggestion was to completely replace the current staff of the Fitness Systems department from the top to the bottom. In our opinion, they were limited in their exercise systems background, were woefully inadequate in their technical knowledge, and were stubborn and inflexible when ideas were suggested. The CES was a new, exciting, and had tremendous financial potential which would go unrealized with the current Fitness System members. Wilson Sporting Goods had a potential gold mine in its hands. The exercise, physical rehabilitation, and sports team fitness and training markets were huge and growing exponentially. Wilson could easily be the market leader before the other companies even began to think about the lucrative potentials available. We stressed our commitment and devotion to the product and to Wilson and hoped that he would find a workable solution.

Furthermore, we had experienced an excellent relationship with all of the Wilson staff prior to the establishment of this new department. Everyone had been helpful and contributed to all of the projects in addition to the CES venture. We had several on-going research projects with Wilson and everyone we worked with was creative and inventive in the approach to the studies. It was only with the people in the Fitness Systems department that were difficult and resisted any and all cooperative efforts. Our hope and suggestion were that the entire staff members of the Fitness Systems be replaced with new, innovative people.

Mr. Beebe thanked us for our candid appraisal of the situation and congratulated us on the newly developed CES. He even had some humorous comments about the announcement that the machine made when it was activated. Then he left the office with the two other Wilson personnel silently walking behind him.

Within two weeks, we were informed by Mr. Caldlish that the Fitness Systems Department had been abolished. He knew of no plans to replace them or even what the plans were at Wilson with regard to the CES.

Needless to say, we were elated that Mr. Tabickman and his underlings had been fired, but we were disappointed that there were no new plans for the CES mentioned in Wilson’s future. We decided that we would continue to work on the CES on our own and, at the same time, proceed with the on-going
research projects with Wilson. We were analyzing their new golf balls and some unique options using different colors for softballs.

Despite our disappointment of not having Wilson Sporting Goods as our ally in developing and marketing the CES, we continued to work on perfecting its performance. One of our continuous challenges was to develop software so that the CES learned how to respond to each individual during an exercise. The response to the person had to feel smooth without any sensation of jerkiness. I had spent much of my time and effort in trying to create the smooth feel that people exercising would want to experience. I knew from my own personal experiences that the feel of the movements had to be smooth because athletic and normal motions are smooth not jerky. The bar movement had to be free of any jerky actions and I was determined to develop the CES accordingly.

At one time during the development, we had a problem with bar movement at the top and the bottom of the range. During the transition from up to down, the bar seemed to move without resistance so that it felt like a spongy gap of air. It was annoying to have this discontinuity in the smooth movement. We tried everything we could think of to correct the situation. Finally, Ann and I decided to return to the university and discuss the situation with the professor of hydraulic engineering who had been so helpful previously. We described the behavior of the system and he immediately identified the problem as cavitation.

“You know, like the submarines,” he explained. Of course, we did not know about submarines but he explained what cavitation was. Cavitation is the formation and then immediate implosion of cavities in a liquid, for example, small liquid-free zones or bubbles, which are the consequence of forces acting upon the liquid. It usually occurs when a liquid is subjected to rapid changes of pressure that cause the formation of cavities where the pressure is relatively low.

Inertial cavitation is the process where a void or bubble in a liquid rapidly collapses, producing a shock wave. Inertial cavitation occurs in nature in the strikes of mantis shrimps, as well as, in the vascular tissues of plants. In man-made objects, it can occur in control valves, pumps, and propellers.

Inertial cavitation was first studied by Lord Rayleigh in the late 19th century, when he considered the collapse of a spherical void within a liquid. When a volume of liquid is subjected to a sufficiently low pressure, it may rupture and form a cavity. This phenomenon is coined cavitation inception and may occur behind the blade of a rapidly rotating propeller or on any surface vibrating in the liquid with sufficient amplitude and acceleration. A fast-flowing river can cause cavitation on rock surfaces, particularly when there is a drop-off, such as on a waterfall.

Since we were creating a vacuum within the hydraulic system, he explained that we could solve the problem by following Bernoulli’s Principles. As far back as 1738, a Swiss scientist, Daniel Bernoulli, explained the principle of fluid dynamics. His principle states that an ideal liquid is affected by pressure and speed of flow. An increase in the speed of the fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid’s potential energy. The Bernoulli equation is a statement of the conservation of energy principle appropriate for flowing fluids. The qualitative behavior that is usually labeled with the term Bernoulli Effect, is the lowering of fluid pressure in regions where the flow velocity is increased. This lowering of pressure in a constriction of a flow path may seem counterintuitive, but seems less so when you consider pressure to be energy density. In the high velocity flow through the constriction, kinetic energy must increase at the expense of pressure energy.

Ann and I returned to the laboratory and discussed the problem with Alan and Jeremy. As the professor had explained, we had to precisely calculate the sizes of all of the hydraulic tubing and the sizes of the check and spooler valves. In a steady flow, the sum of all forms of mechanical energy in a fluid along a streamline is the same at all points on that streamline. This requires that the sum of kinetic energy and potential energy remain constant. Thus an increase in the speed of the fluid occurs proportionately with an increase in both its dynamic pressure and kinetic energy, and a decrease in its static pressure and potential energy. If the fluid is flowing out of a reservoir, the sum of all forms of energy is the same on
all streamlines because in a reservoir the energy per unit volume (the sum of pressure and gravitational potential $\rho g h$) is the same everywhere.

Alan and Jeremy turned their attention to the calculations and within a week we were able to change the sizes of some of the hydraulic lines and the reservoir to adjust the hydraulic oil flow. After that, we had some minor corrections to perfect the feel, but we had eliminated the unpleasant spongy sensation, previously noted. One modification that we made was to change the shape and size of the spool valve into a triangular shape. This provides an increase in the control of the oil flow and, thus, improved the feel of the bar motion during exercise. (This attention to the Bernoulli Principle has served us well for more than 30 years, since no competitor has been able to reproduce the smoothness of our CES system.)

Another significant development in the control of the CES came from a combination of my personal experience in the feel or perceived sensations of exercise as well as my studies at the university in the Cybernetics department. The head of the department was Dr. Michael Arbib who was renown in the field. His work follows the title of his first book, Brains, Machines and Mathematics. Dr. Arbib believed that the brain is not a computer in the current technological sense, but that we can learn much about machines from studying brains and much about brains from studying machines. I first heard him explain this concept in one of the classes that he taught. He presented an attitude that an interdisciplinary environment is one in which computer scientists and engineers can talk to neuroscientists and cognitive scientists.

In his class, he introduced his primary research focus on the coordination of perception and action. This was approached at two levels: (1) via schema theory, which is applicable both in top-down analysis of brain function and human cognition as well as in studies of machine vision and robotics, and (2) through the detailed analysis of neural networks, working closely with the experimental findings of neuroscientists in humans and monkeys. I was excited and enthralled with the concepts of studying the brain, its feedback loops of control, and the intelligence that machines can derive through (in my special application) computer-controlled programming.

Cybernetics is a Transdisciplinary approach for exploring regulatory systems, their structures, constraints, and possibilities. Cybernetics is relevant to the study of mechanical, physical, biological, cognitive, and social systems. It is only applicable when the system being analyzed is involved in a closed signal loop. In other words, when action by the system causes some change in its environment and that information is fed to the system via feedback which enables the system to change its behavior.

Contemporary cybernetics began as an interdisciplinary study connecting the fields of control systems, electrical network theory, mechanical engineering, logic modeling, evolutionary biology and neuroscience in the 1940s.

We were also utilizing what is known as Artificial Intelligence, which was founded as a distinct discipline at a 1956 conference. After some uneasy coexistence, AI gained funding and prominence. Consequently, cybernetic sciences, such the study of neural networks were downplayed and the discipline shifted into the world of social sciences and therapy.

Artificial Intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it. AI textbooks define the field as: “The study and design of intelligent agents” where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1955, defines it as: “The science and engineering of making intelligent machines.” My idea was that the computer software for the CES would be flexible in its ability to control the specific exercise, adapt to the person performing the exercise, and to provide sufficient feedback control to the hydraulic system for a smooth motion.

Thus, my ideas for the CES were with feet in both camps of thought and study: cybernetics and artificial intelligence. The CES needed feedback just as the brain does in coordinating all human functions and intelligence to perceive and act on actions. While I attended classes and studied all the disciplines
described, I had to create the correct applications from each theory in order for the CES to operate perfectly.

We continued our development and manufacturing the CES. I met our first customer when I was demonstrating the Computerized Exercise System (CES) at the American College of Sports Medicine Conference. This was a sports science and physical therapy show in Montreal in the spring of 1980. A young, knowledgeable physical therapist from New Jersey spent about a half an hour asking questions and trying the equipment. Then he inquired about the price.

“The price is $10,000.00,” I answered wondering whether this was an astronomically high figure. Most fitness equipment was far less expensive and most of the physical therapy machines were exceedingly pricey. I held my breath. The man reached into his pocket and pulled out a checkbook. He wrote ten thousand in the appropriate space, signed it and handed it to me as he left the booth.

“Where do I ship it? Don’t you want a receipt?” I called out to his receding back. The fellow turned and answered that the address was on the check and just kept walking away.

When I returned to Amherst at the conclusion of the conference, Ann was as surprised as I had been. “He didn’t even fill the line of who to pay,” she noted. “Who is this guy?” she asked.

The man’s name was Robert Wainwright and his business was in northern New Jersey not too far from New York City. Mr. Wainwright received Serial Number 1 of the CES and, shortly after the delivery, Ann and I traveled to visit him.

He had a small physical therapy business and we spent the entire day working with him on the machine’s capabilities vies a vie his therapeutic needs. We demonstrated the ability to regulate the velocity of the bar, in both pulling and pushing directions. Most of the equipment at that time was either weight-bearing machine, which could not alter the velocity, or closed systems, which allowed only fixed velocity bar movements. We demonstrated how our computerized system permitted the therapist to program the velocity to follow any pattern he or she desired. The same flexibility was permitted with force.

In other words, the therapist could decide about the amount of force that the patient needed to push, or pull, and could program the system to adhere to that pattern. These options of controlling velocity or force were particularly useful with patients recovering from injuries.
Mr. Wainwright told us that he frequently had athletes with knee injuries. They could not maintain a constant force or velocity, but needed the conditions to be more or less depending on the exercise. They were often able to move the bar easily with a reasonable load at the beginning of the exercise but when the action began to generate pain due to the injury, the system needed to respond by reducing the load. Our equipment was the only system, which could provide this control. It was the only one with the brain to program and adjust to the person exercising.

From his point of view as a physical therapist, Mr. Wainwright was extremely pleased with the options. We also demonstrated how he could strengthen a specific section of the movement by adding an isometric contraction in any location that he chose. This was very useful to him for strengthening certain muscles and a technique that was available only with our system.

We spent the entire day demonstrating the numerous exercise options available. He was also able to record and store each individual’s workout and print results for the prescribing doctor and insurance company. In fact, for many years, Mr. Wainwright was able to develop strong relationships with patients, hospitals, doctors, and insurance companies.

We also began to hold clinics at our facility in California since it was newer and larger than our Amherst office. We called these clinics User Conferences and they attracted people from around the
World. We sold many CES to our Japanese distributor, as well as many university research laboratories and physical therapy sites within the United States and beyond.

The CES had the ability to quantify movements greatly improving research studies. Previously, research studies were relatively imprecise in their measurement capabilities. The precision and quantification provided by the CES were also useful for physical therapy treatments and testing. At that time, many physical therapy locations were able to test patients referred by doctors, and insurance companies paid for the tests. This treatment/testing structure had no effect on our revenues, but merely demonstrated the efficacy of the device for treatment and quantitative measurements.

As I look back over the past 30 years in the birth and life of the CES, I experience a multitude of thoughts and emotions. I had an idea for an exercise machine. A machine that could adjust to me if I wanted to adjust the velocity or force of my exercise, to add an isometric contraction at one or more points in the movement, and which could save my data for subsequent evaluation. The machine took on many additional features through the years, but during those first imaginations of the future device, it seemed like a simple concept to create. What a difference reality makes!

A great idea can remain just that – a great idea. But to actually make that idea into a functional system is not as easy as that first flirtation with a concept. In the case of the CES, there were no small computers, spool valves, stepper motors, analog to digital converters, or software to tell the computer when and what to do. None of the components we ultimately needed were available until we either created our own, such as the Blue Box Computer with its own hardwired analog to digital converter, or discovered a part that someone or company had needed in an industry other than ours, such as the stepper motor. We were usually developing our own component before we were able to find someone else who had a need and they had created a solution for themselves. That was how we discovered Mr. Dennis Kitz and his game port board to control his on-screen submarine. The fortuitous discoveries helped to develop the CES into the fantastic machine that it became. But, first, there has to be the idea, the desire for the widget that is needed, and then successful integration of the parts, not to mention the continuous development of the software to control the various interdependent components.

Fortunately, I had an idea and the tenacity to pursue it regardless of the many difficulties along the way. I was able to find the best talent for each need, from hydraulic engineers to software programmers. But perhaps my greatest strength, some might say my greatest weakness, is that I never, never, never quit until the problem is solved one hundred percent.

Upon reflection, I am reminded of Thomas Edison’s effort on what seems today to be a simple light bulb. From 1878 to 1880, Edison and his associates worked on at least three thousand different theories to develop an efficient incandescent lamp. Edison had to blow his own glass, find a filament that did
not melt when electricity passed through it and that would maintain a soft orange glow, and would not blacken the inside of the glass bulb. I certainly am not trying to compare myself to Thomas Edison, but merely convey the difficulties that inventions pose. There is a tremendous amount of work between an idea and its production. I was lucky to be in the right place, with the best people, and at the beginning of the computer revolution. With all of these components in place, the CES idea became a reality.

After nearly 40 years, the CES is still unsurpassed in its abilities. No one and no company have ever successfully copied it. It is still the best device of its kind and I take great pride in realizing that it is my idea.
I was sitting at the desk in the front office in Amherst, looking out of the window at the cars whizzing by on the road and the people walking in front of our office with the quizzical expression that our company name generally evoked. Ann and I were discussing some of the on-going projects when the phone rang. I answered it and the man said, “I’ve heard about your motion analysis system and I want to know if you can meet me to discuss a project on race horses.”

By now, I was used to people and companies asking about our quantification abilities for all types of applications. While most of them had been with humans, with the notable exception of Daisy the monkey, the majority of them had been associated with sporting applications. But: “If it moves, we can measure it,” had been our company motto, so I was willing to listen to his proposal.

“What type of business do you have?” I asked.

“I have several business interests here in the greater Miami, Florida area, but I also own 50 horses which live on my farm near Orlando, Florida,” was his answer. “My name is Irving Pollack and I would like you to fly down here to Miami, so I can discuss some of my ideas and see if your motion system can help me.”

“Ok,” I answered and we agreed upon a date.

After I had hung up the phone, Ann and I looked at each other and shrugged our shoulders in unison. We had studied many topics in our short biomechanical career, so why not horses.

I left the following Tuesday and flew to Miami, Florida. As I left the baggage claim area, I saw a man holding a big white card with my name on it. He led me to a large black limousine and held the door for me as he took my suitcase. I sat in the rear seat next to another man, also dressed in black with
sunglasses as had been the man with the card who turned out to be the driver. I had recently seen the Hollywood blockbuster movie, The Godfather, and I had a few pangs of worry.

The man in the back seat inquired whether I would like a drink. “No thank you,” was my answer as I continued to consider the Godfather movie.

Actually, it was a quite comfortable ride from the airport to the Fountain Bleu Hotel on the beach front in Miami. This was the time when everyone wanted to visit Florida for its sunny, sandy beaches and relaxed life style. I had been to Miami many times in the past, so I was very happy to have this opportunity to return.

At the hotel, Mr. Pollack greeted me at the door, shook my hand, and invited me into the lushly opulent lobby. It was beautiful and welcoming. Mr. Pollack was grey haired, dapper, and cheerfully charming. He possessed an air of relaxed confidence and seemed genuinely pleased to share his hotel with me. We walked through a maze of public rooms onto a veranda which provided a beautiful view of the ocean, gardens, and palm trees waving their fronds gently in the breeze. As we sat on white cushioned couches, Mr. Pollack told me about his various business interests, which included the Fountain Bleu and the Newport Hotels in Miami, as well as his private hobby of horse racing. He owned about 50 horses which were raised and trained at his farm near Orlando, Florida.

After a relaxing conversation on the hotel’s veranda, we rode in his limousine for dinner at his Newport Hotel which was actually located in North Miami. The hotel’s restaurant was beautiful and was a perfect setting for a truly delicious meal. After dinner, we attended a performance in one of the hotel’s public rooms. The entertainers were Ike and Tina Turner. These two musical performers became famous over the years and I was overwhelmed by the energy and passionate display by Tina. If Mr. Pollack could select equine talent with the same skill as these musical performers, then he was going to be repeatedly successful!

After dinner, Mr. Pollack invited me to his home. We drove through the gate, through the lush gardens, and around the circular driveway stopping beneath a large portico. We climbed out of the limo and walked the few steps to the elaborate front door, which was opened by a diminutive Chinese fellow who gave us a slight bow. We followed our Chinese guide, throughout the house as Mr. Pollack described the house and its furnishings. The house was quite large, I estimated that it was at least 20,000 square feet. There were many spacious rooms and the view from each of them was of the lovely gardens of greenery, hibiscus bushes, roses, and other semitropical plants. It was an exquisite home, which generated an air of comfort and luxury.

Mr. Pollack asked me how I liked his home.

“It is an extraordinary house,” I answered.

“It should be,” he replied. “It was once owned by Al Capone and he lived here most of his successful years.”

After the tour, Mr. Pollack showed me to my room, which was not only beautiful but enormous. It had a lavish bathroom and a patio which wrapped around the corner of the room. The patio was furnished with chaise lounges, chairs, and small tables situated among plants and small trees. The
accommodations were nearly as large as my house in Belchertown! Mr. Pollack asked me if this was satisfactory and I assured him that the room was more than merely satisfactory. We arranged to meet for breakfast the next morning and closed the door as he left.

Fortunately, the Chinese fellow tapped on my door in the morning to take me to the breakfast area. I would still be wandering around that enormous house without his guidance. As with everything associated with Mr. Pollack, breakfast was magnificent and delicious.

It was a working breakfast. While we ate, Mr. Pollock introduced me to some of his equine staff. There were two trainers and the farm manager. We discussed biomechanical analysis in general, as I explained how we evaluated people and products. Then I described how biomechanics could be applied to all four legged creatures including horses.

Racehorses Biomechanics or as it is more appropriately know, Equine biomechanics, applies biomechanical analysis techniques to horses. Newtonian laws of motion are the bases of analyzing horses in the same manner, like those applied to human athletes or any other body in motion. The primary difference when analyzing horses and humans are the number of joints selected since the number and location of the joints vary slightly from people. The same techniques are also used, including digitization of the movement and similar computer programming, to analyze the gait of horses running.

The first equine biomechanics should probably be credited to Eadweard Muybridge's work for Mr. Leland Stanford in the years from 1877-1878. Muybridge was an English photographer known for his pioneering work in photographic studies of motion and in motion-picture projection. He is equally famous for his pioneering work on animal locomotion, which used multiple cameras to capture motion, as well as his zoopraxiscope which was a device for projecting motion pictures that pre-dated the flexible perforated film strip.

Eadweard Muybridge

http://arielnet.com/ref/go/1207
Eadweard Muybridge had immigrated to the United States at the age of 25, arriving in San Francisco in 1855, a few years after California became a state, and while the city was still the "capital of the Gold Rush." He started a career as a publisher's agent for the London Printing and Publishing Company and as a bookseller. By 1860, Muybridge was a successful bookseller. He left San Francisco on a trip to England to purchase more antiquarian books for sale in his shop. On the trip, a violent runaway stagecoach crash resulting in severe head injuries to Muybridge. He spent time in the both the United States and England during his approximately five years of treatment and recovery. In England, he began a new profession in the new field of photography. Although Muybridge had left San Francisco in 1860 as a merchant when he returned in 1867 he returned as a professional photographer. He possessed highly proficient technical skills and an artist's eye. His photographic reputation was established with his pictures of Yosemite Valley wilderness and he quickly achieved notice for his landscape and architectural subjects. He traveled to Alaska to photograph Tlingit Native Americans, lighthouses of the American west coast, and the Modoc War between Native Americans and the U.S. Army in northern California and southern Oregon. He made a sequence of images of the construction of the San Francisco Mint from 1870 to 1872. In 1878, Muybridge made a 13-part photographic panorama covering 360 degrees of San Francisco which was presented to the wife of Leland Stanford.

In 1872, Muybridge was hired by Leland Stanford, a businessman and race horse owner. Leland Stanford had decided to challenge a belief common in the late 19th century that when a horse trots at least one foot was on the ground at one time in the stride. The debate also included the actions of a horse’s feet during the gallop. Stanford believed that all feet left the ground at one point in the cycle.

Muybridge settled the debate with a single photographic negative showing Stanford’s Standardbred horse, Occident, being airborne during the trot. By 1878, encouraged by Stanford, Muybridge expanded the process by using multiple cameras to photograph a galloping horse.

The technique used by Muybridge to determine how and when the horse’s feet were in contact with the track was to place numerous cameras in a line along the edge of the track. The shutter for each camera was triggered by a thread. As the horse galloped down the track, the hoof hit each thread which activated the camera to photograph that moment. Thus, each camera recorded a single image of the motion during the entire stride as the horse galloped. Muybridge copied each image in the form of silhouettes onto a disc to be viewed on the machine that he had invented, which he calls a zoopraxiscope. This device was later regarded as an early movie projector and the process as an intermediate state toward motion pictures or cinematography. It was easily seen that during the gallop, as had been with the trot, all of the horse’s feet were momentarily in the air.

Muybridge’s contribution to biomechanics, beyond his work with horses, was continued in Pennsylvania. Between 1883 and 1886, Muybridge made more than 100,000 images, working obsessively in Philadelphia under the auspices of the University of Pennsylvania, which sponsored Muybridge’s research. He used banks of cameras to photograph people in a studio and animals from the Philadelphia Zoo to study their movement. The human models, either entirely nude or very lightly clothed, were photographed against a measured grid background in a variety of action sequences, including walking up or down stairs, hammering on an anvil, carrying buckets of water, or throwing water over one another. Muybridge produced sequences showing farm, industrial, construction, and household work, military

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maneuvers, and everyday activities. He also photographed athletic activities such as baseball, cricket, football, boxing, wrestling, fencing, rowing, discus throwing, and a ballet dancer.

Muybridge was influenced by the French photographer Étienne-Jules Marey. Muybridge visited Marey's studio in France and viewed stop-motion studies before returning to the U.S. to further his own work in the same area. Marey's work in scientific achievements in the realms of cardiology and aerodynamics, as well as pioneering work in photography and chronophotograph, are indisputable. Muybridge's efforts were, to some degree, more artistic rather than scientific. As Muybridge explained, in some of his published sequences, which he had substituted images where original exposures had failed. He did this in order to illustrate a representative movement rather than to produce a strictly scientific recording of a particular sequence.

Muybridge's success brought him national and international fame. Scientific American and others magazines published articles about his work. In addition, his breakthroughs unwittingly began the motion picture industry.

"The Science of the Horse's Motions"
Muybridge’s ultimate gift to equine biomechanics was the use of multiple camera exposures to capture the movement. While Muybridge’s created spectacular images, both still and moving, they lacked the scientific applications which could be applied to bodies in motion. Creation of scientifically accurate quantification requires the use of photographic images, captured in sequential order at a known camera speed. Multiple camera sequences allow for the application of Newtonian laws to the identified joint actions. Equine biomechanics has evolved significantly since Muybridge's days and currently impacts several fields in equine management, including injury prevention and treatment, performance enhancement, and several equine sports.

The competitive racing of horses is one of the most ancient sports. Its origins seem to have arisen from among the prehistoric nomadic tribesmen of Central Asia who first domesticated the horse about 4500 BC. Archaeological records indicate that horse racing occurred in ancient Babylon, Syria, and Egypt as well. For thousands of years, horseracing flourished as the sport of kings and the nobility. By the time humans began to keep written records, horse racing was an organized sport in all major civilizations from Central Asia to the Mediterranean. Both chariot and mounted horse racing were events in the ancient Greek Olympics in 638 BC and the sport became a public obsession in the Roman Empire.

The origins of modern racing lay in the 12th century when English knights returned from the Crusades with swift Arabian horses. The British settlers brought horses and horse racing with them to the New World and the first racetrack was laid out on Long Island as early as 1665. Although the sport became a popular local pastime, the development of organized racing in America did not materialize until after the Civil War. The American Stud Book, which is an official list of all the Thoroughbred horses within the United States whose parents are known, was begun in 1868. The rapid growth of the sport without any central governing authority resulted in the domination of many tracks by criminal elements. In 1894 the nation's most prominent track and stable owners met in New York to form an American Jockey Club. Shortly thereafter racing was ruled with an iron hand and much of the corruption was eliminated.

Although horse racing is one of the oldest of all sports, its basic concept has undergone virtually no change over the centuries. It developed from a primitive contest of speed or stamina between two horses into a spectacle involving large fields of runners, sophisticated electronic monitoring equipment, and immense sums of money. Its essential feature has always been the same, however, which is the horse that finishes first is the winner. In our modern era, horse racing developed from a diversion of the leisure class into a huge public-entertainment business.

The style of racing, the distances, and the type of events vary significantly by country. There are three major types of racing: flat racing, steeplechase (racing over jumps), and harness racing, where horses trot or pace while pulling a driver in a sulky. A major part of horse racing's economic importance
lies in the gambling associated with it, an activity that in 2008 generated a world-wide market worth around $115 billion U.S. dollars.

In the early 1900s, however, racing in the United States was almost wiped out by the antigambling sentiment that led almost all states to ban bookmaking. By 1908 the number of tracks had plummeted to twenty-five. That same year, however, the introduction of pari-mutuel betting for the Kentucky Derby signaled a turnaround for the sport. More tracks opened as many state legislatures agreed to legalize pari-mutuel betting in exchange for a share of the money wagered. At the end of World War I, prosperity and great horses like Man o’ War brought spectators flocking to racetracks. The sport prospered until World War II, declined in popularity during the 1950s and 1960s, then enjoyed resurgence in the 1970s triggered by the immense popularity of great horses such as Secretariat, Seattle Slew, and Affirmed, each winners of the American Triple Crown: The Kentucky Derby, the Preakness, and the Belmont Stakes.

For hundreds of years, people have asked, "What is it that makes one horse run faster than another?" This question is at the heart of biomechanics as applied to thoroughbreds. Equine biomechanics applied to thoroughbred performances focus mainly on the mechanical systems. Important gait differences occur in time intervals impossible to see with the naked eye or even with slow motion video. The eye can observe differences in style, particularly with slow motion video, but it is impossible to see forces, velocities, and joint displacements without performing mechanical calculations. Using high-speed video to record thoroughbred horses at racing speeds has provided an opportunity for detailed gait analysis. The gait analysis can examine such factors as stride length, leg angles, joint positions of the shoulder.
and neck. In addition, hoof movement patterns and alignment of the body are important considerations.

Equine biomechanics also examines the relative positions of the limbs at each phase of the stride and the timing of each hoof placement. The track material is another consideration, which can affect the horse’s performance either positively or negatively. American thoroughbred horses race on soft sandy tracks, compared with many of the tracks in other countries which utilize grass.

Track material can help to minimize the forces transmitted to their joints in an effort to prevent or reduce injuries. Just as human runners have more shock absorption when running on dirt paths with proper shoes compared with running on concrete roads without shoes, horses must contend with shock as well. For horses, it is possible to change the track material but not as easy to provide more shock absorbing footwear.

The weather is another factor since some horses thrive while others dislike running in the rain or on muddy tracks. Regardless of the weather influence, sinking in the sand affects the net velocity of the horse. Some energy is lost in this shock absorbing strategy. The important question is, “How much energy is lost?” The answer to this type of question can be addressed by calculating biomechanical parameters.

Another consideration that can be applied to horses is how their joint speeds correlate to their linear speed on the track or, as yearlings, in the meadow. How a young horse, when startled, can easily be accessed through biomechanical procedures and more accurately predict future performance since the angular rotations at the hip are exact measurements without regard to heritage. Determination of whether the angular velocity at the hip joint changes dramatically from the morning breezing training time and the afternoon racing time can provide interesting comparative evaluations.

The biomechanical techniques applied to determining the horses’ joint speeds as they correlate to their actual speed on the track had been previously utilized on human racing events. I had been asked to calculate the speeds of human sprinters who had performed in prior Olympic competitions. Comparisons were frequently made of previous Olympic competitions or world records. In order to compare two sprinters, for example, several problems were encountered including: (1) it is impossible to exactly replicate the situation and (2) the competitors may be too old or have passed away. However, we did our best estimate with the data provided.

One question posed had been to compare two of the best sprinters, Ben Johnson and Carl Lewis, to Jessie Owens. Try to imagine how these three great sprinters would run around the track against each other. Of course, it could only happen in a dream or a vivid imagination. What we were able to accomplish biomechanically was to digitize the great Jessie Owens and have his run against the two modern sprinters. Jesse Owens had won 4 Gold medals and broken the world record in the 100-meters dash at 10.20 seconds in the 1936 Berlin Olympic Games. His 100-meter dash record stood for 20 years and was broken by Willie Williams in 1956 at 10.1 seconds. The question was how Jessie Owens’ results compared to sprinters who ran the same distance in 9.90 seconds and faster. The modern sprinters were running on artificial tracks, use starting blocks, and had access to special sprint shoes with spikes to gain better contact with the running surface.

Bud Greenspan, the famous producer of the series on the Olympics Games, was a friend of mine. One of Mr. Greenspan’s most beautiful and moving productions was Jesse Owens Returns to Berlin (1968). Mr. Greenspan gave me access to the original film of Jessie Owens’ Berlin Olympic performance. I had in my data collection various Olympics and International competitions including sprinting performances of Ben Johnson and Carl Lewis.

When a sprinter runs, the movement results from the displacement of his/her rotational leg and hips segments. In addition to the hip displacements, the movement of the ankle joint is added to that of the displacement at the knee and the hip joint. When all of these angular displacements are calculated in their coordinated actions, the total stride length is created. Of course, the net distance always is slightly less since some motion is wasted at the surface contact, while another motion is absorbed due to the flexibility of the shock absorbing joints. Another factor is air which will resist the movement forward.
The amount of time that the runner is out of contact with the ground and the height that the center of gravity is displaced will, also, affect the result.

However, the most important joints about which forces are generated to propel the body forward are those at the ankle, knee and hip. By calculating the angular velocities at these joints, it is possible to calculate the absolute velocity and compare athletes that ran at different times and different conditions. For example, one athlete might run a hundred meters in 10.0 seconds, but another athlete running into the wind might run the same distance but in 10.20 seconds. In other words, the distance covered would be the same, but circumstances might be the factor causing the time differences. If the calculation of their speed was measured by determining the angular velocities at the joints, a comparison of the absolute speed of two people running at times, places, and under dissimilar conditions could be made.

Using the films provided by Mr. Greenspan, we applied biomechanical analysis to several of the sprints Jesse Owens ran in the Berlin Olympic competitions. Based on our calculations of his joint center kinematics (which yielded positions, velocities, and accelerations), Jessie Owens was as fast as Ben Johnson and Carl Lewis. These modern day sprinters were able to win the same 100-meter race, but at faster speeds. Carl Lewis won the Gold medal in the 1984 Olympics at a speed of 9.99 seconds. However, Carl Lewis was able to perform on an artificial surface with special sprint shoes. Comparing the kinematic parameters for these athletes suggests that they would have been competitively equal.

I was pleased and honored when Bud Greenspan selected me to receive The CAPPY Award named in honor of his late wife. I received this special life achievement at the Jewish Sports Hall of Fame in 1991.

I remember meeting Jessie Owens in one of the World Championships in Track and Field. I was in awe of him and his accomplishments on the track and in life. He introduced himself to me and told me how much he appreciated my study that was published in Track and Field Quarterly Review Journal. He was a great athlete and a wonderful person.

The same techniques could be applied to analyze racehorses and determine the joint speed that correlated with their actual speed on the track. We know that horse race on soft sand to minimize the forces which are transmitted to their joints. There reason for running on softer surfaces is to minimize the injuries caused by the repetitive pounding caused by running. In other words, the harder the surface, the more forces transmitted into the joints. However, the effect of sinking in the sand results in a reduction of the velocity of the horse. Energy is lost by this shock absorbing mechanism, so the trade-off is a slower running speed but reduced damage to the joints. Since all of the horses experience the same conditions, the logic would be to protect the joints.
All of these subjects were discussed during our delicious breakfast in Mr. Pollock’s house. After several hours, we had talked about nearly every aspect of biomechanical analysis and its application to humans and horses. Mr. Pollock suggested that we drive to the track to see some of his horses.

Another question frequently asked is why the velocity at the hip joint changes dramatically from the morning training time to the afternoon racing time. We measured a reduction of 40 percent in the joint angular velocity in one horse between the morning breeze and the afternoon race. We were able to detect this change, but were in no positions to evaluate the cause. One possibility would be a pharmaceutical effect, injury, or deliberate speed reduction by the jockey. The biomechanical analysis could only reveal the differences, but not the cause.

We drove to the racetrack near Mr. Pollack’s home in Miami, Florida and walked around the barns. I was introduced to a number of trainers and saw some of his beautiful horses, which were housed there for the current racing season. After this firsthand experience, we returned to Mr. Pollack’s home to discuss the next step.

In general, Mr. Polack wanted to know if we could analyze his horses and provide information as to which of his horses had more potential. He also wanted some information on the horses of some of his competitors. We discussed many topics including training suggestions and shoes in addition to the normal running analysis. At one point, Mr. Pollock offered to include a percentage of the prize money. I declined the offer since we would receive ample payment for each analysis.

I returned to Amherst where Ann and I prepared a proposal for Mr. Pollock. The project we envisioned that would provide the information that he requested was initially for twelve horses. In this pilot study, we restricted our focus to the parameters which would contribute to the speed of the horse. The parameters we selected were:

1. Ground contact time
2. Time in the air when all feet were not in contact with the ground
3. Stride length
4. Ratio of stride length and time in the air

Since this was only a pilot study, we anticipated that other factors would be revealed during the analysis which was equally or even more significant. We sent our proposal to Mr. Pollack who agreed with it. Now we, as well as the horses, were “off and running”.

One of the first things we had discovered was that there was little research related to horse racing. In general, the information was still in the Dark Ages since most knowledge was based on hearsay,
guesswork, and tradition. However, since all objects on earth must obey the same laws of motion, the forces created by and acting upon horses, depend on the same biomechanical characteristics. Our primary objective for this pilot project was to identify those parameters that would optimize selections of new horses, training of both young and currently active racers, and to determine the most effective manner to maximize the forces produced in racing performances.

Ann and I flew to Florida with all of the photographic and biomechanical gear that we needed. In retrospect, we were lucky that we were traveling in 1980 because the modern travel problems related to security concerns would have made the trip more like one of Jason’s epic voyages to retrieve the Golden Fleece.

Once we arrived at the race track, we began organizing the cameras and other items necessary for the biomechanical analysis that we would process back in the lab in Amherst. For this cinematographic phase, we had to film both the horse as well as the special apparatus referred to as test points. The test points are needed to calibrate the visual field through which the horse ran. We explained to Mr. Pollock that the test points would allow us to know precisely the measurement and angles as well as converting the tiny horse shown on the computer screen into the correct three dimensions of an actual Thoroughbred, as it raced down the track.

Another essential factor was that everything had to be filmed simultaneously from the three separate camera angles. This procedure was required for the subsequent computer processing of the data. The computer program made all of the calculations based on the assumption that the timing was exact as designated for each camera view selected.

At that time, we used Photosonic high speed cameras placed at appropriately calculated locations. In those days, we used the most modern cameras available, but their fastest speed was only 500 frames per second. These cameras incorporated a pin registration to advance the film and had a variable shutter to eliminate any blur at that filming rate. In addition to utilizing a mechanically driven camera, rather than a digital one, we also had to wait for the film to be developed. Digital cameras, which are available in today’s modern world, were figments of our imagination and could only be dreamt of for the future. We had to rely on experience and luck when we filmed the desired action.

We coordinated the filming process for each horse with the trainer and his staff. We would first film the test points and move them off of the track. Then we would tell the trainer to signal the selected horse to race down the section of the track usually following another horse. It turned out that racehorses are more easily encouraged to run at full speed when they see another horse galloping ahead of them. We filmed each horse from three views as it ran at a full gallop and kept records of the name of the horse and some distinguishing characteristics such as the color of the jockey’s shirt for subsequent coordination of film sequences.

After we had filmed all of the horses, we discussed with Mr. Pollock and his staff what the next steps would be in the biomechanical calculations. We were able to learn from them some of their questions and flew back to Amherst to try to find the answers. As we left, we assured Mr. Pollock that we would work as quickly as possible to provide a report for him.

The biomechanical procedures required an extensive time commitment. Analyzing all of the horses from three cameras was more time consuming than humans, since horses have more joints than people have plus the strides are much longer than human runners. A schematic representation of the horse and the designated joint centers are shown in the diagram.

We applied our standard analytic techniques for processing the films and executing the numerous biomechanical calculations. We prepared extra graphs and tables with the stick figure representations, since non-scientists frequently are able to perceive more information from visual rather than numerical presentations.

After the work was completed and the report prepared, I flew to Miami to present the findings to Mr. Pollock. I explained that we had selected twelve horses for analysis as a pilot study so that we could identify those parameters which appeared to contribute significantly to the speed of the horse.
The first parameter we evaluated was the ground contact time. This parameter is the time that each foot is in contact with the track. The shorter the contact, the greater the magnitude of the force with which the horse pushes against the ground. For example, if a particular horse produced a contact time of 94 milliseconds, that horse would run faster than one which had a 100 millisecond contact time. Assuming that all other factors remain the same, horses with shorter contact time would be faster.

The second factor concerned the duration of the airborne phase, which occurs when all four feet are off the ground. It should be remembered that the horse can propel its body forward only when the feet are in contact with the ground. No forward thrust can occur during the flight phase, since the horse has nothing to push against. The horse cannot propel itself forward until returning to earth at the speed of the earth's gravitational pull. Since all horses are subject to the same gravitational effects, a horse which spends less time in the air and more time pushing against the ground will obviously run faster.

To optimize ground contact time parameter, the horse should have a long stride with a short airborne phase. A long airborne phase is caused by the horse pushing upward rather than forward, which results in a longer time in the air. To increase speed, it is important to minimize the up and down fluctuations of the center of gravity of the horse. The optimal air phase time was determined to be one of short duration. Horses which can maintain the center of gravity on approximately a level plane, that is, with little wobble or bounce up and down, are faster than horses which do not have this pattern.

Another phenomenon we detected was a movement behavior which we labeled rear leg delay. After pushing off with the rear legs, which propelled the horse into the air, the faster horses appeared to be more energetic in bringing the rear legs forward in preparation for the next stride. The slower horses appeared to relax and merely waited for the rear legs to swing forward. It seemed that the slower horses relied on the energy from the impact of the front legs to naturally bring the rear legs forward in a manner similar to a human’s arms swinging when walking. Our calculations revealed that the sooner the horse contracted the rear legs after the completion of the push-off, the more efficient the movement and the faster the horse ran.

Another factor we observed was that the longer the horse allowed the rear legs to stretch, the greater the angle of impact and, therefore, the greater the force of the forelimbs impacting the ground upon contact. This has the undesired effect of slowing the horse’s forward speed, since the force of this impact functions as a brake. The longer the delay in rear leg activation and the acuter the impact angle, the greater this braking force. Therefore, it is an advantage for the horse to activate the rear legs as rapidly as possible.

A critical component of fast speed was the front foot placement. Our analysis found that the speed was faster when the horse landed with the angle of the forelimb nearly perpendicular. At this angle, little stopping or braking force from the ground slowed the horse’s forward motion. The greater the deviation of the impact angle from perpendicular, the greater the deterrent force to the movement forward.
Our analysis found that, in the better horses, the body angle remained nearly parallel to the ground. Slower horses demonstrated a rhythmic change in the angle up and down as the horse rocked in the plane of motion in a manner like a teeter-totter. This rotation caused the head to bobble up and down and also increased the energy expenditure. This was analogous to the technique that we had discovered with the best track hurdlers in the world. The runner who was able to leap over the hurdle without displacing the center of gravity usually won the race.

Carrying our large report, replete with graphs, pictures, and extensive details, I flew to Florida to meet with Mr. Pollock and his trainer. The purpose of the pilot study was to demonstrate our techniques and capabilities and to provide as much information to him as we could. We each sought the same knowledge, but we were fledglings in identifying exactly what we needed to know. The ultimate goals were:

(1) To identify the characteristics produced by horses during racing
(2) To optimize these parameters
(3) To properly select young animals for racing
(4) To devise effective training techniques to optimize performance

Based on our pilot study, however, a continuation of the present research would focus on specific measurements and statistical determinations of the various parameters for the horses studied. These results would be compared with performances by other horses. We suggested some specific routines and training techniques to try on some of his horses and proposed a model for testing future animals.

Needless to say, our pilot study was extremely impressive and well-received by Mr. Pollack and his staff. They realized that this was a fantastic method with enormous potential for substantial profit. The ability to train his horses for better endurance, quicker speeds, and more sensitive detection of injuries was very promising. Mr. Pollock was quite enthusiastic and promised to contact us as soon as he could arrange for additional analysis.

I returned to Amherst and our CBA staff focused on our two ongoing studies. It was about three weeks later that Mr. Pollock called our office. He requested that we evaluate one very special horse and compare it with some of his own horses. He would arrange travel to the appropriate tracks where the horses would be racing as well as securing permission for us to film on the track premises. We agreed to the proposed terms and Ann and I flew to Miami to film the first set of horses.

As soon as Ann and I arrived in Miami, Mr. Pollock explained that he wanted us to see his horse farm. We readily agreed and off we went. He owned a large farm of beautiful gently rolling hills covered with green and in all of the fenced areas were horses. It was amazing to see a big pasture filled with young horses, their mothers, as well as other horses munching on the grass oblivious to all of the humans standing at the fence. Mr. Pollock and his training staff led the tour through the barn, paddocks, training circles, and to the track. It was a beehive of activity with all of the different stages of care and training that was more than uninformed horse observers would know existed. Ann and I were fascinated.

After the tour, we sat to discuss the project details. Because we were at the farm, we inquired about the preparation of each of the horse athletes. Since we had extensive knowledge about training and nutrition for humans, we were curious about how these four-legged athletes were trained. The answers to our questions were beyond our ability to fathom.

We discovered that the techniques and practices were deeply rooted in old traditions. They had been feeding the same food, at the same time, to horses in what seemed to us to have been popular with Alexander the Great in 300 BC. The training procedures apparently dated to the 1700s in England. We were beyond astonished by what they were actually doing and, more shockingly, that the trainers were rigidly opposed to changing anything. “This is the way that it has always been done,” was the mantra of horse training.

We told Mr. Pollock that we had some ideas and would come to him with suggestions. In addition, we wanted Mr. Pollock to meet Dr. Arie Selinger. Our friend and colleague, Aryeh ("Arie") Selinger,
was widely regarded as one of the greatest volleyball coaches of all time. He happened, at that moment in time, to be residing in Coto de Caza, our second home, as the head coach of the U.S. Women's Volleyball Team.

For our purposes, it was Arie’s expertise in physiology from his college and graduate studies that provided a factual knowledge basis for training his volleyball players to reach their maximum potentials. There was no reason to doubt that he would be able to provide valuable insight into training practices for horses.

We explained all of these concepts to Mr. Pollock, as we drove back to Miami. He was very receptive to any information that we could provide that would improve his horses and their performances. I believe that the achievement of his horses was a challenge more than anything else. He had enough money, his business was incredibly successful, but he needed “windmills at which to tilt” as a modern Don Quixote and perhaps we were his latter day Sancho Panza. Regardless of his underlying motive, he was extremely receptive to our ideas and was hopeful that we would be to improve the racing performances of his horses.

After we had returned to Miami, we set about preparing to film at the racetracks that Mr. Pollock stabled his horses. There were three racetracks, Hialeah Park, Calder, and Gulfstream, for us to collect data in Florida.

We needed permission to collect data within areas which were normally unavailable to the public. In addition, we had to have a sufficiently large area for setting the cameras, since we needed to film several running strides. To record the longer stride of a horse running at its maximum speed required approximately 30 to 35 feet in order to capture the entire movement pattern. We also needed the same area to be viewed from at least two camera views in order to create the three-dimensional results. One of the results during the pilot project was that we needed a much larger area for the horse to run than we had previously known. Mr. Pollock was able to secure the permissions necessary to accommodate our filming needs.

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**Letter from Joe Tanenbaum & Associates, Inc.**

August 6, 1960

Dr. Gideon Ariel
Computer Biomechanical Analysis
316 College St.
Amherst, Mass. 01002

Dear Gideon:

According to the current plans for Spectacular Bid, he will work out on Thursday, August 14 at Monmouth Park at 6 a.m. It will take us about a half hour to drive there from our motel to the track. You will have to determine how much time you will need to set up your equipment so that we will know when to leave the motel for the track on Thursday.

I expect to arrive at the Molly Pitcher at approximately 7 p.m. on Wednesday, August 13. I am looking forward to seeing you and Anne Wednesday evening.

Best regards,

Joe Tanenbaum

J8.3g

cc: Mr. Irving Pollock
Additional correspondence we received from Mr. Grant Gravitt, the president of Tel-Air Interstate, which was the director of Public Relations at Monmouth Park Racing track.

*Dear Mr. Haight:*

*This will identify Gideon Ariel and Ann Penny of my staff who will be shooting still photographs of Spectacular Bid. I would appreciate your issuing press credentials to them. Joe Tanenbaum has obtained permission from Bud Delp for the pictures to be taken.*

We were present in many races and I will discuss only a few of the results we obtained, which yield fantastic winning bets for Mr. Pollack and his team. We are talking at least 100 Million Dollars of winning based on our analysis.

In addition to four horses of his own horses, Mr. Pollack also wanted us to quantify another horse, which was owned by his friend Mr. Harry Meyerhoff, owner of Hawksworth Farm. At that time, Mr. Meyerhoff’s pride and joy was a magnificent steel gray horse named Spectacular Bid and the people who knew horses were confident that he was the best horse of the time. In order to film Spectacular Bid, we would have to film at Monmouth Park, which was a racetrack in New Jersey. We filmed Spectacular Bid at Monmouth Park on Aug. 16, 1980.

After collecting data from several sprinting sessions as well as actual race performances with these remarkable horses, Ann and I returned to Amherst to process the films. It took longer than the pilot study had taken because there were more complicated questions to answer with these specific horses. Ann insisted that she was nearly cross-eyed
and completely crazy because the sequences were extremely lengthy and the horses had so many joint centers. I knew that she was correct since each analysis consumed at least three to four times the time necessary to process a human runner. Finally, however, we completed all of the biomechanical results.

I flew to Florida to present our research results to Mr. Pollock and his training staff. Since they were familiar with the biomechanical procedures, I proceeded directly to the results. We had divided the horses into three general categories:

1. **The best horse** - Spectacular Bid
2. **A grass runner** (which happened to be injured at the time) - Clayton Delaney
3. Horses owned by Mr. Pollock: Midnight Mystique, Arkansas Bev, and Gentle Knight.

We prepared a large, detailed, and extensive report for Mr. Pollock. However, only a summary of the more salient points, is presented here. The complete report can be found in our website.

The results of this horse study were presented in three different formats. The first was a stick figure representation of the motion of each of the horses in an orientation such that the horse is running from left to right across the page. An example of the motion of one of the horses displayed in this mode is shown in the figure. The lines connect the body joints and, thus, represent the bone structure of the horse rather than an outline of the body of the horse. The head is represented by a single line from nose to ears and is not connected to the body. The number of lines on the figure of the horse is, thus, reduced in an effort to enhance clarity especially when multiple images are presented in the same figure.

![Composite multiple images Stick figure of Horse Running](image)

The formats for presentation to Mr. Pollock included: plotting graphs of joint center movements, graphs or “X-Y” plots of the biomechanical data, and *gait analysis*. The footfall pattern and the data measured in the 3-D analysis were utilized in a *gait analysis*, which determined the number of parameters.

The data was reported by the absolute magnitude and by percentage of a full stride, the latter being useful for comparing animals running at different velocities. A *gait analysis* is a good summary of the locomotion pattern of a horse, since it most directly relates to the horse's efficiency in propelling itself along the track. To better understand just what factors make one horse more efficient or faster than
another, required an examination of the more complex relationships between the various body joints and limbs especially in the patterns and magnitudes of accelerations produced by the muscular action.

Despite having a longer stride duration, (indications were that Spectacular Bid was being prevented from running at his maximum speed), this long stride length resulted in the highest average velocity of the group. Of the two track horses, Midnight Mystique demonstrated the highest average velocity, followed by Arkansas Bev. Midnight Mystique achieved a high velocity, though significantly shorter stride duration, despite having a shorter stride length than Arkansas Bev. Since Mystique is a smaller horse than Bev, the shorter stride length is not unexpected. It appeared, however, that Bev was not running at full speed (confirmed by the trainer). If, a similar, stride duration could be achieved, Bev could have an average velocity significantly greater than Mystique and closer to that of Spectacular Bid.

Clayton Delaney was unique among the horses, since he ran on the grass while the others ran on turf. Therefore, a direct comparison of velocity is probably invalid. Clayton Delaney exhibited the shortest stride length and a stride, duration similar to that of Bev. Again this may be attributed to the grass track. However, it was subsequently learned that Delaney was experiencing shoulder problems and this was most likely the prime factor behind the short stride and low velocity.

In a comparison of the stance (ground contact) phase and swing (airborne) phase for individual limbs for the various horses, Midnight Mystique exhibited the shortest stance phase (in both time and percentage) of any horse. The limiting factor in the animal's ability to produce a high impulse is the individual limb structure and muscular strength. It appeared that Mystique more closely approached this physiological limit compared with the other horses in the group. Thus, considering the potential of the various horses, Mystique appeared to be running near maximum speed. The other horses, assuming that they possessed the ability to similarly shorten their stance phase through an increase in impulse (i.e. exerting more force), showed the potential to increase their speed by at least 10%. In that case, Bev would be running considerably faster than Mystique, and Delaney only slightly slower than Mystique. Spectacular Bid would still be in a class by himself, a full 10% faster than Bev.

Another factor of concern in stride efficiency is an overreach. This is the distance beyond the point of foreleg lift that the same side (ipsilateral) hind leg strikes. Obviously it is directly related to the speed of the horse, but by comparing the percentage of overreach length and duration to total stride length and duration, relative efficiencies in this area can be compared. A long overreach indicates good hind leg extension, which in turn indicates a good use of the large muscle groups in the area of the back and rump. Spectacular Bid again showed his superiority with both the longest overreach and the highest percentage of the overreach to the total stride when compared to the group of horses.

A final concern in comparing the gait of the various horses was the suspension phase, which is that time when the horse has no ground contact. It is probably advantageous to minimize this time since, while the horse is airborne, he cannot be exerting propulsive force. Also, excessive time in suspension may indicate misdirected force (i.e. too much vertical and insufficient horizontal).

However, certain positive aspects of efficient locomotion tend to lengthen suspension. The first is good hind leg extension, which is the movement of the hind legs forward during the suspension in preparation for the next stride. The second is that increased impulse (higher force between the hoof and ground) results in a shorter time on the ground and a longer time in the air.

Spectacular Bid demonstrated the longest suspension, both in magnitude and percentage, which was probably due to his excellent hind leg extension. Clayton Delaney showed the shortest suspension but had poor hind leg extension (smallest percentage of overreach). Arkansas Bev showed perhaps the most efficient suspension phase combining good overreach with a short time in the air. With greater impulse and at a higher speed, however, this time might well lengthen and, thus, it was difficult to draw any direct conclusion in comparison to Spectacular Bid. Midnight Mystique already demonstrated a high impulse (short stance phase), and thus any efficiency increase would have to come through an increase in hind leg extension and a corresponding increase in suspension.
The discussion of *gait analysis*, thus far has addressed only the horizontal component of the motion of the feet. Brief consideration should be given to the vertical motion of the feet during the execution of a typical stride, since this will provide additional information on how each of the horses used the various limbs during locomotion. The general pattern for each hoof is the same:

1. Ground contact, followed by a rapid lifting of the hoof
2. Forward motion of the hoof during which the height of the hoof may vary
3. Rapid lowering of the hoof
4. Ground contact

Within this general pattern, several distinct variations were noted. Midnight Mystique demonstrated a high degree of symmetry in the motion of the fore legs and the hind legs. Also, the peak height for each foot was nearly identical. Arkansas Bev showed good symmetry between the fore legs, but the left hind hoof demonstrated a slow, steady descending pattern, while the right hind hoof performs a *hitch* followed by a more rapid descent. Spectacular Bid showed a similar hind hoof pattern, with an even more exaggerated *hitch*, while his front hoofs showed a higher degree of asymmetry. In fact, his right front hoof reached a peak height of 51 cm, while his left front hoof reached a peak height of only half that value. This may have indicated a strong *footedness* in his gait, or it may perhaps, revealed that he was favoring the left foreleg for some unknown reason (perhaps pain or discomfort). Clayton Delaney showed a lower magnitude of vertical hoof motion, which may be due to the grass track. Symmetry was high for the fore legs, less so for the hind legs.

In addition to the motion of the hooves, it was valuable to consider the motion of other major body points during the stride. The motion of the body points for all the horses followed the same general pattern with the head (nose and ears) showing the most vertical motion through the stride and the withers showing the least. Midnight Mystique and Clayton Delaney demonstrated considerably more vertical motion in the back and rump than did Arkansas Bev. Reducing the up-and-down motion of these heavy body parts minimized the motion of the center of gravity and, thus, conserved energy and increased efficiency.

The data collected and analyzed in this study demonstrated that differences in locomotion patterns between horses can be measured in a valid and consistent way using the methods employed. Furthermore, measured differences can be related to the goal of maximizing the speed of the horse and the overall efficiency of motion. In a specific sense, this study showed that several unknown horses: Midnight Mystique, Arkansas Bev, and Clayton Delaney, could be compared to a *model horse*, Spectacular Bid, in a practical and straightforward manner. This comparison demonstrated that one of the horses, Arkansas Bev, showed the most potential for being able to approach the performance of the model horse and that another horse, Midnight Mystique, was near the limit of its potential development.

In the process of performing this study, much knowledge was acquired as to the best methods to be used in the equine analysis, as well as the type of data format that is most useful in comparing horses and evaluating performance. In that sense it quite successfully fulfilled its role as a pilot study.

At this point, I could recommend that these methods be placed into production in the form of a continuing program of monitoring the development of individual horses and of selecting horses with good potential to receive additional training. In addition, I suggested to Mr. Pollock that various training methods be evaluated by measuring the progress of horses, which possessed similar potentials, utilizing different training regimens. The end result of such a program would be to maximize the returns in a horse breeding and training program through superior selection and achievement of maximum potential. Mr. Pollock and his head trainer thought that this was a good suggestion. We decided to work with Arie Sellinger, in addition to Mr. Pollock’s staff, to outline some prospective training protocols.

One interesting episode occurred during our project with Mr. Pollack. The situation was created because of the personalities of horses. We learned that some racehorses were *gifted athletes* because they can run faster than the other horses. However, even these star athletes maintain their herd instinct and prefer to associate with other horses, rather than live solitary lives, regardless of the luxuries of privacy.
available to them. Apparently, horses are like teenagers; they need to hang out with others that look and think like they do.

For this reason, even the most valuable horse needs a friend, which is usually another horse. There are other options available besides another horse, including donkeys, goats, dogs, and, occasionally, chickens. Mr. Pollock’s “million-dollar horse”, Gentle Knight, had a friend referred to as a pony. In this case, it was not actually a pony, but rather an inexpensive horse compared with her more expensive friend. In this case, the pony was a filly named Arkansas Bev and she and Gentle Knight were inseparable.

On the morning we were to film Gentle Knight, we arrived at the track at 5 a.m. The plan was to film the horses as they executed their morning workout session. We had requested the trainer to have the session include a maximum speed sprint at the location of our cameras. He told us that race horses run their fastest when they have to run with, or try to catch up to, and pass another horse. Therefore, he suggested that we let Arkansas Bev run ahead of Gentle Knight. Then Gentle Knight’s jockey would urge him to run faster in order to overtake Arkansas Bev. We had no quarrel with this strategy, since our expertise was biomechanics of locomotion and the trainer’s knowledge was in knowing how to get horses to run faster. During our data collection, however, we recorded both horses as they raced past the camera locations.

We completed our data collection and Ann returned to Amherst to process everything. She had a large amount of data to work on and it was going to require a dedicated and intense work schedule. These were the old slow days when 35mm film development times and expensive overnight delivery charges were normal business problems to overcome. As soon as Ann completed digitizing and analyzing of some of the horses, she would send the results to me in Florida. Some of the first results were for Spectacular Bid, Gentle Knight and his companion, Arkansas Bev. As the soon results arrived in Miami, I would immediately present the findings to Mr. Pollock.

I presented the most recently acquired data to Mr. Pollock. (A more comprehensive report of the data presented to Mr. Pollock is available in the by scanning the QR Code.)

(Scan the QR Code on the left for more information: Biomechanical Analysis of Selected Race Horses)

Of course, the most impressive results were those of Spectacular Bid. I described to him the various characteristics that made this horse as impressive as his name. Some of Spectacular Bid data is presented in the following graph and table.

Some Results for Spectacular Bid

After I had explained some of the results for Spectacular Bid, I noticed that Arkansas Bev had incredible angular velocity at her hip and knee. In fact, she demonstrated a gait pattern that was equivalent
to Spectacular Bids! Gentle Knight’s results were much less impressive. When I presented it to Mr. Pollack, he did not believe it. He insisted that Ann had made a mistake or some kind of miscalculation.

I called Ann and told her: “Ann you made a mistake with the pony, Arkansas Bev.” I could hear a special kind of skepticism and frustration as she answered: “I did not make a mistake. You know how precise I am with details.”

“I believe you,” I told her, “but, Mr. Pollock doesn’t know how exact you are, so he is rejecting our results. In order to convince him, we will have to repeat the analysis.”

“Please don’t make me do them again. There are 32 joints per horse, 75 frames per view, and three camera views. It takes so many hours to digitize each view and it’s unbelievably difficult to see some of the joints because the light was dim, since we filmed so early in the morning,” she pleaded.

I had absolute confidence in Ann because I knew how meticulous she was in everything, but especially when it came to the biomechanical processes. But Mr. Pollock was paying the bills and we wanted to convince him to continue horse projects with us. Ann relented and agreed to reprocess the analysis for the pony, Arkansas Bev, as well as Gentle Knight and Spectacular Bid.

After several more days, she sent the repeated calculations for the three horses. The results were nearly identical to the first set of findings. Excluding Spectacular Bid, Arkansas Bev was the best of all
the horses we analyzed at that time. Mr. Pollock examined the results very thoroughly as I pointed out the extensive points of comparison among all of the horses. He was disappointed that the horse that had cost him the most money was much less impressive than the inexpensive companion horse.

After pondering the results for hours, Mr. Pollack reached a decision. He decided to take a risk and enter Arkansas Bev in a race, despite the fact that she had no experience except for some of the times she had been used to run with Gentle Knight to assist in his practice sprints. He found an appropriate race and when she was on the track, the odds against her were 70 to 1. Mr. Pollock also decided to bet on her, but he made his wager in Las Vegas. “I want to be anonymous in my bet, since I would be embarrassed to bet here in Florida with my friends able to make fun of me!”

With the odds against her at 70 to 1, Mr. Pollack bet $10,000.00 on Arkansas Bev. I think I held my breath during the entire race because the horse had only her nature not scientific knowledge about her biomechanical advantages. But, I should have had more belief in our biomechanical calculations, because Arkansas Bev won by five body lengths and Mr. Pollack won $700,000.00. I immediately called Ann and we shouted with joy about her victory. We felt vindicated about our biomechanical process. Another factor was that we were pulling for the underdog who had no chance of winning. It was an especially happy event for us to see this little horse, and additionally for a girl to win with such impressive results.

One thing I noticed, perhaps because my background involved humans running on artificial track surfaces, was that horses lost time because they were sinking into the sand on every stride. Historically, equine racetracks are one of three types: dirt, turf, or synthetic. Dirt tracks are the most popular for spectators wagering on a race, as conditions are easiest to gauge to choose a winner. Turf (grass) is kinder on a horse's legs, as there is much more shock absorption. Synthetic tracks have been installed for years, but have come to the United States fairly recently.

Dirt tracks are easy to maintain and are the most economical option for any track. They can be softened with the use of ground pine or other mulches and provide a good, clean running surface. While horses tend to slide a little more on dirt, it is preferred over turf because horses can maintain an increased speed that it not hindered by the softer landing grass gives. The downside to dirt lies in its inability to give. Dirt is very hard on a horse's legs because there is little to no shock absorption at all. It can be compared to a human trying to run down the road on their hands at 40 mph. Horses have thin legs holding up a thousand-pound body and are very fine boned from the forearm down to the hoof. Fractures can occur easily even on the softer ground.

Another result we detected during our studies was the different responses of running on a dry dirt track compared with racing on a wet, muddy surface. Horses seemed to prefer one over the other. I suggested to Mr. Pollack that we experiment with a Polyurethane shoe placed over the hoof joint. The idea was to increase the size of the hoof in the same way that fins increase the size of a swimmer’s foot. It was legal and, as far as we could determine, no one had thought about it. We made the shoe in a special manufacturer and used it on various horses. They all improved their time by at least one second on 8-furlong track regardless of surface conditions.

We also arranged for Arie Selinger to meet us at Mr. Pollock’s horse farm located in the central part of the state of Florida. The gentle hills were green with grass and trees, as well as the usual heat and humidity. Mr. Pollock and the trainers gave Arie a tour of the barns, training facilities, and exercise yards.

We all sat together to discuss some of the training strategies that we thought would be useful in developing stronger faster horses, preventing injuries, and increasing the longevity of each animal. Because Arie, Ann, and I came from different concentrations, we were able to suggest a variety of training proposals.

To improve the strength development, we suggested having the horses run in both directions around the track. This would allow for a more balanced muscular development, since both right and left sides would have equal training. Without this balanced exercise, one side of the horse would be stronger than the other side and the imbalance would eventually lead to injury.
Another suggestion was to use water exercises. Having the horse swim would be extremely beneficial because:

1. There would be less stress on the joints and bones because the gravitational pounding on the ground would be eliminated.
2. The horses could increase their cardiovascular strength without having to run on the ground. Swimming constituted an inefficient method of exercise much like having track runners practice in soft sand.
3. Injury prevention as well as safer rehabilitation was usually quicker.

Because Arie had coached athletes around the world, received his advanced academic education in physiology, and was currently the head coach for the U.S. Olympic Women’s Volleyball Team, he was well versed in training athletes, even the four-legged ones. In addition to the water exercises previously discussed, he also recommended different daily strategies for development of endurance, as well as balanced strength increases. These techniques were also recommended so that the horses would be continually stimulated mentally as well as physically.

Arie was particularly interested in the food and timing of meals. His recommendations included adequate protein intake during the developmental times and while recovering from injury. He advocated, what was known at the time, of carbo-packing on the day of the race. This meant excess carbohydrates, with reduced protein, on race day.

He discovered that the normal timing of meals on the day of the race was that the horses were fed early in the morning and only after the race were they fed again. Arie insisted that the horse is given a high carbohydrate snack prior to the race, since they were running on empty when they most needed some high-powered fuel during the race. Imagine our shock when he was told that the horse could not eat before a race because they would explode!

Arie asked, “What do you mean ‘explode’?”

The trainers insisted that the horse’s stomach would explode all over the track during the race. None of them had actually seen such an event take place, but they each agreed that it was a known and irrefutable fact.

We discussed the situation with Mr. Pollock and determined that there was one horse that he was willing to try the dietary technique we advocated. After following the meal pattern for several months, the horse was entered in a race. Despite ingesting his snack two hours before the race, he did not explode and actually won in better time than predicted.

However, most of the suggestions we proposed were met with skepticism and, I am sure, were totally ignored after we left. To say that horse racing was locked in antiquated tradition is an understatement. It operated like the medieval guild system with a master at the top and apprentices on the bottom. The individuals were close-minded, inflexible, and secure in their place in the societal structure. Perhaps in today’s more modern, forwarding thinking and technological world, things have changed within horse racing. I hope for the sake of the horses that this is true.

We continued to work with Mr. Pollock and analyzed many horses. At his direction, we evaluated other racing horses, as well as young horses, which were offered for sale. Eventually, our activities at the racetrack were noticed, as were our successes. Some of the other horse owners were less than appreciative of our work and the obvious results with Mr. Pollock’s horses. One day Ann and I returned to our hotel room to discover that all our cameras had been smashed. We read a note left on the bed, which read: “Your knees are next!”

Regardless of the source of this warning, we decided that analyzing horses was too time consuming for our small business. We worked with Mr. Pollock so that he could the biomechanical analysis and training regimens that we had successfully implemented. We were sorry to conclude our
relationship with Mr. Pollock, which had been interesting and lucrative. However, we had been forced to put many of our other projects on hold and we needed to return to those customer projects.

Several other groups were interested in analyzing horses and purchased our biomechanical analysis system of hardware and software. Most of these institutions were universities and were used for the veterinary research.

Another group that utilized our biomechanical analysis was Hilary Clayton. In preparation for the 1988 Olympic Games in Barcelona, she used the APAS system to analyze the gait of the horses, which were to participate in the Olympic Games. We corresponded with Hilary and instructed her how to set the cameras to collect data for our analysis system.

In the Olympics, a multitude of cameras was focused on Barcelona where they captured Olympic athletes in motion for sports fans worldwide. The vast majority of the cameras were for television broadcasting, but there were also several cameras whirring away at the equestrian events with an entirely different purpose.

These video cameras recorded specific parts of the performances of elite equine athletes for gait analysis. With her studies, Ms. Clayton envisioned help in answering one of the main questions in gait analysis research: does a horse possess certain gait characteristics that are essential for superior performance.

Together with several scientists from Spain, Clayton videotaped the most difficult of dressage movements: the piaffe, a stylized trot in place, and the passage, a very slow trot with an exaggerated elevation of the limbs. Olympic contenders must execute two passage-piaffe-passage sequences in the center of the arena and their performances at these movements, accounts for 25% of their total marks. Three cameras were set up along the edge of the arena to capture a minimum of six steps of passage preceding and following the piaffe, the piaffe itself, and the transitions between them.

Ms. Clayton also positioned three video cameras at the show jumping event in order to record world-class horses as they approached and cleared a specific obstacle. The motion included the final approach stride, take off, airborne phase, landing and the first stride as the horse ran to the next obstacle in the course (the recovery stride).

Ms. Clayton reported that winning jumpers at the 1988 Olympics differed in their recovery strides after negotiating a fence compared to their competitors. Successful horses had briefer time intervals between hind limb impacts and shorter time intervals between fore leading limb contact with the ground and the initiation of the next stride. Fewer penalties were garnered by horses whose hind limbs were planted closer together during takeoff and whose forelimbs landed nearer each other.
There are still some questions to answer before gait analysis can be used routinely to select the youngsters that could become stakes winners, futurity stars, or Olympic contenders, as well as identifying young horses that are structurally disadvantaged or poorly coordinated. It is generally accepted that an individual's inherited movement patterns can be enhanced by practice (your piano teacher didn't say "Practice makes perfect" a million times for nothing). Those drills induced subtle refinements in your neuromuscular coordination to translate notes on a page to accurate movements of your fingers. Whether the same need for practice applies to horses has yet to be scientifically verified.

Researchers are scratching the surface to understand how much equine gait characteristics changes over time due to training and/or maturity, and which characteristics are reliable predictors of ability in a given sport. To complicate matters, the final performance is more than just the sum of the horse's innate talent and any improvements through training. It involves the ability of the rider or trainer, the nature of the working surface, furriery modifications, the overall health of the horse and that elusive, unquantifiable quality, heart.

Nevertheless, as both a performance predictor and diagnostic aid, gait analysis holds great promise. Whether you want to compare limb to limb, before to after, your horse to a superstar, your horse to a composite ideal or your horse to the norm, its advantages are clear: gait analysis is noninvasive (no wires or sensors attached to the subject; skin markers optional), flexible (cameras are portable and can be set up just about anywhere, from the clinical setting to the competition arena).

The biomechanical analysis that Ms. Clayton performed on the various equine events held promise for use in several areas. She suggested that horses in rehabilitation, may benefit from gait analysis. Just as physical therapists for human patients could utilize biomechanics analysis to evaluate a patient's, a clinician could compare a horse’s movement before and after treatment to help evaluate its effectiveness.

At the opposite end of the gait analysis spectrum would be the talented horses that perform in a superior manner. Their abilities to move more economically or efficiently than their less gifted peers may be separated them from their peers during competitions. A superstar appears only too rarely, but when they do, the contrast can be spectacular, as in the classic case of Secretariat. The advantage of biomechanical analysis is that without invasive procedures or examination of bloodline records, good horses can be identified.

From a quantification point of view, Ms. Clayton suggested that the question of, "Is this horse lame?" should be rephrased as, "How lame is this horse?" A permanent record of a film or tape can be replayed repeatedly. The films would form a baseline for comparison or stored as an archive. This stored data can be analyzed and presented in innumerable ways to give a clearer picture of what is happening currently, compare to previous movement patterns, or evaluate relative to other horses.

To summarize, the same system that we used to maximize the performance of race horses were applied to Olympic horse athletes to achieve their Gold Medals. Prior to these projects with horses, our experiences had been with two legged athletes, with the notable exception of Daisy the monkey. With these experiences
working with exceptionally talented racehorses and equally skilled Olympic horses, we had again demonstrated our company motto: “If it moves, we can measure it.
In 1975, Vic Braden, a friendly-appearing man with a cherubic smile and a sunny disposition walked into my Amherst lab. I had never met Vic before this meeting, but I had heard several stories about him. Vic attained his degree as a psychologist from Kalamazoo College in Kalamazoo, Michigan, with advanced degrees from UCLA and California State, but he achieved greater fame in tennis. He was introduced to tennis at the age of 12 and had been quoted in Sports Illustrated about hitching a ride to Detroit to watch Don Budge play Bobby Riggs. His reason for the trek was to discover how Budge hit his backhand. While a student at Kalamazoo College he had served as the captain of the tennis team.

As Vic was relating these and other stories during that first Amherst visit, he described his crazy work history that began when he was very young. In fact, during college, he had lived in an upstairs closet in the athletic facility because he could not afford to live in the dorm. Times may have been tough for him as a youth, but he was a happy, funny adult that day in Amherst.

Vic briefly described his short professional tennis career that included three invitations to play in the World Tennis Championships where he reached the round of 16 twice, in 1953 and 1954. Although he may not have been the most successful tennis player, he had become a fantastic tennis coach. Jack Kramer, the 1947 Wimbledon champion, called him "the world's best all-around tennis coach," who can improve the game of anyone "from a beginner to a champion."

By 1975, however, he was best known for his humorous, yet extremely successful, method of teaching tennis. Vic had been featured on the cover of Tennis magazine, on television commercials touting Tennis Our Way, and on film with Arthur Ashe and Stan Smith. Besides, millions of sports fans
chuckled at his commentaries on cable and network TV. The best known of his five books, Vic Braden’s Tennis for the Future had sold 200,000 copies.

After a short time chatting with this charming, funny man, I silently wondered what he was doing in my lab. I was a discus thrower, not a tennis player. When I finally was able to ask why he was in Amherst, Vic told that he wanted me to explain a statement that I had made in one of the Tennis magazines. In the article, I had described that the biomechanical analysis about a “top spin” did not mean that you hit the tennis ball on its top. In most tennis strokes, the racket face was relatively perpendicular to the ground, and the swing from back to front roughly maintained that orientation. A “top spin” was created by tangentially hitting the ball with the racket.

To create a “top spin” the racket moved from below the ball with an upward movement so that the racket contacted the ball with the racket face at an angle. The racket movement began below the ball and then was swung upward hitting the ball as the racket continued in the upward angle. The racket moved from below the ball up towards the sky rather than hitting from behind and continuing towards the net with the racket face nearly perpendicular to the ground that is how one would execute a normal, flat tennis stroke. The racket never “rolled” over the ball.

In the magazine article my statement continued by describing that, “If you roll the racket over the ball, the ball will hit you on your big toe.” This was somewhat of an exaggeration about hitting yourself in the foot, but I wanted to help the reader understand that the ball was on the racket for only a few milliseconds and was hit with a different movement pattern to create “top spin.” The racket face had to be properly angled to hit a “top spin”. Also, there is only a narrow range of angular displacement of the racket face in which the ball would land in the court of play. It was a mechanical impossibility that turning the racket over during the impact could successfully produce a “top spin”. Any movement of the arm and racket after the few milliseconds when the ball was actually in contact with the racket face was purely theatrical. It might look impressive, but it had no effect on the flight of the ball.

In addition to how the racket is swung and impacts the ball, the friction that the ground imparts on the ball at contact affects how the ball will react. The ball travels through the air with a spin caused by the ground, and subsequent racket contact affects this spin. In most cases, the return ball hit the ground on the opponent’s side of the court and reversed its spin. This looked like a top spin to the average player. Professional tennis players, such as Bjorn Borg or Rafael Nadal, are able to swing their rackets with such precision and pace, that they can change the spin of the ball on impact. This skill is usually beyond the ability of the average tennis player.

Only minutes after I explained my “top spin” conclusion, Vic suddenly asked me, “Do you play tennis at all?”

“No,” I replied.

“Well, how were you able to come to such an unusual and unexpected comment about ‘top spin’?” he asked?

Ann and I gave Vic and his wife, Melody, a tour of our laboratory including the digitizing process, the force plate, and all of the three-dimensional capabilities that we had. Also, we showed them some of the research we had done for Spalding and AMF using high-speed film. Some of the 10,000 frames per
second films of the tennis ball impacting the floor and sliding like a pancake as well as the tremendous distortions and vibrations the racket exhibited after being struck by the tennis ball were awe-inspiring even to a knowledgeable tennis man like Vic. We were able to answer every question he posed or described the research project that would be able to determine the answer his query.

After many hours, Vic suggested that we continue our conversation during dinner. Ann, Melody, Vic, and I set off talking non-stop as we drove. We discussed additional research projects we had performed including the development of the large head tennis racket and the differences in stringing options between gut and nylon. The large head on a tennis racket allowed the “center of percussion” to be closer to the hand for better control. The use of nylon as a stringing option was relatively new to the tennis world. We had also been involved in a research project to develop a pressure-less tennis ball. Traditional balls were sold in pressurized cans, and Spaulding had contracted us to develop tennis balls that maintained the same level of performance but did not require pressure. We had accomplished this task, and Spaulding was marketing the “Australian” tennis ball.

At some point during the evening, Vic asked, “Would you like to come to my tennis college in Coto de Caza and meet the students and staff? You will also have a chance to look around the area. I think that you will love the beautiful climate and place where my facility is located. It has been called the hidden Shangri-La of Orange County” he said. We agreed that the next time I had to travel to the Universal Gym Company in Fresno, I would rent a car and visit him.

About a month later, I had to travel to Fresno, California to work on one of the Universal projects. I called Vic to arrange the meeting, and he gave me directions from the airport to his tennis college.

On this trip, I had separately arranged to get together with my friend Bill Toomey. Bill was the 1968 Olympics decathlon champion and had been named on ABC’s “Wide World of Sports” as the Athlete of the Year. The following year, he received the James E. Sullivan Award as the top amateur athlete in the U.S.. Bill was a terrific person and possessed a fantastic sense of humor. When we were together, I was usually laughing so much that my sides hurt.

Bill had married Mary Bignal/Rand in 1969. Mary Bignal had competed in the 1960 Olympics in Rome and, therefore, was one of the foreign athletes invited to participate in the Maccabean Games in Israel. She traveled with her British teammates to Israel in 1961 to compete in the Games during which I threw the shot put and discus. I was completely enthralled with her beauty and athletic abilities at the time and was proud to show my friends the picture of Mary and me which appeared in the Israeli newspapers. Mary was an incredible athlete. She won the gold medal in the long jump in the Tokyo Olympics as well as breaking the World Record. She also won the silver medal in the pentathlon and a bronze medal in the 4 x 100 m relay. Mary is the only Great Britain female athlete to win three medals in a single Olympic game.

Before marrying Bill, she had been married to oarsman, Sid Rand, whom she agreed to marry after knowing him for only three days. They married five weeks later and had a daughter, Alison. The marriage lasted five years. In December 1969, she married Bill Toomey, and this marriage lasted 22 years. When I visited them in Laguna Beach, California, they had two adorable daughters, Samantha, and Sarah.

I stayed with Bill and Mary the evening before we drove to Coto de Caza to see Vic Braden and his tennis college. As usual, Bill had me in stitches laughing about stories from his track past. There were times that I had to beg him to stop, so I could catch my breath.

Mary Bignal  Bill Toomey
http://arielnet.com/ref/go/1217
The next morning, we left Bill and Mary’s beautiful beachside home in Bill’s vintage Rolls Royce. In the middle of the 1970s, Orange County California was populated along the coast, but as you traveled away from the ocean, the land was covered primarily with citrus groves. There were few homes and fewer businesses as the small roads led away from the beach. The small county road, which led away from the newly constructed interstate highway, twisted and turned between citrus groves and hilly terrain covered with untamed patches of sparse wild grass and cactus. The smells from the flowering citrus trees were divine and reminded me of my childhood in Israel.

Eventually, Bill turned right from the county road onto an even smaller side road. At the intersection, was a ramshackle building with a sign “Cooks Corner” atop the structure. In front of the building were 50 to 60 Harley Davidson motorcycles as well as riders wearing leather jackets, large helmets, with more than a few tattoos. There were more men than women, but the females had the same type of black leather, big helmets and were riding the same massive motorcycles. I could imagine this being a very scary corner on the weekend when even more bikers would roar up on their Harleys and head for the beer inside. I assumed that Bill was lost, but he assured me that we were on the proper road.

Probably my jaw had dropped, and my eyes widen as we passed Cook’s Corner because Bill chuckled at my disbelief. “They are happy to group usually” he explained. “That is until Sunday night when they come back down the hill after a weekend of beer and other activities. Then they are either belligerent or extremely docile. The police with their paddy wagons were usually waiting for them to eliminate drunken driving problems.”

We continued driving past Cook’s Corner on a small narrow road that curved its way up the hill.

At the crest was a magnificent expanse of wild flowers of yellows and pinks that was breathtaking in its beauty. The road plunged down over the crest and became the most crooked road I had ever seen. Almost immediately, we were sheltered by a vast canopy of oak trees so thickly spaced that little sun penetrated through the leaves. I was beginning to realize that California was a truly beautiful and amazing place!
Our car passed out of the oak trees, and this crazy road changed again. Now we were driving in a flat valley through a county park, passed several paddocks with relaxed horses watching us drive by, and then we traversed a dry creek bed. Little did I know that during the rainy season, this road could become a raging torrent of water rather than a normal transportation corridor. The road climbed a small hill of S curves and switchbacks and then opened onto a wide spacious pasture with occasional cows and even a few small deer. I was, by now, speechless with the changes in the land and the beautiful scenes that seem to greet me at every turn.

Finally, we arrived at a small, wooden “guard” gate. Our names were listed on the log, so into the Valley we drove. I gasped again at the beauty of this protected valley that opened out in front of me. There were hills, wildflowers, fences, and even windmills! California landscapes were entirely different from those which I had experienced in Wyoming or Massachusetts. Those states had greener trees, and they grew in more prolific “forests”. Here in the drier western U.S., a large oak tree with vast branches that appeared to drape and shelter the ground below were more isolated and stood majestically in a field alone. The hills, flowers, trees, cactus, and wild grasses repeated themselves in many permutations but with each little vista uniquely beautiful. I was enthralled by it all.
I had to pinch myself to make sure I was not dreaming. Every place I looked was beautiful. We had had breakfast at Bill’s house watching the surf pound the sand. Now, only 20 minutes’ drive eastward, we were in a tranquil valley of wildflowers, large graceful trees, and, suddenly, a deer appeared at the edge of the oak grove. In this section of California, you could drive 2 hours in the morning to snow ski and drive back to the beach in the afternoon to bask in sunny 75-degree temperatures. At night, you could play tennis on lighted courts, and there were no bugs! By now, I was sure that all of this was just a dream, and I must be nearing the end! These images and unbelievably beautiful vistas could not be true; they must be dreams, mirages, or maybe hallucinations!
It was about 5 minutes down into the valley that we arrived at the Vic Braden Tennis College. We parked in front of a large sprawling wooden building reminiscent of the old West but nicely modern in upkeep with grass and trees in front. This was the Clubhouse, which housed the front desk for checking into the hotel, the restaurant, as well as shower and changing rooms. Behind and beyond this building was the swimming pool. Just beyond the pool was Vic Braden’s Tennis College.
Vic met us at the Clubhouse. He gave us a tour of that building and then of his Tennis College. Vic had a creative and interesting educational center. Several courts had video camera positioned to film the students during and after their instruction period. Then the instructor would show them what their swing looked like as well as what they should do to change or improve their performance. Surprisingly, some students denied that they were the ones on the screen! Even with an accurate comparison of their attire was verified, some students refused to accept the assessment of their swings!

Another unique educational tool was a circular series of pie segments. At the center of the circle were a series of ball throwing machines. Tennis balls would be projected towards the player who was positioned at the top of one of the pie segments. With this arrangement, some players could all practice hitting balls at different speeds according to their ability levels. The balls would be channeled back to the center of the circle for continual ball throwing events. The instructor could walk behind each of the players and give individualized corrections without interrupting the other hitters. It was an ingenious and efficient technique.

We were also shown the large meeting room. Vic began each day with his entertaining and informative speech. Lectures and films were shown, and small groups could meet for verbal instructions. After the tour, that first day, Bill and I sat together in a small conference room beside Vic’s office and talked. Bill told Vic about our work with the Olympic Committee and some of the projects that he and I had worked on during the last few years. However, I was unable to focus on the conversation and finally, I asked Vic if I could call Ann. It was 2 pm in California and 5 pm in Amherst. With a knowing impish grin, he handed me a phone.

“Ann, you would not believe this place. Please jump on a plane tomorrow morning and come.”

“Are you crazy?” she answered. “I have to finish digitizing which will take many days to complete.”

“You must come, please. I have found our future home whether we have a job here or not; you must come. This is it.” I persisted. “You will not believe me unless you see for yourself, and I am willing to risk the lost days. I know you will make up the time.”

I could see Vic smiling as he overheard my conversation. “Gideon, I am so happy that you came to visit. Plus, I hope that we will have many things to enjoy in the future.”

The three of us returned to our discussion about the future of sports medicine and sports athletics until late at night. Bill finally stood up and said that his wife would kill him if we did not get back soon. I believed each of us was surprised to discover how much time had passed as we had been so enthralled in our conversation. Bill and I said our goodbyes to Vic and drove the crazy road back to his house to the beach. I was so exhausted by this time my head hit the pillow that even the exciting events of the day could not keep me awake.

The next morning, I drove my rental car to the then tiny Orange County Airport to get Ann. As we drove past the same citrus trees I had seen the day before, she said, “Gideon, this seems a little insane.” But I told her to watch the scenery and then decide later. Despite the difficult road and its constantly changing character, I found Coto de Caza. As I anticipated, Ann’s eyes began to widen with awe. My nature-loving partner and girlfriend were as shocked and inspired as I had been and her reaction was what I had expected. As we drove through the rolling hills, under the massive oak trees, and past the vast open areas, she saw what I had meant on the phone. “Wow! This is unbelievable!” she blurted out.

After we had arrived at the main Clubhouse area that provided facilities for both the residents and Vic’s tennis college, Vic joined us for a complete tour. We began with a quick lunch at the Clubhouse restaurant and then a drive through the Coto de Caza valley. The area was about 5000 acres in a long, narrow, flat floor bordered on both sides by hills. There was one black strip of asphalt in the center of the valley floor that we followed. The few trees we saw were mainly oaks that were hundreds of years old and their branches spread outward so that they seemed to consume a large area of space. They were not as majestically tall and massive as one would experience with a giant sequoia, but they possessed their quiet strength.
We had driven about three-fourths of the valley before we turned into an oak grove with a building in the center. There were a broad covered porch and wooden walkway around the building. On the far side was an area for skeet shooting. A few people were shouting “pull” and we watched the targets splinter in the air with each successful shot. Other people were sitting around tables watching the target shooters or just chatting over beers. There were several oat trees growing through an opening in the deck which provided lovely and unique shade for the guests. The building was for snacks, beverages, and purchasing targets for sports shooting. These were new and different activities from those that Ann and I had experienced in our quaint New England college town of Amherst. I guess we were in the Wild West.

Vic drove us back up the valley to the tennis college. We passed some horse paddocks and the horse barn where weekend “cowboys and cowgirls” left their pristine, expensively decorated lives of law and finance to play “John Wayne”. There were fewer than 25 residential houses in the village and ten condos for people attending the Tennis College.

After an excitingly eventful day, Vic took our picture on the deck of his Tennis College. He wrote “don’t forget to digitize this” on the picture. In retrospect, the comment became a more accurate predictor than the ones you find in fortune cookies at the conclusion of a Chinese dinner. At the time, none of us knew what was to be. We never digitized the picture, of course, but it was one of the first mementos of what was to become a new life for Ann and me.

Vic and I became good friends. I did some research work for him, and we appeared together in some presentations related to tennis. One day Vic asked me: “Gideon, what would it take for you to move to Coto?”

“Vic, I would love to move to Coto. However, I have a business and some projects I am working on in Amherst plus my work at the University. How could I leave?” was my answer.

Vic persisted. “So what would be necessary for you to move to Coto on a permanent basis?”

I had no answer to that question. Ann and I had wanted to move from what for us was the alien climate in Amherst, Massachusetts but we had not found the perfect place. From our brief experiences
in California, it seemed like this was the place for us, but we had to deal with the where and how. Vic’s question, however, might provide the answer to our quest.

“I have a meeting with Mr. Vic Palmieri, who is the Chairman of the Board of Penn Central Company which owns the properties here,” he said. “If you can come to Coto during his visit, I’ll introduce you to each other. Perhaps there will be enough overlapping interests and we can find a way for you to have your business site here.” Vic explained.

Vic arranged a time when both Mr. Palmieri and I could meet in Coto. Vic suggested that I arrive in Coto two days before the meeting so that we could discuss the various issues we wanted to cover. As soon as I arrived, Vic and I discussed my needs for a building, housing, and some of the items I would need to arrange for my staff. Vic showed me the various constructions underway and, in fact, he was confident that I could purchase two of the new condominiums that were being built as additions to his Tennis College if I were interested.

Finally, it was the day of the meeting. Victor Henry Palmieri was a lawyer, real estate financier, and corporate turnaround specialist. For a time, he was an Ambassador at Large and U.S. Coordinator for Refugee Affairs in the United States Department of State during the Jimmy Carter administration. He was born in Chicago and earned his A.B. and LL.B. from Stanford University. Mr. Palmieri was also the chief executive officer of The Palmieri Company, a general management consulting firm that had specialized in large-scale reorganizations and restructurings since 1969.

At that time, Coto de Caza was part of the vast land holdings of the Penn Central Corporation and Mr. Palmieri was working with the company for a successful emergence from bankruptcy. The task for the company was to sell their holdings for as much profit as possible. As part of the numerous holdings of the Penn Central Corporation were the subsidiaries of Great Southwest Corporation and the Six Flags Corporation. The goal was to create an increasingly attractive and visible role for Coto de Caza to elevate its standing as a desirable destination resort. To that end, any ventures that would enhance the worth of the land would be a positive step for everyone concerned. It was in this atmosphere of mutual goals that Mr. Palmieri and I met on a normal sunny day in what I had taken to refer to as “Paradise”.

We decided to meet at a nice restaurant not too far from Coto called “Delano’s.” I was very excited, and my hands were shaking. I had a feeling that this meeting could change my whole life or could be a complete disaster. My previous meetings with Irving Pollock and Larry Graham had been very successful, so I was trying to keep a positive and optimistic attitude.

Vic introduced Mr. Palmieri and me. Then we sat at a round table and ordered coffee. Suddenly, before anyone said anything, Mr. Palmieri tossed an issue of Sports Illustrated on the table and asked in a loud voice: “Gideon, how did you do this?”

“What do you mean? I do not know what you are talking about” I answered.

Mr. Palmieri opened the Sports Illustrated magazine, thumbed through several pages to find the place he wanted, and began reading:

“… It took Ariel more than 10,000 hours to program his computer to analyze an athlete's motions. Now Ariel offers the sporting world a chance to lift itself from, as he puts it, out of ‘the dark ages’, a witchcraft business where everything is made of thin air. Over those years, Ariel transformed himself as well, from a carefree discus thrower to a compelling innovator.”

“So,” Palmieri said, crossing his legs, “Here I was sitting on the plane in first class on the way to meet you, and there you are on the front cover followed by a 9-page story. Quite an amazing coincidence, don’t you think?” he said with a smile on his face and twinkle in his eyes.

I was shocked and probably stuttered my response. “They interviewed me a few weeks ago,” I explained. “Then never told me whether they would write an article or describe how extensive it would
be. I was not sure if, never mind when, a publication would be printed. But now that it is out, I am more than pleased!” I said.

At that time, most subscription magazines, including Sports Illustrated, were shipped to subscribers and businesses, including airlines, before appearing on newsstands for purchase by the general public. I had no advanced warning when, or even if, Sports Illustrated would publish an article about me. Then had spent nearly a week in our Amherst office, but after that time, there had been only silence. I was especially thrilled to see that the magazine cover showed a Discus Thrower created by using a unique technique of computer coding symbols. I instantly recognized that this unique creation was my dear friend Bill Toomey as he threw the discus in his World Record Decathlon performance in Mexico in the 1968 Olympics.

Mr. Palmieri asked for more details about my life including my education and work histories. Since I did not know how much Vic had told him about our previous projects in Amherst nor the new ones that we had performed with Vic at the Tennis College, I launched into the stories with my normal gusto.

Finally, I said, “Well, Mr. Palmieri, what more can I tell you? I have a fantastic laboratory in Amherst Massachusetts with some projects running currently.”

“Could you do them here?” he asked.

“I could not perform them with what is currently here in Coto De Caza. I have a laboratory packed with computers, graphic systems, force platforms, and all of the hardware and experimental spaces necessary for technical work. None of those components or capabilities exist here in Coto.” I explained.

“What if we were to build you a laboratory according to your specifications? Can you tell me what you would need?” Mr. Palmieri replied.

This was a fun idea. I had previously only modified building such as my kitchen in Belchertown or the existing lab we had in Amherst. Now I had an opportunity to design a dream biomechanical laboratory from the beginning. I took the napkin from the table and asked for a pen. Mr. Palmieri handed me his and I started drawing the “Dream Laboratory for Human Performance.” I have no artistic talent for sketches, but I could easily imagine where testing equipment and computers should be located as well as where the experimental testing centers could be. Ideas percolated in my
imagination. It was a rough, crude sketch but I could describe in words what my picture may have lacked. I still have the original napkin with the research center sketch. The original is presented below:

Obviously, I was never an architect and the drawing made more sense with my verbal description. However, the idea was to have a two story building with a track going through the lower floor. Force platform could be placed at various locations on the track. They would be flush with the surface so as not to impede the runner and the cables would be funneled through underground conduits. The track would surround a general area in the center which could be used for Tennis research as well as any other sports. The surface would have sensors so every ball that hit the ground would send a signal to the main Data General Eclipse-MV/8000 which was the most advanced minicomputer at that time.

The track portion that ran through the first floor could also be used for projects unrelated to track. That section would essentially be an indoor lab area adjacent to the computer room. Small rooms that could function as offices or other needs would be located along the interior wall just beyond the computer room.

The computer room would need an elevated floor to enable an air-conditioned environment and would be adjacent to the indoor track lab area. In addition to the computers, special 3D monitors made by Megatek would be installed to present data in 3D in real-time.

The digitizing room would be part of the computer room. Separated by a door, the digitizer would be seated in a relatively small area. The projection room would lie on the further side of the screen and would be sufficiently long so that film sequence could be easily projected onto the digitizer screen.

The upstairs would have a gym with cardiac equipment to be able to measure oxygen consumption and other physiological parameters including electromyography (E.M.G.). A large exercise room would accommodate all of the new Ariel computerized exercise equipment in addition to any other equipment or devices we might need for future research projects.

Next to the main laboratory building, in my dream research facility, would be the second building. This smaller building would have offices for Ann and me, as well as additional staff offices. There would also be a reception room with space for a secretary or receptionist. Of course, Vic could have his office there if he wanted one.

Mr. Palmieri stopped me and said, “You know, Gideon, your dream will cost in the millions of dollars.”

“Mr. Palmieri, you asked me to tell you what would bring me here, not how much it would cost. Oh,” I added, “also, I do not want to have a boss. This dream should be a joint venture between Coto De Caza and Ariel Dynamics. I must be the boss and decision maker for my Research Center.”

Mr. Palmieri’s face reflected a flabbergasted expression. Perhaps he thought I was a lunatic. However, the Sports Illustrated article, my lengthy research credibility, the numerous television appearances, and Vic’s enthusiasm were compelling enough to overcome what might have been perceived as arrogance. Since the cost for this magnificent, imagined facility would be high, I did not imagine there was any chance that the dream could come true.

Then Mr. Palmieri asked: “If we decided to do this project, when do you think we should start?”

I paused for only a moment to think and then answered, “Today is Wednesday, how about starting on Friday?”

Mr. Palmieri looked at Vic who looked tense and nervous. Could this happen? Suddenly, Mr. Palmieri extended his hand to me. I put my hand out to his, and he said, to everyone’s amazement, “Gideon, it’s a deal.” All of us began laughing. I almost wondered if this was a dream, like my research center vision, or if it was true.

I was so happy that I suddenly upped the ante of what I would deliver. “Mr. Palmieri, if you are going to bring me here to Coto De Caza and build this awesome Research Center, I will bring the Olympics to Coto in 1984.”

“Gideon, please stop.” Mr. Palmieri responded. “You don’t need to anything more spectacular for this meeting. I am more than impressed with your charisma and your outstanding capabilities.”
“You’ll see,” I responded. I am going to bring the Olympic competition to Coto De Caza, mark my words.”

We all stood up with broad smiles on all of our faces. I was incredibly excited about the enormous potential which the future held for me, Ann, and our company. Vic, I’m sure had his dreams. As for Mr. Palmieri, I can only hope that he did believe in me and was not merely throwing the dice and hoping for the best. In retrospect, I can appreciate his doubts and skepticism, but the reality of success would be the truthful conclusion of the dream.

We left the restaurant bubbling with conversation and agreed to meet soon. Each of us had our tasks to complete to make this new Research Center a reality. As we walked toward our car, Vic told me that he was afraid that I had lost it all when I promised to make Coto an official Olympic Site. He said “You almost blew the whole idea with that ‘ridiculous statement.’” I made no comment but, in my mind, I was already planning the next step towards making that promise a reality.

Vic and I drove talking non-stop about what we were going to do in the new Research Center. I cannot say that either of us heard what the other had in mind since my recollection is that we were each having our own non-stop monologue!

After the meeting and our drive back to Coto, we stood on the Tennis College deck and stared at the empty lot that would be the future home of our research center. It was just dirt but in my imagination, it was already a 21st-century futuristic laboratory for analyzing all manners of sports and human performances. I am sure that Vic and I filled the sky with the fantasies about the California research center of the future.

Soon after our return to Coto, I called the lab in Amherst. “Ann! Get ready to move to Coto. I just shook hands on a 5-million-dollar deal!”

“No way,” she exclaimed. Did you really? Yippee!”

“I will fly back tomorrow, so call Larry Graham and see if we can meet him as soon as possible. The new center will be called ‘The Coto Research Center.’” I told her. Ann promised to get everyone organized for a meeting including arrangements for my flight back to the East Coast.

During the following weeks, we met Larry Graham, who was extremely enthusiasm for us and our future. Sweet and bitter would be the best description of the situation. Larry had been a mentor, an investor, and very much a father figure to Ann and me. He had been one of the most significant figures in our corporate growth and our understanding of the big world outside of our small, sheltered, academic experiences. It was tough to imagine the world without Larry backing us up and providing his wisdom. However, Larry insisted that this was a deal that we must make and that we pursue the opportunity of moving to California and embarking on this big venture. He promised to help us arrange the most advantageous terms and, with his help, we were successful.

Larry’s attorneys in Boston worked with those of Great Southwest Corporation (GSW) to create the Research Center dream that Mr. Palmieri and I had discussed at Delano’s restaurant. GSW sent one of their leading corporate auditors, Mr. Collin Hatch, to examine our records. Mr. Hatch sat in our front office in Amherst pouring over our financial records. It was embarrassingly funny that every time Mr. Hatch asked us a question, Ann and I never knew the answer! We were scientists! What did we know about spreadsheets and tax forms? Fortunately, Larry was both a businessman and a banker, so our records were clean and straightforward, if you knew what you were looking for, at least. Mr. Hatch gave us a clean bill, and Great Southwest proceeded with the contract. I should note that nearly 40 years have passed since Mr. Hatch audited our books and today, he has been our accountant for most of those intervening years. Also, he has become a dear and trusted friend as well as advisor. We are lucky to have him since we still do not know the answer to spreadsheets or tax forms.

We signed the contract, and I began two years of flying back and forth between California and Amherst while the Coto Research Center was under construction. The Contract is demonstrated in the QR Code in the picture below. One thing that was amazing is that I was the “Boss”, I was responsible to no one. Read the contract! Many were thinking that we were to made part of Vic’s tennis college. But no
way, I am only responsible to my self. No Boss and I own 50 percent of the Coto Research Center. It was a Joint Venture, 50/50 between my company and the Great South West corporation that was owned by Penn Central the old Train company. I had no idea the number of seemingly trivial decisions that had to be considered with a new building. We had to decide on the number of electrical outlets and where they should be located; office window sizes and shapes; color schemes, and so it went. The building, as viewed in the following pictures, began to take shape. Ann and I were thrilled about the entire project, the location, and the ability to design a sports and testing research center from the beginning.

![Construction of the Coto Research Center](http://arielnet.com/ref/go/dtdf-apx25)

Then catastrophe struck! The foundation was finished, and most of the lower levels of the two buildings had been completed when it began to rain. I had seen rain before but nothing like this. It poured non-stop for 24 hours a day for days and days. This constant rain created floods in and under the foundation. I felt as though I was reliving the biblical story of Noah’s flood and was waiting for a dove to fly in with a branch and the rainbow to appear!

After the sun finally showed again in a brilliant blue sky, the whole area dried. Unfortunately, the state building inspector declared the building foundation was unfit. We would have to tear everything out, grade the earth again, and restart the building from the foundation. It was a setback but not the end. The construction began anew, and we continued the building project.

During the days of rain, the small, twisting and turning road from the highway to Coto also flooded. It was at the location where the road crossed a normally dry creek bed. Now, with so much rain, the creek became a raging torrent and completely cut off the two sides from each other. After many days of rain, the sun finally beamed down on the still raging waters. On each side, people gathered and shouted greetings to each other with many toasts with beer and wine!

Now, Vic had quite a problem to solve. On Sunday, the participants for the next week’s instruction session needed to register at the Tennis College. Many of these participants had reserved their week of participation many months in advance. How were these people going to get across the river was the dilemma? Finally, Vic arranged for some of the large, earthmoving equipment currently being used
at the Research Center construction site to serve as transportation vehicles! Imagine the crazy scene of tennis players and all of their suitcases and tennis paraphernalia climbing on to an earthmover, being ferried across the turbulent creek, and climbing down on the other side to ride to Coto in whatever vehicles were available at the time! People were being transported in the beds of pickup trucks, golf carts, and with volunteers in their private cars. I am sure that these people had so much fun in such a genuinely unique experience that they continue to tell the story even today.

After the buildings had been completed, we moved the most important testing and scientific materials from Amherst. Some of our CBA staff were content to remain in Amherst primarily because of family members who were in school or had other jobs. Since communication from coast to coast was so simple, it made little difference for the execution of our projects. Also, it was easy enough to fly people during those times when we all needed to be in the same place.

Anything that we required in addition to those items we brought from the East Coast we purchased. Finally, the Research Center was finished, and we were ready to continue our research projects. However, we wanted to announce the Research Center to the world.

We planned a splashy Open House for the Coto Research Center scheduled for November 20, 1980! We invited professional colleagues, members of the Coto community, all of the equipment vendors, as well as personnel of the companies for which we had performed research projects. There must have 500 people walking around the buildings, admiring the facility and the beautiful, sunny environment of the valley. Our visitors stuffed themselves with the delicious tasty treats and beverages. I think that was the first and last time that Ann allowed any beverage into the computer building!!

The cost was enormous. But, we had the most well-built, well-designed buildings in an exquisite setting. Several pictures of the Research Center are pictured below:

[Images of the completed Coto Research Center]

Completed Coto Research Center
http://arielnet.com/ref/go/1221
Ann and I purchased two beautiful condominiums, one for us to live in and the other for visitors. They were located within walking distance of the Research Center. Every morning, Ann would read her book while she and our dog, Ringo, walked to the Center. I was too excited to take the time to walk, so I rode my small motor scooter.

But as they say, “You can’t judge a book by its cover.” The inside of our Research Center was awesome. We had state-of-the-art computers and graphic terminals in addition to the best high-speed cameras. There were eight force platforms on the track and in the laboratory.
Brochure Cover for Research Center
http://arielnet.com/ref/go/1222

Downstairs: array of force plates ready for data collection
On the outside court, we could collect data from multiple viewing angles simultaneously. We had several projects for Vic Braden that we began the day after the open house.

Our staff was small, with four people in California, and two in Amherst. But, like diamonds which are small in size but sparkle brilliantly, these few scientific workers were efficient, intelligent, and worked diligently to complete each project. They are pictured below:

California staff members: Dany Saar, Vic, Author, Ann, and Alan Blitzblau
Fortunately, we had previously secured some projects while we were still in Amherst. This allowed us to continue working on profit generating research in our new Coto Research Center. One of our clients, Wilson Sporting Goods, provided us with interesting and detailed project proposals. We were working on two major projects with them when we moved the laboratory to Coto de Caza so we were extremely busy even before we had our fancy open house for the Research Center.

One project was the Computerized Exercise Machine which we had begun developing several years earlier. It had been renamed “Wilson-Ariel 4000” and we were modifying the external shape as well as improving and expanding the software. We arranged the upstairs portion of the larger, research building into an exercise training facility. We offered free exercise training sessions for the local community members explaining to them that they would be divided into three different study types: (1) high intensity/fewer repetitions, (2) low intensity/more repetitions, and (3) “fatigue” mode. All of the community participants were excited to be in this research program as well as being able to exercise on our unique, futuristic exercise equipment. Interestingly, after nearly thirty years, we still meet people who participated in our exercise study. The amazing thing is that they are as enthusiastic now as they were at during the study.

There came a time in our relationship with Wilson which took the CES to another, different level. This development was covered in a previous chapter. However, in the early days of the Coto Research Center, the Wilson sponsored CES development and testing continued with great excitement.

We had other research projects that Wilson wished to pursue such as examining the effects of different colors for softballs, comparison of nylon to gut strings for tennis rackets, as well as other topics. Each project was usually large and detailed in scope and generated research dollars for us. Of course, these research project monies, excluding the Exercise Machine, contributed to the joint venture of the Research Center.

One of our more complex Wilson projects was on the flight of the golf ball. We were surprised to learn that in the 14th to the 17th centuries, hard wooden round balls were the first golf balls used. They were made from hardwoods such as beech and box trees and typically made by carpenters with tools of the day. Also during this time, the "feathery" ball was developed and introduced. A “feathery” was a hand-sewn round leather pouch stuffed with chicken or goose feathers and coated with paint, usually white in color.
New technology shows that linemen, not players, are usually right

by KEVIN MCEAN

The scene is set in the midlands of Tennessee. John McFarland, an Arena
Center, Inc., the National Basketball Association's innovative
system, is deployed at a high school basketball game. Although most
people expect the game to be hard-fought, they suspect that the players
are not right. After all, these are high school teams, where
substitutions are common and the coaching staffs are not
infamous. The implications for tennis and
many other sports are profound.

Those surprising conclusions are held by
the No-Fault Tennis, Inc., a new nonprofit
organization dedicated to improving tennis
rules. The organization's mission is to
educate players and officials about the
effects of various rule changes. The
organization plans to hold seminars and
workshops for coaches, players, and
officials, and to publish a newsletter and
magazine. The organization's website is
http://arielnet.com/ref/go/1223

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Obviously, there were a few drawbacks to the “feathery”. First, it was hard to make a perfectly round, spherical ball, and because of this, the “feathery” often flew irregularly. Also, when the “feathery” became too wet, its distance would be reduced as well as the possibility of splitting open upon impact when hit or hitting the ground or other hard surfaces. Despite these drawbacks, the “feathery” was considered by contemporaries to be a dramatic improvement over the wooden ball and remained the standard golf ball well into the 19th century.

In 1848, the Rev. Dr. Robert Adams Paterson invented the “gutta-percha” ball or “guttie” The “guttie” was made from dried sap of the Malaysian sapodilla tree. The sap had a rubber-like feel and could be made round by heating and shaping it in a round mold. Because “gutties” were cheaper to produce, could be reformed if they became out-of-round or damaged, and their improved aerodynamic qualities, they soon became the preferred ball for use.

Accidentally, it was discovered that nicks in the “guttie” caused by normal use provided a ball with a more consistent ball flight than when a “guttie” had a perfectly smooth surface. Thus, “guttie” makers began intentionally creating indentations in the surface of new balls using either a knife or hammer and chisel. This gave the “guttie” a textured surface. Many patterns were tried and used. These new gutties, with protruding nubs left by carving patterned paths across the ball's surface, became known as "brambles" due to their resemblance to bramble fruit, which Americans would refer to as “blackberries”.

The next breakthrough in golf ball development came in 1898. Coburn Haskell of Cleveland, Ohio had driven to nearby Akron, Ohio for a golf date with Bertram Work, the superintendent of the B.F. Goodrich. While he waited in the plant for Work, Haskell picked up some rubber thread and wound it into a ball. When he bounced the ball, it rebounded nearly to the ceiling. Work suggested Haskell put a cover on the creation, and that was the birth of the 20th-century wound golf ball that would soon replace the “guttie” bramble ball. The new design became known as the rubber Haskell golf ball.

For decades, the wound rubber ball consisted of a liquid-filled or solid round core that was wound with a layer of rubber thread into a larger round inner core and then covered with a thin outer shell made of balata. Balata is actually a name of a tree that grows in Central and South America and the Caribbean. The tree is tapped and the soft, viscous fluid is a rubber-like material similar to gutta-percha was found to make an ideal cover for a golf ball.

In the early 1900s, golf balls underwent another alteration. Concave dimples that were concave rather than the raised protrusions, which had inspired the “bramble” idea, provided even more control of the ball's trajectory, flight, and spin.

Dimples first became a feature of golf balls when English engineer and manufacturer William Taylor registered a patent for a dimple design in 1905. Other types of patterned covers were in use at about the same time, including a "mesh" and another named the "bramble", but the dimple became the dominant design due to "the superiority of the dimpled cover in flight".

A smooth golf ball hit by a professional golfer would travel only about half as far as a golf ball with dimples does. Most modern day golf balls have between 300 and 500 dimples, with an average depth of about 0.010 inches. The lift and drag forces on a golf ball are very sensitive to dimple depth such that a depth change of 0.001 inches can produce a radical change in the ball's trajectory and the overall distance it can fly. Dimples have traditionally been spherical in shape, but it is possible to optimize the aerodynamic performance of other shapes. The HX golf ball by Callaway, for example, uses hexagon shaped dimples.

The question was and is how does air affect the flight of the golf ball and how do dimples interact or cause flight variations. The simplest explanation is that air exerts a force on any object moving through it. Holding your arm out of the window of a moving car easily illustrates this phenomenon. Aerodynamicists break down this force of the air on your arm into two components: (1) lift and (2) drag. "Drag" acts to directly oppose the motion and "lift" acts in a direction perpendicular to motion (it is
usually directed upward in the case of a golf ball). As you rotate your hand in the air stream, you vary the amount and direction of the lift and drag forces acting on your hand.

In addition to the “drag” and “lift” forces, a moving object has a high-pressure area on its front side. Air flows smoothly over the contours of the front side and eventually separates from the object toward the back side. A moving object also leaves behind a turbulent wake region where the air flow is fluctuating or agitated, resulting in lower pressure behind it. The size of the wake affects the amount of drag on the object.

Dimples on a golf ball create a thin turbulent boundary layer of air that clings to the ball’s surface. This allows the smoothly flowing air to follow the ball’s surface a little farther around the back side of the ball, thereby decreasing the size of the wake. A dimpled ball, thus, has about half the drag of a smooth ball.

Dimples also affect lift. A smooth ball with backspin creates lift by warping the airflow such that the ball acts like an airplane’s wing. The spinning action makes the air pressure on the bottom of the ball higher than the air pressure on the top; this imbalance creates an upward force on the ball. Ball spin contributes about one-half of a golf ball’s lift. The other half is provided by the dimples, which allow for optimization of the lift force.

The pattern of dimples has an effect on the flight of the ball as well as the number of them. By regulation, the arrangement of the dimples on the ball must be as symmetrical as possible. However, the dimples do not all have to be the same size or be in a uniform distribution. Most golf balls on sale today have about 250–450 dimples, although there have been balls with more than 1000 dimples. The record holder was a ball with 1,070 dimples—414 larger ones (in four different sizes) and 656 pinhead-sized ones.

This freedom allows designers to arrange the dimple patterns in such a way that the resistance to spinning is lower along certain axes of rotation and higher among others. These differences cause the ball to "settle" into one of these low-resistance axes, that golfers prefer, which is close to parallel with the ground and perpendicular to the direction of travel. This flight pattern reduces or eliminates "sidespin" induced by a slight mishit causing the ball to curve off its intended flight path. A badly mishit ball will still curve as the ball will settle into a spin axis that is not parallel with the ground which, much like an aircraft's wings, resulting in the ball banking to left or right.

We evaluated all of the information available included some of the interesting historical data. We discussed with Wilson what their ultimate objective was. Then we discussed among ourselves the most efficient and effective research design that would provide the information that was sought.

We were ready to study the effect of golf ball parameters on the initial speed, spin, and launch angle due to the ball/club impact. Typically, the golf ball remains in contact with the club for about 0.5 milliseconds when it is hit with a golf club known as a driver. During that impact time, the club face moves approximately one inch. Our research focus was to examine the response characteristics of the ball during this impact. We needed to see a few frames after contact to determine the speed, spin, and launch angle in addition to the actual impact response. Also, we needed to determine the flight pattern after impact as well as measuring the distance that the ball traveled.

We proposed to examine a minimum of five different balls that were to be hit with a minimum of two different clubs. In addition, we would examine four different variations of the same ball using only the driver to observe the effects, if any, on the flight of the ball.

To standardize the strikes on each ball from each of the different clubs, we needed a method to consistently repeat each swing of the club. The ball would have to be struck with the same amount of force and with identical club face angle if we were to identify differences in the responses of the various golf balls.

Wilson provided a machine used within the industry for this purpose. The Iron Byron is an electro-mechanical machine used by the United States Golf Association to test golf clubs and golf balls
for conformity to standards. The Iron Byron is a robot named after the great Byron Nelson, whose swing was so consistent and perfect that legend has it that only a mechanical man could replicate it.

The Iron Byron can be adjusted to repeat the same swing ten thousand times which is useful for comparing the relative properties of clubs and balls. If a new model of the golf ball is submitted by a manufacturer for approval by the U.S.G.A, it is hit a few hundred times by the machine and the average distance the ball travels forms the basis of whether it conforms to acceptable limits of carry and roll for a given swing velocity.

In actuality, the Iron Byron is not an anthropoid, meaning that it is not shaped like a human being. It cannot walk or talk. If fact, it has more in common with one of those automated welding machines found on an automobile assembly line than it does with anything in a science fiction movie. It is a floor-mounted pedestal, 4 or 5 feet tall, which has a mounted swiveling machined-metal arm, articulated with elbow and wrist hinges to mimic the dimensions and motion of a human swing. An adjustable sleeve at the end of this hinged arm is used to fasten the club being used during tests.

A sketch of Wilson Sports' robotic club tester appears below.

A sketch of Wilson Sports' robotic club tester appears below. These illustrate the Iron Byron, some of the cameras and computers, as well as the outdoor setting.
http://arielnet.com/ref/go/1224
screen, first to a code-lettered box then to Nicklaus’ right knee joint, which the dot pushed backward. That done, the dot skirted back to the code-lettered box then to the joint of Nicklaus’ left knee, showing it forward. With both knees bowed, Jack Nicklaus looked like an old cowhand.

The dot disappeared. Ariel reset the knees to conventional address position, and the stick figure was again put through a full golf swing. At impact this time, the knees flared in and out in the manner of a dancer doing the Charleston.

It was a funny sight. Even Nicklaus would have laughed. But Gideon Ariel was not passing the time playing a video game. You won’t find his equipment in any local arcade. It is a highly sophisticated and expensive combination of units: a Super Sports Analyzer Projector that projects slow-motion film of golfers, javelin throwers, sprinters, baseball pitchers, etc., in action onto a large screen, a Graf-Pen Digitizer that traces those movements, a Data General Nova 3/D computer that banks the information gathered on those movements and plays it out instantly on demand. And a smaller screen on which this orchestration is given a new life.

Ariel uses his equipment to obtain and measure data on each body movement—velocity, rate of acceleration and deceleration, location of center of gravity, joint forces and moments of force. He then can interpret the significance, or contribution, of each body segment to the entire motion.

He also can formulate theoretical body movements to see whether any of them might be more effective than the real thing. If there were a universal, a perfect golf swing, Ariel could create it on his equipment. But, says Ariel, no such thing exists because everyone is built differently. Which takes care of golf’s Holy Grail. Ariel concedes, however, that the individual can make his own perfect swing. Which gets us back to the quest.

Jack Nicklaus doing the Charleston at impact won’t produce a better golf shot. The example is an exaggeration to show Ariel’s equipment capability. But he has created less bizarre simulations that have brought actual changes in athletic techniques, and consequently improved performance. Using simulation and/or analysis of “straight” material, Ariel helped U.S. Olympic shot-putter Terry Albritton set a new world record.

So Gideon Ariel is not fooling around. He is deeply and professionally involved in the biomechanical analysis of athletic movement, an area of study within the general field of sports medicine that is beginning to have significant impact on athletics. From this field are coming new, improved and sometimes safer techniques and equipment. For example, Ariel has a patent pending on an inflatable athletic shoe designed to improve the foundation from which almost all athletics build. Air is injected through the heel to form the inner sole precisely to the shape of the individual foot. One does indeed walk on air, packaged air.

A number of other persons are currently working in the field of biomechanics in sport, but Gideon Ariel, a 39-year-old Israeli, who has been living in the United States for the past 14 years, is perhaps the best known. This may be due in part to Ariel’s enthusiasm, which in turn may be a personal compensation. A poor athlete as a youth who wanted to excel in sports, at 17 Ariel was drawn to the discus throw. Labored at it with exceeding fervor and became good enough to make the 1960 and 1964 Israeli Olympic teams. His best Olympic toss was 171 feet, far back in the pack (“I was too nervous,” he says now, “and I must say that science cannot do anything about that—yet”).

After earning his masters’ degree from the School of Exercise Science at the University of Massachusetts, he took courses in computer programming, eventually going into the motion business full-time and on his own by forming Computerized Biomechanical Analysis, Inc., in Amherst. Despite his science/math background Ariel has a gift for metaphor, for phrases that simplify his scientific findings and convey them colorfully. His English recalls Israeli Prime Minister Menachem Begin in serious moments, a Jewish-dialect comedian in lighter ones. In Ariel-ese, feet are “fit,” cats are “kets” and, “De formation of de hends, de golf grip, is important. But not so much as pipple tink. If you hev a perfect grip and de abder parts are not right, it’s like hevving a diamond studded ignitiun key for a rotten 1945 car.”

If the old Scottish pros could get through with their brogue, why not an Israeli scientist?

As head of the U.S. Olympic Committee’s biomechanical and computer science division, Ariel has been helping athletes prepare for the 1980 Moscow Games. He has shown that a smaller hockey player can hit a slap shot faster than a bigger man can with a sweep shot, because the small man hits down on the ice behind the puck and bends the stick so it becomes loaded with energy. “A woman basket-

Above: With his Graf-Pen Digitizer, Ariel traces and analyzes GOLF’s sequence photos of Nicklaus’ swing. Left: the “print-out” of Jack in action.
After several days of data collection and many weeks of processing the information, we presented an extensive, detailed report to Wilson. We had identified a number of factors that affected the flight pattern and the distance that each type of golf ball. This information was based on our detailed study without bias since Wilson personnel retained the code associated with each of the different balls. All of the Wilson scientists and product development specialists were very happy with the information we provided. Needless to say, we were pleased that they had received our dedicated efforts with such positive responses.

After the long and detailed study on these Wilson golf balls, we switched our attention to other projects. Some of the initial projects were for Vic at his Tennis College.

Although it resided in an adjacent facility, the Vic Braden College was a separate business entity entirely independent from the Coto Research Center. We shared some common walkways and Vic had his office in our Research Center, so it was easy for all of our interactions.

Vic was unique in his effervescent personality and attracted many exciting people to his Tennis College. We collected data on famous professional tennis players, including the late Arthur Ashe, who had won three Grand Slam titles, and Jimmy Connors, a U.S. Open winner as well as ten Grand Slam titles. Our job was to collect data and analyze the advantages and disadvantages in these athletes’ strokes.
We had an interesting project with the great and entertaining Jimmy Connors. James Scott “Jimmy” Connors was a World Number 1 tennis player from the United States. Connors won eight Grand Slam singles titles, and two Grand Slam doubles titles with Ilie Năstase. He was also a runner-up seven times in Grand Slam singles, a doubles runner-up with Năstase at the 1973 French Open, and a mixed doubles runner-up with Chris Evert at the 1974 U.S. Open. He held the top ranking for a then-record 160 consecutive weeks from July 29, 1974, to August 22, 1977, and an additional eight times during his career for a total of 268 weeks. Jimmy was considered a maverick by many in 1972 when he refused to join the newly formed Association of Tennis Professionals (ATP), the union that was embraced by most male professional players. But he made his first big splash by winning the 1973 U.S. Pro Singles, his first significant title, toppling Arthur Ashe in a five-set final.

In 1974, Connors became the second male in the open era to win three or more Grand Slam singles titles in a calendar year (Rod Laver being the first in 1969 and having been joined since by Mats Wilander, Roger Federer, Rafael Nadal, and Novak Djokovic). Connors is also the only person to win U.S. Open singles championships on grass, clay, and hard courts.

Jimmy Connors won a record 109 ATP tournaments, 15 more than Ivan Lendl and 32 more than Roger Federer and John McEnroe. His career win-loss record of 1243–277 (81.77%) is second after Björn Borg (82.7%) with Ivan Lendl (81.76%) third and he holds the record for total number of wins for a male player.

Jimmy Connors won three year-end championship titles, including two WCT Finals and one Masters Grand Prix. He also won 17 Championship Series titles (1973–1984). He was the first male player to rank Number 1 for more than 200 weeks in total and the first male player to be Number 1 for more than five years in total. He is the only male player in the open era to win more than 100 singles
titles during his career and also holds the record for most major quarterfinals (41) reached. Since most of
the lost standing athletic records eventually fall, Jimmy’s many records will probably be surpassed. But,
it goes without saying that he was an exciting player to watch.

Although Connors never won the French Open, his victory at the 1976 U.S. Open came during
the brief period (1975–77) when that tournament was held on clay courts. Connors, therefore, is one of
only five men (Mats Wilander, Andre Agassi, Roger Federer and Rafael Nadal are the others) to have
won a Grand Slam singles title on grass courts, hard courts, and clay courts.

In today’s era of sophisticated, technology-based racket construction and string variations, Jimmy
may have been forgotten. His era of wooden rackets and off-the-shelf snickers for foot wear may place
him among the dinosaurs of tennis. But his accomplishments are facts and he should be remembered as
one of the greatest tennis players of all time due to his many records in the game.

It was brought to our attention that Jimmy had a problem with blisters and pain on his feet. To
know how to fix something, you must understand the problem. We began by trying to determine the causes
of Jimmy’s foot problems and, with that information, we hoped to be able to develop shoes to assist in
alleviating these difficulties. Connors suffered from a profusion of blisters and foot pain. One factor was
his unusual foot structure. There seemed little doubt
that these foot difficulties were aggravated by the excessive stresses encountered during the game
activities.

We began by photographing him during a
tournament and at a special filming session in Palm
Springs, California. High-speed motion pictures
were taken simultaneously from four different
cameras. We even employed a camera suspended
from a cherry picker to obtain an overhead angle of
the various tennis strokes. I suspect that the residents
were confused or amused by all of the cameras in
addition to a man hanging high above the court.

We filmed various tennis strokes hit by
Jimmy including his serve, forehand, and backhand
volley. We also had him run at his maximum speed
to different court locations to simulate trying to reach
a ball. We filmed him changing directions quickly and “sprinting” to reach a distant ball as one would
have to scramble to reach a strategically placed drop shot. Special close-up views were collected to
facilitate examination of the shoes during these various motions.

We returned to our new laboratory in Coto, digitized the reams of the film we had collected. Our
motion analysis programs were used to measure both the stresses on the foot and the forces of the foot on
the ground. Our intention was to determine what and how Jimmy ran and stopped. If we could identify
particular stresses and forces that he produced, we were optimistic that we could design a shoe that would
be better for his foot and play style.

The films revealed that many of Connors' motions were extremely abnormal and unconventional.
For example, (1) he moved backward without changing his body-net orientation. (2) He frequently
changed direction and dragged the trailing foot on the toe. Jimmy was (3) constantly in motion, and he
rotated on the medial balls of the feet. (4) His foot was unstable within the shoes, and he appeared to slip and slide into the shoe. (5) He often landed on the medial edge of the heel, and his heel tended to drift within the shoe. Other movement factors were observed which contributed to his instability within his footwear.

Based on our observations and calculations, we designed new tennis shoes for Connors that factored in his particular idiosyncratic movements. The shoe included a specially designed toe box reinforcement engineered from plastic to shield the toes. It also featured a cushioned sponge insert to minimize transmission of shock to the toes. The surface of the sole was designed to minimize rotational friction. We built in a double lace system to minimize foot movement inside the shoe. We elevated the heel slightly to reduce Achilles tendon stresses and improve stability in the "hard to get shots" that demand extended or stretching stances.

Now that we had improved his footwear that we hoped would reduce the problems that had plagued him, our task was to analyze Jimmy’s serve. His maximum ball velocity was recorded at 72 miles per hour which are well below the average ball velocities among professional male tennis players at that time. Our biomechanical analysis revealed that Connors could increase the ball velocity to more than 100 miles per hour with some modifications in his swing technique.

To increase the velocity of the ball of his serve, we recommended that he maintain a more solid base of support with the ground until contact was made with the ball. He could do this by allowing the ball-racquet impact to occur a few centimeters lower than the point where he was striking the ball before our analysis. In other words, his ball toss should be lower so that at the impact he could hit the ball without having to jump in the air to reach it. As we have emphasized many times, you have less force when you jump into the air since you can only “push” against air. That is to say again; you cannot shoot a cannon out of a canon without sinking the boat! Following our recommendations, Connors was able to overcome his weaknesses and his serve velocity improved to 90 miles per hour.

We also performed a biomechanical analysis of his backhand swing. Connors style was what we referred to as a “tracking motion”. “Tracking” meant that the forearm and hand segments function as guides rather than for ballistic, whipping actions.

We completed all of our analysis and gave them to Jimmy and his staff. He was quite an exciting player and person, so it was a wonderfully enjoyable project for us to execute. We were surprised when we received a letter of appreciation from his mother who was also involved with the tennis management company. A copy of the letter is included in our website.
Jimmy Connor’s Form
http://arielnet.com/ref/go/dtdf-apx18

http://arielnet.com/ref/go/1300
LEAP AHEAD WITH BIOMECHANICS

The body is a machine like any other. Analyze its performance on a computer and startling things happen.

At the age of 43, former US Gold medallist Al Oerter decided to make a comeback. He had quit in 1968 after the Mexico Olympics, but 12 years later he threw the discus about 18 m further than his gold medal distance of 64.6 m. What is his secret? Biomechanical analysis. Oerter is one of many athletes whose techniques have been dramatically improved by this computer-aided science designed to optimize performance.

The mastermind behind Oerter’s newfound success is Dr Gideon Ariel, director of research at Computerized Biomechanical Analysis Inc., at Amherst, Massachusetts, a professor at the University of Massachusetts and Chairman and Co-founder of the Coto Research Centre. Ariel, himself a former Israeli Olympic discus-thrower, is a passionate exponent of biomechanics and already the hero of hundreds of athletes.

Biomechanics is the study of the structure and function of the body which replaces the medical with the mechanical model. Working on the principle that the same laws of physics apply to any system in motion, regardless of whether it is a living organism of a machine, Dr Ariel has devised a method of assessing an athlete’s performance using computer graphics. The necessary program took 10,000 hours to write—but enable an analysis time that can be accommodated within the training periods of all types of athlete.

What happens is as follows: a camera shoots an athlete’s motion from two or three different angles, simultaneously, at speeds of up to 10,000 frames a second. The high-speed images are then projected onto a screen over an array of 20,000 sensitive microphones. The analyst uses a sonic pen microphone to trace the athlete’s position in each photo frame. (The film is frozen at any point.) A composite trail of the centre of the performer’s joint is translated into X and Y coordinates. The coordinates of each joint and each stage of the entire sequence are keyed into the computer’s memory. The joint centres are then linked together with trace lines to make a green stick-like image on the video display unit.

Once the joint centres have been digitized the analyst makes calculations involving anatomical data. The measured forces and moments of force require knowledge of the mass of each segment.

http://arielnet.com/ref/go/1225
We analyzed hundreds of famous tennis players in our Laboratory at the Coto Research Center. We were provided films of players from competitions in locations or tournaments that we were unable to travel ourselves to collect the data. However, we could perform the biomechanical analysis of those films and create “stick figures” or “dress” the sticks with skeletal coverings. Representations of this technique are shown for two international players during that time:

![Computer Representations of Two Tennis Players](image)

We were quite involved with several projects to analyze sporting equipment. As part of our on-going contractual relationship with Wilson Sporting Goods, after concluding the project on golf balls and clubs, they assigned us a research project for tennis rackets. Fortunately, with Vic Braden involved with us, and with our background in Tennis equipment for Spalding and other manufacturers, we became an expert in the world of Tennis.

Our knowledge was presented in an article for Wilson Sporting Goods. The article was called, “Current Research and knowledge in the Tennis Game.” In it, we pointed out that:

“Tennis is not a ball, a racket, and a player that can be considered separately. It is a series of interactions between the ball and the racket, the ball and the surface, and the racket and the player. Because of this, there are many misconceptions about the game and the contribution of each component.”

When a player is moving about on the court, he/she must absorb nearly five times the body weight in the knee and ankle joints. Thus, a player weighing 150 pounds subjects his/her knees and ankles to forces up to 750 pounds. Tennis shoes and courts, then, must be designed to have the correct energy absorption, compressive stiffness and recovery rate needed to protect the players.

In general, there are traumatic results from the repetitive shocks caused by the running and jumping motions associated with tennis. To reduce exposure to these shocks, practice devices should provide the opportunity to improve tennis skills while simultaneously lessening the stresses related to the game.

One well-recognized term in tennis is the "sweet spot" on the racket. The term refers to the center of percussion of the racket and can be calculated mathematically quite readily. It is usually found to be on the string somewhere between the center of the strings and the throat of the racket. This is a result of assuming the pivot point to be at the handle. Analysis of high-speed film, however, has shown that the handle-wrist-hand relationship is a fairly rigid one and that the pivot point is the shoulder. Using the whole arm as the system then results in a center of percussion slightly above the wrist.”

We conducted a series of tests to examine the amount of muscular involvement of arm segments during various tennis strokes. Our objective was to illustrate to Wilson the relationship of these muscles and limb segments in tennis and how they could use this knowledge to their advantage. For example, they might be able to modify the racket or change the materials in the grip. Regardless of whether they
changed the equipment or not, they would be able to make their advertising claims based on objectively, scientifically measured results.

The following photos show some of our data collection apparatus on the muscular responses to the impact of the tennis ball on the racket. We used Electro-Myography (E.M.G.) to evaluate the effective muscular action on the racket. In the photographs, the E.M.G. electrodes are seen as small dots on the forearms and white or red tags on the racket. We also collected biomechanical data to compare racket swings with and without the E.M.G.

EMG Data Collection

A LABORATORY FOR JOCKS

http://arielnet.com/ref/go/1226
One of the project we developed was to be able to program a throwing machines to simulate the actual the tennis ball velocity, angle and spin of a particular tennis player. For example, by collecting hundreds of shots from Jimmy Connor we could determine for each shot the speed of the ball, the angle of the ball and the spin on the ball. Then, we were able to program a special throwing machine to simulate these shots. All that was done automatically by our computers.

Each lane in the above photo had a throwing machine which was programmable to simulate a particular shot. Imagine that you play against you neighbored in the community and he is “killing” you on the back hand. What if you hire one of our pros to video you playing with him and every back hand shot is saved in a computer memory after digitizing it from the video. Then, you assigned one lane on the programmable throwing machine and every shot from the machine is one of your Neighbor backhand. You practice against your neighbor while he is not there and he does not know about it. The next weekend you are “killing” him on his backhand shot. This was one of our early project. In addition, we developed a Reaction Time Machine, that indicate your reaction time to particular condition on the court. The whole training in the Vic Braden Tennis College became computerized running by intelligent machines.

We were able to supply Wilson with a great deal of information about muscular activity with tennis strokes. We also tested, at their request, differences
between using gut and nylon strings in the racket. As usual, they were pleased with our tests and thanked us for our work.

Now that we were settled in California and had ongoing projects, I invited my old friend and colleague, Dr. Irving Dardik, to our new Center. He was as excited as I was and even proposed that Coto might be attractive to the U.S.O.C as a training facility. As the Head of the Committee, Dr. Dardik decided that the first meeting of the new quadrennial Olympic Sports Medicine Committee should be at the Coto Research Center.

The Sports Medicine Committee consisted of different disciplines which directly impacted Olympic athletes and their performances. Included in these areas were physiology of exercise, psychology, biomechanics and medical applications specifically focusing on sport-related injuries. I was appointed for an additional four years to serve as the Chairman of Biomechanics. An additional decision was to designate the Coto Research Center as an Olympic Training Site. This was a perfect arrangement since it was good for both athletes and Coto de Caza. The real estate specialists might not have understood biomechanics or sports medicine, but they did recognize the value of the U.S.O.C and its marketability for their interest.

We concluded this inaugural meeting with specific directives for each member. We agreed to reconvene within three months to report our progress. We had, unfortunately, missed the 1980 Olympics in Russia for political reasons beyond our control. To make us for this loss, we agreed to focus
enthusiastically and intensely on the 1984 Games to be held in Los Angeles. There were four years of preparation available and all of us departed the meeting with renewed determination to prepare for success.

In addition to all of the projects we were working on for Wilson, the Sports Medicine Committee, and Vic Braden’s tennis players, I had another task to perform. I decided it was time to fulfill my promise to Vic Palmieri for Coto de Caza to be selected as a venue site for the 1984 Los Angeles Olympic Games.

The first step was to decide which sport would be the most appropriate for our location. Initially, Ann and I considered swimming. Unfortunately, we only had one pool and it was not the length required for Olympic events. It seemed unlikely that we would be able to convince the Coto developers to build more pools. Scratch that option. Next we examined the shooting events. At that time, there was a “hunt lodge” at the end of our beautiful valley which was used for skeet shooting. We would have to construct other target areas, spectator seating, and address safety issues. Again, it did not seem that a shooting event was a viable option.

Suddenly, while perusing the list of Olympic events, I realized that Modern Pentathlon would be a perfect match. Modern Pentathlon consisted of five events: fencing, 200-meter freestyle swimming, show jumping, pistol shooting and a 3200-meter cross-country run. The sport has been a core sport of the Olympic Games since 1912 but has undergone several modifications to its format over the years.

The origins of the modern pentathlon have been disputed. On the one hand Baron Pierre de Coubertin, the founder of the modern Olympic Games, claimed that he created the sport. On the other hand, Viktor Balck, the President of the Organizing Committee for the 1912 Games demonstrated that he made use of the long tradition of Swedish military multi-sports events, to create a modern pentathlon. The name derives from the two Greek words “penta- "five" and “athlon" contest”. The addition of “modern” to the name distinguished it from the original pentathlon of the ancient Olympic Games, which consisted of the “stadion” foot race (which was an ancient running event), wrestling, long jump, javelin, and discus. As the events of the ancient pentathlon were modeled after the skills of the ideal soldier of that time, the Modern Pentathlon has created the contest to simulate the experience of a 19th-century cavalry soldier behind enemy lines. That soldier had to ride an unfamiliar horse, fight with pistol and sword, swim, and run.

In the 1912 Games, with only officers competing, they were, however, permitted to use their own horses. As long as there was no official international federation for Modern Pentathlon, an IOC committee was set up for the sport making use of the expertise of IOC members. The event was first held at the 1912 Olympic Games, and was won by Swedish athlete Gösta Lilliehöök.

The modern pentathlon has been on the Olympic program continuously since 1912. Except for the fencing competition, athletes do not directly compete against one another in the five events. Athletes gain points for their performance in each event and scores are combined to give the overall total. This is similar to the procedure for the decathlon in track and field athletics.
For the 1984 Olympic Games, each event was held and completed on a single day beginning with the equestrian event. The second day, all competitors completed the fencing portion. These were followed by a day of swimming and, lastly, a day of shooting. The finally day, all athletes competed against each other in the cross country run. The winner would be the individual who completed the run with the fastest time. The start had to be staggered due to a large number of participants and they were positioned according to their performance results.

Coto de Caza had everything necessary for this event. Since the United States had never won a gold medal in the modern pentathlon, maybe we could have the venue as well as produce an Olympic champion. The modern pentathlon has been considered by some as possibly the most mentally and physically demanding of all Olympic sports because it requires proficiency in five very different athletic skills: fencing, riding, swimming, shooting and running. Now I had to find a way to bring the Sport to Coto de Caza.

The first step was to identify the people in Modern Pentathlon and convince them that our location was a perfect choice for their sport. I had to travel to Colorado Springs, CO, for a regularly scheduled meeting of the Sports Medicine Committee. Fortuitously, there was a meeting of the heads of the different sporting events as well as a number of international governing bodies from around the world scheduled to meet at that time. One of the international groups was from Sweden and, conveniently for my interests, the head of the Modern Pentathlon was Swedish and in attendance.

I was able to speak with a few members of the Swedish committee and explained what Coto de Caza had to offer to participants of Modern Pentathlon. They were quite interested since I was able to describe a location where the five event locations were in close proximity. Normally, the individual event locations were as much as 50 miles apart. Having all of the events at one location was a luxury they had never enjoyed. We agreed to find a mutually agreeable date for them to come visit me in California.

Now, I would have to make the correct connection within the LA Olympic
Game venue selection committee. Luckily for me, there were other groups of Olympic officials in Colorado Springs at the same time as my meetings. One these group meetings was for the members of the 1984 LA Olympic Games which were exactly the group of people that I needed to find. With another stroke of luck, I was introduced to Mr. Richard (“Dick”) Sargent who had been tasked to select the venues for the events for the upcoming 1984 Games. Once again, I explained the uniqueness of Coto de Caza for the Modern Pentathlon and the enthusiasm that everyone involved shared to have the Games come to our home. Mr. Sargent explained that he would be pleased to visit and see if our location was as perfect as I had proclaimed. Then we would have to verify that all five events could, in fact, be conducted according to the rules of that Sport. Since I was so confident that all five events could be performed at Coto de Caza, he agreed to come for a visit.

The day of the meeting, I was quite nervous. The butterflies in my stomach reminded me of the times before I had to throw the discus. When Mr. Sargent arrived with the Modern Pentathlon committee, I instantly felt myself enter a “competition mode”. I smiled and greeted everyone and introduced them to Mr. Richard (“Dick”) Boltinghouse who was the head of the real estate in Coto de Caza. His job was a big as mine since he would have to agree to any of the changes at each venue that were required.

The meeting proceeded smoothly. Initially, we drove them to each of the five event sites. At each location, there were discussions about what, if any, changes needed to be made. For example, the indoor horse riding ring was an open-sided, covered area. Coto would need to have a temporary floor installed for the fencing portion. For the equestrian event, we discussed the arrangement for each of the jumps as well as the spectator space. The day continued in this fashion and, in the end, we were informed that Coto de Caza most certainly would be selected as the Olympic site.

Shortly after this meeting, Coto de Caza was officially designated the site for the 1984 LA Olympic Games Modern Pentathlon.

Everyone involved was ecstatic about this development and eventually, the entire population of Coto residents was integrated into the event. Residents opened their homes to team members and coaches, the officials conducting the events, and event family members of participants. The 1984 Games were a real “love fest” reminiscent of the 1960s.

I was especially pleased since I had promised Mr. Palmieri that I would bring the Olympic Games to Coto. I had fulfilled my promise and also made Coto de Caza even bigger on the map. In addition to successfully creating Coto as an official 1984 Olympic Games venue, I also brought another Olympic sport to Coto. The team was the Women’s Olympic Volleyball team.

In 1977, before I had even been to Coto de Caza, I went to the Colorado Springs Training Center for a biomechanics meeting in the lab. During that time, I had the opportunity to meet Dr. Arie Salinger, a fellow Israeli, who was the head coach for the U.S. Women’s Volleyball team. At that time, neither women’s volleyball nor being their coach was a position of particular status. In 1977, the U.S. Women team was ranked 45th in the World.

Ariel was an impressive looking man of medium height with chiseled features and striking
blue eyes. He carried with him the vaguely reflective, slightly pained expression of a person who is walking around with far too many things on his mind. The more I learned about Arie, the more impressed I was with his history, his accomplishments, his focus, and obsession for volleyball.

At that time, the Colorado Springs Training Center was still under development. The team members were housed in a military barrack with four girls in each room. The dining room supplied regular meals, but they were not programmed for athletic performance nor, from the reports the girls gave me, were they particularly appetizing. Another disadvantage was the altitude of 7000 feet. Colorado Springs was an excellent location for training long distance running due to the altitude but was not conducive for volleyball training.

In spite of these difficulties, Arie was demonstrating remarkable improvement in the skills and gamesmanship of the team. They continued to play better, but, they were still not a medal contender by any means.

Arie and I spent hours during my visit discussing his background and the history of American women volleyball. He explained that the United States had never brought a national team together so early and had never before had a national team been offered the training advantages customarily granted its competitors throughout the world. Challengers in Japan, Korea, Cuba, Russia, and Hungary had lived and practiced together for decades. However, until now, the United States had been satisfied with doing no more than throwing strangers together at the last moment and then telling them to play.

The results of waiting until the last moment, throwing a group of individuals together, and hoping that raw talent would prevail had been disastrous. In 1964, the first time their game was an Olympic sport, the U.S. had finished fifth in a field of six; four years later, they finished eighth in a field of eight; in 1972 and 1976 they failed even to qualify for the Games. Their status was so low that other countries refused to send their finest squads to America compete.

But things have changed. "We have," says Arie Selinger," improved from nothing." Although Arie was not bragging about himself, the reality of this remarkable improvement was due to one crucial element that was a dedicated coach with his specialized, focused training regimen.

We talked for a long time, in Hebrew, as Israeli compatriots do. I learned about Arie’s personal history. Arie was born in 1937 in the Jewish ghetto of Krakow, Poland. During World War II, he and his family successfully evaded the Nazis for two years but eventually were caught and shipped to the concentration camp called Bergen-Belsen. In 1945, he and his mother were stuffed into a boxcar, headed toward an execution site. The train had been diverted to a side track at the bottom of a hill to allow
another train to pass when a squad of American soldiers crested the hill. The American soldiers forced the Nazi guards to surrender, and the prisoners were freed from their stifling boxcar prisons.

Arie and his mother were sent to a specialized hospital for recovering prisoners of war. Arie, being younger and healthier, was able to travel with his uncle to Palestine, as Israel was known at that time. He told me a funny story about his early days in Israel where he lived on a Kibbutz with his uncle and other family members. Every night, Arie would sneak to the farthest back section of the Kibbutz. The entire Kibbutz was surrounded by a fence to keep all of their animals in and prevent predators from coming in and creating havoc. Arie would cut a hole in the fence and run away. His uncle and the other members would spend hours every morning searching the area around the Kibbutz and, every time, they were able to find Arie with enormous relief when he was located. Finally, his uncle took Arie to the front gate and showed him how to open it. Arie was told that the gate was never locked, and he could leave any time that he wanted. They begged him, however, to please stop cutting the holes in the fences because their animals would escape which took precious man hours to recover as well as the time needed to repair the fence. The concept of freedom of movement was a revelation to a very young man, who had spent all of the life he could remember hiding in fear. It took a little time for him to adjust to the new and exciting life in Israel. Also, he had to learn that he lived in a country that was founded on the premise that Jews were home, save, and treasured. After the years that he and his family had endured Nazi prosecution, this required another mental adjustment.

After his mother had recovered her health, she was able to join Arie in Israel. She too adjusted to the newfound freedoms, as had her son, and lived a long life. Arie credits her with saving both of them and for creating an environment for him, that mimicked as normal a childhood as she could and sheltered him, as much as possible, from many of the real horrors of the Camp.

The rest of Arie’s background was similar to most Israeli children. After he had finished high school, he served in the military. Following his military service, he competed as a sprinter, long jumper, and volleyball player on Israel's national teams. Later he coached men's club teams and the national women's team before moving to the U.S. in 1969. He moved to Urbana-Champaign, Illinois and enrolled at the University of Illinois. He earned a Ph.D. in the physiology of exercise. In 1975, he was named coach of the women's team in the U.S.. When I met Arie, he was living with his wife and one of their daughters in a military barracks across the path from the one that housed his players.

Arie explained to me how the sport of volleyball functions around the World. "Take the top teams in the world," he said. "Korea, China, Cuba, Russia, Japan, and Peru all follow the same training regimen. They practice six hours every day for six or seven days a week. If we want to get to the top, we must compete against and beat those teams.

"How," he asked rhetorically? "One of our advantages is that we have an edge in talent. This is due to the large population of American athletes from which to select. Since the U.S. is a country crazy about basketball, it is easy to find tall girls. However, height alone will not defeat these teams. We have to train in the same fashion and for the same number of hours as all of our competitors. Japanese teams are notorious for the intensity of their training schedule. They train for eight hours a day, and they rarely get a day off. For the U.S. to successfully compete against Japan or any other world class volleyball team, we will have to train for at least seven hours a day. We either have to train as much as they do, or we will fail among the top teams.

"Many people tell me that we don't have to be like other countries. That's true. But if the United States Volleyball team is expected to compete successfully for the internationally level and win medals at the Olympics, they must be prepared. I also get the argument that we're trying to develop sports monkeys or that the team members should be going to school. I don't understand that line of thinking. Nearly everyone understands the necessity of practicing the violin eight hours a day. But the same person
fails to see the logic of athletes practicing eight hours a day. So, the team and I must continually focus on training and try to improve our skills.”

This conversation stayed with me as I played it around in my mind. I had personally seen how the East Germans trained their athletes, and that had led to the establishment of the Colorado Springs Olympic training site. Despite a fantastic and dedicated coach and an excellent team of hardworking athletes, I was worried about their chance for success. At that altitude and under those living conditions, I could not believe that the woman’s team would persevere. I tried to think of a good solution, but it continued to elude me.

However, miracles sometimes do happen. The Coto Research Center was the miracle. When Ann and I signed the contract in 1978, I realized that this would be a perfect solution for Coto and the Volleyball Team. The real estate personnel could make much about an Olympic team living and training in Coto de Caza.

Arie and the volleyball team would have a dedicated gym for playing and training, they could live close to their “job” in private, normal apartments, and they could use the Wilson-Ariel computerized exercise machine for fitness. Besides, I could work closely with Arie on analyzing various skills with the motion analysis system. We could analyze his team members as well as players from other countries. We could see what and how his competitors were executing their techniques to improve his team and learn how to defeat their opponents. It seemed to be a perfect solution for everyone.

Although the team was doing well and improving in every aspect of their game, I reiterated my thoughts to Arie. “You won’t earn a medal in the Olympics from a training location at Colorado Springs.”

“I know,” Arie replied. “But it is all that I have available to us.

“Arie, what if I show you a place where you CAN prepare the girls for the Gold Medal? Come with me and I will show you an alternative for your consideration.”

We flew to Coto de Caza and, as I had expected, he could not believe what he saw. We walked the court that would be his for training. I showed him my computerized exercise machines and the motion analysis system in operation. I presented studies that we had done before on volleyball. Arie’s eyes lit up. “It could happen here,” he said, musing to himself. “The promised land for athletes.”

I smiled and knew in my heart that the deal was done. There would have to be a few details worked out, but that would be resolved in short order.

“But now,” Arie said, “for the 64-million-dollar question, Gideon. How and who will finance my bringing the girls here? Obviously, the U.S. Olympic Committee will not allow me to move here with 14 players and then have to allocate funds to support them.”

I told him that if he wanted to live and train here, I would make the necessary arrangements at Coto de Caza. Arie’s job, I told him, was to write a wish list for training for his team in a letter. I asked him to direct the letter to Dr. Dardik, the Chairman of the Sports Medicine Committee. Then, I assured him; I would find the money.

Arie’s requirements were logical for a total team approach. He needed housing for the team members and the coaching staff; funds for food, equipment, and travel expenses for international tournament competitions. He wanted to be able to
use our motion analysis program for his players and also to determine what other volleyball teams were doing. This was a “weapon” that no other team had and would give the Americans a slight edge in knowing how to play against them.

I took Arie’s list to Dr. Dardik and reviewed the details. We decided on a united front to meet with Colonel Miller and explain how the team could be successful in Coto de Caza as well as why they would fail if they remained in Colorado Springs. We also had some ideas regarding funding that would support this move. Fortunately, Colonel Miller was impressed with the improved training opportunities and was quite willing to approve the arrangement.

Needless to say, my head was abuzz with ideas for funding. Coincidentally, we were working with the Mizuno Corporation to analyze protection pads and shoes for various sports. We had completed a section of the project, and I needed to present the results to them in Japan.
Arie also had to meet Mr. Mizuno in Japan because of his involvement with the Women’s National Volleyball team of Japan. Japan, after all, has been a perennial power in women's volleyball since the early 1960s. The Japanese approach to building championship volleyball teams reflected no less devotion to detail than did their approach to manufacturing automobiles, cameras, and computers. They were focused on the tiniest detail and were willing to work hard for perfection.

and players earn huge amounts of money with company sponsors. The Japanese team was a formidable foe for us. For not only had the Japanese charted the strengths and weaknesses of every young woman currently playing on the U.S. National Team, but they had also scouted the top collegiate talent and even evaluated a handful of talented juniors. To the Japanese, any young woman who had any chance of representing the U.S. in the 1980 Olympic Games were of interest to the Japanese. “One thing about the Japanese,” Arie used to say, less in anger than in bemusement and admiration, "When they're committed to something, they don't fool around."

But I reminded Arie of another facet of the Japanese. “They also like to make money. What if you suggest to Mr. Mizuno the possibility that the American Women’s Volleyball team would wear Mizuno shoes and clothes for all international tournaments and, if they qualify, during the Olympics?”

“Can’t hurt,” he replied. “I’ll discuss the potential when I meet with Mr. Mizuno in Japan.” During his trip to Japan, Arie was able to meet Mr. Mizuno and discussed the possibility of funding of the U.S. Women’s Olympic volleyball team. Mr. Mizuno was quite willing to support the team and, in addition, would provide all of the shoes and clothing which would carry the manufacturer’s logo on them.
To my mind, it was quite an unusual arrangement that a foreign company was more willing to help the Women’s team that the home country. In professional sports, such as football, basketball, and softball, teams owever, with amateur players, including Olympic sports, there were fewer corporate sponsorship and little financial assistance from the Olympic bodies. Things may change in the future, but, in 1979, we were only able to accomplish the purpose of securing funds to support the team by successfully appealing to a foreign company and, luckily, with an excellent and profitable result.

The basic idea was that Mizuno would finance the move of the Women U.S. Volleyball team from Colorado Springs to Coto De Caza. Also, Mizuno would finance the team for two Olympiads that would cover 1980 in Moscow through the 1984 Olympic Games in Los Angeles. In return, the players would wear Mizuno clothing and shoes. Where possible, they would integrate the Mizuno logo on their Olympic uniforms in subtle innovations that did not violate the Olympic rules.

Mr. Mizuno, Arie and I met in Japan and signed the contract. The week after the signing, Arie rented a bus and moved the whole team to Coto de Caza. This move provoked a tsunami-like shock wave, and I received quite a lot of criticism from some people in Colorado Springs who were unhappy that the team was leaving. Fortunately, I had a solid defense. “Do you want a Gold Medal in Women Volleyball or not? If you want to produce a medal winning team, this is the only way to do it.” Eventually, tempers cooled, and I retained my position as Biomechanical Director of the U.S. Olympic Training site. More importantly, the volleyball women were set to train in Coto for the next eight years.

(Scan QR Code on the left for more information: Volleyball Magazine)

The team averaged five months a year traveling throughout Europe, Asia, South America, and within the United States on barnstorming tours in which it was not unusual for them to play as many as 28 matches in 28 consecutive days. When they were not traveling, they trained eight hours a day, six days a week (okay, they only trained for half a day on Saturday) and they did so with relentless intensity.

Since the women were "amateurs," they received no salaries. They were provided room, board, and a modest sum for expenses each month to cover such luxuries as personal clothing, suntan lotion, and long-distance phone calls to families and boyfriends. (A note to younger readers; this was the time before cell phones or smart phones. Long distance calls cost real, serious money for each minute. YouTube videos and text messaging were far into the future. Additionally, no one dreamed of taking pictures of food to send to their friends.)

No one on the team, in other words, was playing for the money. I suppose it was no surprise that most Americans were unaware that there was a national Olympic women's volleyball team, so the players were certainly not on the team for personal glory. Each player was on the team for one basic reason: to win an Olympic gold medal for the United States in women's volleyball. If they could achieve this goal, they would be the first to accomplish the feat.

The team continued this intense training with their eyes on winning Gold in Moscow. The shock and dismay that followed the presidential announcement that the United States would boycott the Moscow games were a severe blow to all of the players and staff. Needless to say, Arie and all of the U.S. Women's national team were bitterly opposed to the boycott. They were convinced that they would
have achieved their goal in Moscow. A victory would have been more than amazing since it had not been very long ago that the United States women’s volleyball teams would have been unable to qualify for the Olympics. Believing that they would actually win a gold medal was hubris of the highest level. But they did believe in themselves and, after this setback, they were even more determined to win a Gold medal at home in 1984.

The intense concentration on the face of Rita Crockett (left photo)  
[http://arielnet.com/ref/go/1230](http://arielnet.com/ref/go/1230)

All of the team trained on my computerized exercise equipment every day they were in Coto for four years. The average increase in vertical jump was 6 inches although, for some of the girls, they improved their jumps by 8 inches. Each team member was self-sufficient with operating the equipment and storing their individual data to evaluate their performance as well as giving Arie a chance to build the team profiles.

[http://arielnet.com/ref/go/1230](http://arielnet.com/ref/go/1230)

Training On the Computerized Exercise Equipment
The girls not only operated the computerized exercise equipment, they learned how to perform biomechanical analysis on themselves. They were able to digitize their motion and execute the software resulting in performance evaluation for different specific skills, such as setting, digging the ball, or blocking techniques.
Then we would have conferences to discuss the results with Arie and determine what strategy to employ based on the skills of his players and the techniques of each opponent.

I traveled with Arie and my Biomechanical research team traveled around the world and collected data on every team. My staff and I would sit in strategically located seats around the arenas and film the games. We filmed teams in Russia, Cuba, Peru, Brazil, Japan, China and other countries.
that participated in the Volleyball World Championships. Then, we digitized the motion data and performed two types of analysis: biomechanical analysis of individual players and team movements under various playing situations.

For the team strategies on the court, we divided the court into 36 squares with each square given its own number. The following figures show two examples:

![Diagrams of Volleyball Team Strategies](image)

Our software calculated what the opposing team would do under different conditions. In a game of volleyball, the players cannot wait for the ball to be spiked or hit before they react. They have to predict where the ball will come from since the time duration from being hit by the opponent until it reaches its target on their side of the net is only 0.2 second or so. We studied and calculated how each team moved and how they arranged themselves during actual game play. We analyzed hundreds of games and were able to build strategies to use against each team. Not only did we know whether a player was going to
spike the ball or whether she was bluffing, but we also determined their team movements on the court as the following figures show:

![Examples of Team Movements During Single Volleyball Points](image)

Imagine playing poker against someone and having a mirror behind him to see his cards. That was our unique ability. We amassed a collection of game performances for four years before the 1980 Games. Then our library of teams and players continued to grow during the next four years in anticipation
of the 1984 Olympics. In this way, we could watch for any changes in personnel or techniques and plan our training and game execution precisely.

Also, we periodically created a “simulation” game on the training court in Coto de Caza. We hung a large, white bed sheet from the ceiling and projected video or films from actual games. Our players had to play against the silhouettes projected on the sheets. Arie would frequently adjust the speed of the projector so that the opponents played faster than they were able to do in reality. Then, at future competitions, when our girls then played against those teams, they would comment how slow the opponents were that day.

This was how the U.S. Olympic Women’s Volleyball team rose to be ranked among the top of world teams. They had been rated 45th in the world in 1977. After four years of hard work, they were ready for the Moscow Games in 1980. When the U.S. boycotted those games, that setback inspired the team to redouble their efforts and bring Gold home in the 1984 Los Angeles Games. By the 1984 Games, the team was in the top echelon of the volleyball group of competitors and was ready to prove to themselves and the rest of the world how good they were.

The rise to greatness resulted from the intensity, hard work, years of dedication every day and every month, and with computerized assistance. They were able to improve their volleyball skills, their muscles were strengthened with a computerized machine tailored to each player’s unique needs, and computerized libraries.
of calculated opponent strategies enhanced Arie’s ability to coach his players against every other team. This enabled the U.S. to win the bronze medal in the 1982 World Championship in Peru.

In the 1984 Olympic completion, the best team in the world was the Chinese. They had defeated Peru in the 1982 World Championships and had dominated all of their opponents in the intervening years. The venue in 1984 was Long Beach, California and the U.S. was in the same pool as the Chinese.

There were two pools, A and B. Pool A consisted of teams representing Japan, Peru, South Korea, and Canada. The other group, Pool B, included the United States, China, West Germany, and Brazil. Because of the boycott of the western countries against the Russians in 1980, the Soviet block of countries and their allies boycotted the 1984 Games. Thus, many of the other strong volleyball countries, such as Russian and Cuba, did not compete in the LA Games.

The U.S. had some limitations unlike the Chinese. For example, all of the Chinese players, except for their setter, were the same height. This was a big advantage since their setter could place the ball at the same height for everyone. Our setter had to adjust the ball location specifically for each player. Not only did she have to have great skill to make this adjustment for each of the spikers, but it also signaled the opponents about who would be hitting the ball. We were able to overcome this and other physical differences with our computerized team strategy.

Olympic volleyball teams play preliminary rounds in group or pool play. The top two winners of the group advance into the next rounds which are the elimination competitions. China was in the same group as the United States. Therefore, we had an early match against the Chinese. This early match in pool play ended with the U.S. women winning with a score of three games to one. The U.S. girls played fantastically and were encouraged that they might even beat the mighty Chinese if they made it to the finals. Although they had to be cautious in their optimism about continuing to play well, it was hard to contain their bubbling excitement.

Both China and the U.S. continued to defeat their respective opponents until they both reached the final Gold medal game. The winner would receive the Gold medal and the loser would receive the Silver medal. Unfortunately, China had understood our secret team strategy. Therefore, in the final game, the Chinese coach rearranged his players within the court and used different game strategies for passing and spiking. They played differently than what the U.S. had expected and defeated the U.S. by a score of 3-1. The U.S. received the Silver medal, which is an amazing feat. They may not have won the actual Gold medal, but they had truly soared to greatness.

(Scan QR Code for more information: “Can Computers Win Gold Medals?”)

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U.S.A. National Women’s Volleyball Team

http://arielnet.com/ref/go/dtdf-apx20
Can computers win gold medals?

Computer technology allows us to analyse athletic performance in more detail than ever before. We can learn why some athletes win and how others might...

Gidean Ariel uses an electronic pen to trace a film frame of a shot putter; a computer simultaneously displays the image.

Dr Gideon Ariel is director of research at Compuanlerized Biomechanical Analysis Inc., Amherst, Massachusetts.

All top athletes are highly trained, but why are some so obviously better than others? In the past, performance depended largely on raw talent, and was improved by training, new subtleties of technique, and better equipment. But now the computer is giving a new edge to training, technique and selection of athletes; it can help us to refine an athlete's performance precisely to what he does; and also to find out why some people are innately better equipped for particular events than others.

To throw, run or jump, the human body must obey the same physical laws as all other earthly objects; the laws of motion govern its performance. It is impossible to throw the shot 70 feet (21.3 metres) if the thrower cannot achieve the right shot velocity and angle of release. These values do not vary from athlete to athlete; for each particular shot velocity there is one optimum angle. If a person wants to leap 20 feet (6 meters)—as only one man in history, Bob Beamon, has ever done—he must produce forces on the ground that will propel his body with a specific force of reaction at a particular angle. This force is unique: it is impossible to ever the same distance with less force, as gravitational forces act uniformly, wherever you jump.

Biomechanical research relies primarily on data from high-speed ciné films and measurements of body motion and forces. The data comprise kinematic data, including a description of the motion in terms of the displacement, velocity and acceleration of parts of the body; and kinetic data consisting of the measurement of forces, moments of force and analysis of the body's centre of gravity. Computer technology helps us to combine the results of high-speed photography with the anatomical data so that we can find the best use of the human body, and reduce long tedious hours of tracing and hand calculations to a matter of minutes.

In the technique we have developed at Computerized Biomechanical Analysis Incorporated, we photograph the athlete in action and project the developed film on a "director screen." We then touch the image's joints with a stylus which transmits the X-Y co-ordinates of each point touched to a computer memory. As each frame of the film is digitised the computer writes the points on a graphic display and connects them by lines to form "stick figures." In this way an athlete's complete movement can be reconstructed as a series of stick figures on the screen, and we can follow the movement of different parts of the body (see box). Reproducing these procedures for several camera views produces a 3-dimensional analysis of the action; at least two cameras are needed to give two lines of sight to define the position of any point in space.

To calculate the forces, and moment of force, we need to know the mass of each body segment, or limb, as well as its centre of gravity; a publication by the Aerospace Medical Research Laboratory supplies the necessary values. A program we have developed computes the length, angular displacements, velocities and accelerations for each body segment. Using the graphics display we then observe the effects of adjusting the values of these variables until they best reproduce the curve followed by a particular point of the body during the movement filmed. That is, the displacement of each body segment from frame to frame is adjusted independently to obtain the best smooth "fit" to the raw data; this is necessary to overcome human errors inherent in the digitising process.

http://arielnet.com/ref/go/1231
The following photos are some of the gatherings at the Coto Research Center.
Sidik—World Record Holder in the Hammer Throw and his Wife, World Recorder holder in the Shot-Put

Russ Hodge

Olympians at the Coto Research Center
The Olympians at our Coto Research Center
In addition to our work with the volleyball team, tennis players, and our Wilson Sporting goods projects, we also had magazine articles and television coverage. We were dubbed as “A Laboratory for Jocks” because of the many innovation techniques that we employed to study athletes and their performances. As the picture below illustrates, we used EMG and a specially designed visual apparatus to analyze these tennis player’s net volley techniques.

http://arielnet.com/ref/go/1233
Building the Athlete of the Future

Researchers are deepening the biomechanics of motion and the chemistry of strength.

By Patricia Loverock
Adapted from the Los Angeles Times Magazine

A research subject by the name of Orel Hershiser appears on a movie screen in a hospital laboratory. Hershiser is pitching the ball for the sake of science, rather than Dodger blue. He wears only a baseball glove, short pants, shoes, and an array of electrodes and wires. As he throws, the upper body that looks slightly skinny on the mound is remarkably muscular and fluid. He zooms and zooms across the screen in slow motion—frame by frame—hands, wrists, arms, trunk, hips, and legs flowing together in perfect synchronization as he winds up and lets the baseball go.

Sixteen-millimeter cameras are filming front, side, and overhead views of the pitch at 500 frames per second. On an 8-foot-high console, 2,000-foot reels of quarter-inch magnetic tape record microprocessed signals from every twitch of Hershiser's muscles. An oscilloscope's electrical wave traces his muscular activity, and a printer simultaneously spews out a copy of the image appearing on the scope.

Hershiser's cooperation with the scientists at Centinela Hospital Medical Center is helping to define the path of athletic excellence to come. On film and on an electrical energy graph, Hershiser is part of a study of human movement that may one day uncover to understand how muscles function, and malfunctions. The information they're gaining could allow them to diagnose and treat injuries without surgery and ultimately help prevent sports injuries. It's just one of the experiments being conducted in biochemistry, biomechanics, psychology, and genetics that may change the way American athletes are trained, treated, and expected to perform in the next century.

Surprisingly, in this country "the whole idea that science has something to do with the performance of athletes is new," says Harmon Brown, chairman of sports medicine and science for the Athletic Congress, the governing body for track and field in the United States. Americans, he says, have been slow to accept the idea of sports as a legitimate focus for research. The Soviets pioneered the field before the 1962 Olympics; they traveled around the world to film outstanding athletes and study their training programs. Then in 1952, instead of just copying, they began designing their own research.

In 1980, the prominent performance of East Bloc athletes in the 1976 Summer Olympic Games spurred the U.S. Olympic Committee to fund scientific research.

The science of biomechanics is based on observation. Watch the body perform a movement, analyze that motion, and use the findings to adjust the next performance. Increasingly, scientists and coaches are using advanced technology to observe activity that is not readily visible to the eye, breaking a single motion into finer and finer parts and, theoretically, perfecting it. In coming decades, experts say, they'll be watching athletes move from the inside out.

Movement of the joints is a clue to the workings of the muscles, showing which muscles are working the hardest and pinpointing possible weaknesses. Seilinger and Ariel used the computer data to adjust the team's training programs and Ariel says, make models of what might have been a 16th-place team.

Each computer model is being used to answer specific questions—for example, how high does an athlete's hips move above the hurdles during a race? That information might tell a coach that the hurdler needed to lower his lead leg to clear the hurdle more efficiently.

http://arielnet.com/ref/go/1234
Another article appeared in *Science Digest* in 1989 described, “Building the Athlete of the Future.” Again, discussing the techniques available to athletes to improve their performance levels in their chosen sport was the theme.

One of the magazines was *Golf Magazine* and it described the *perfect swing* as being unique for each individual. There is not a single, *cookie-cutter* perfect swing that fits everyone. People are not identical in size and weight and there is no reason to assume that there exists a *perfect swing* to fit all golfers. Individuals must identify their own swing of *perfection*. 
Using advanced computer technology, Gideon Ariel has proved what we've known all along: The perfect swing is different for each of us.

by AL BARKOW

Gideon Ariel was on the phone telling someone that he could make Ken Norton the greatest fighter in the world, or at least able to beat Larry Holmes the next time they fought. "Norton is stronger, but has slower reflexes by 20 milliseconds. So he should stand closer to Holmes to mitigate his speed, take it away from him. Simple."

A few minutes later Ariel sat down at his computer keyboard. With the touch of Peter Nero doing an arpeggio, he tapped out a "tune," which appeared on a pitch-black screen to his left, an aqua stick figure of a golfer going through a full swing. Amazingly, the erector set in motion looked familiar; there was the big turn of the shoulders, the right one dipping rather steeply, and especially a pronounced forward thrust of bent knees at impact that resembled Jack Nicklaus. Indeed, that is who it was.

Now Gideon Ariel began to doodle, improving his image of the "greatest golfer in the world." By manipulating a control stick, Ariel sent a tiny dot racing around the...
The Magic Putter was designed to carefully calibrate the putter's center of gravity so that when the golfer used it, the club functioned like an extension of his or her arms. The whole system (the entire arm from the shoulder down to and including the putter) moves like a single, unsegmented pendulum.

The game of golf relies on two distinctive skills for delivering the golf ball to its target. One is the swing from the tee which requires force velocity and power as well as a level of accuracy. The other skill, which requires a higher degree of accuracy and precision, is putting on the green into a small hole. A high level of precision requires efficient neuromuscular control. The movement of the club depends on an efficient biomechanical technique allowing the neuro-muscular system to execute the movement at a high level of accuracy. Optimum performance depends on the efficiency of control. It does not matter how strong the muscles are or how good the golfer’s metabolism may be; control is the most important factor. The brain must execute complex computing functions to generate and control extremely sophisticated behavior.

The fineness of control depends upon the number of motor nerve units per muscle fiber. The more neurons involved, the finer the ability to maneuver, as in the case of the muscles that control the eye. When there are fewer motor nerve units involved, the action becomes less refined as, for example, walking. The individual fibers that cause a muscle to contract function with elaborate synchronization. Synchronization of muscle firing is critical for optimizing a particular movement such as putting. In the power events, such as in the drive off of the tee, it is critical that the muscle action is simultaneously activated to optimize the force. This is done by the central nervous system sending signals to the individual muscle fibers. However, in the putting movement, control is of great importance.

What, then, are the elementary requirements of movement? The first is muscle; the second, a signaling system that makes the muscles contract in an orderly manner. Our movements are generated in different ways depending on the level of skill we needed. When putting, golfers recruit their muscles at a different time in the movement depending on the level of skill that they have achieved. The motor program is constantly changing in order to produce efficient movement. Different instructions to the muscles must come from the nervous system. Since there are numerous combinations of muscles which produce a similar putting action, the internal programming movement model will vary as situations change. Thus, the neuro-muscular program sent by the brain will activate a selective set of muscles as the situation dictates.

For some sporting activities, the participant can repeatedly practice the action enough times that the skill becomes nearly automatic. For example, the shot, hammer, or the discus throws are the same nearly every time. Therefore, these athletes can train their neural patterns to be constantly recruited in the same pattern. This is not the case with golf. Every shot requires adjustment to the ball location, soil conditions, the wind, and distance to the hole, among other things. Somewhere within the nervous system, a model of movement is formulated which is structured for the muscular and coordination demands of a golf swing. But the optimal motor control of the skilled movements, such as with putting, is generated by a higher motor program involving our central nervous system and conscious adaptation to conditions.

Based on our studies, we decided to test the hypothesis of whether minimizing the number of body segments involved in the putting movement would enhance the accuracy of the putt. We helped to
design a special putter whereby the golfer would hold the club in a way where the swing was a pendulum action of one arm from the shoulder. To properly use the putter, the golfer needs to stand in the proper position facing the hole. The putter is held with one arm while the other arm supports the club in a stable position. The movement of the putter is like a pendulum initially going backward and then swinging forwards. The golfer uses only the arm while trying to eliminate or, at least, stabilize movements of the trunk and hips.

Another significant advantage with this club movement is that the golfer faces the hole directly. That is, the golfer looks directly at the target rather than standing and looking sideways in the more traditional putting stance. This allows the golfer to putt using normal binocular vision facing the target. The sideways style of putting requires a constant turning of the head from facing down towards the ball and twisting back to see the hole. Not only is this an abnormal biological disadvantage, but it also requires constant movement of the head. The Magic Putter eliminated this visual disadvantage.

This invention, the Magic Putter, has been used by many golfers. Like any new tool, it necessitates practice to feel comfortable using it. But the positive response from those golfers who adapted to the unusual stance, had only praised, as well as good results.

After the project with the “Magic Putter,” we were not idle for even a moment. Our life was fun but hectic during that time. Not only did we have projects with Wilson Sporting Goods, efforts to bring the Women’s Volleyball team and the Modern Pentathlon to Coto, on-going testing and improving the Computerized Exercise Machine, but I also was approached to be on several television shows.

One of the first was by David Letterman, the comedian, which surprised me initially. Mr. Letterman told me that he loved the game of paddle ball and wanted to know if I could analyze his game. He wanted to know how Hillary Hilton, one of the game’s champions, was able to beat him every time. He explained to me that he was much faster and stronger than she was, but Hillary was able to win using smaller movements and with weaker shots. How could this happen?

I said, “We will take our biomechanical equipment to the paddle ball court and film you are playing with Hillary. Then we will analyze the shots and the positions on the court. With these quantitative findings, we should be able to answer your questions.

Ann and I traveled to New York City with our cameras and other necessary equipment. We set the cameras and collected data for two days as Dave and Hillary played many games. As David had predicted, Hillary was able to defeat him in every game.

We were able to collect all of the film data necessaries so that we could process it according to our normal analytic procedures. Following this filming session in New York City, we returned to our laboratory and began the long process of analyzing the data. Ann had to digitize for many hours because there were two camera views for every shot. We selected several backhands and forehands shots by each player which required many hours to complete the process. After the digitized film data was available, we processed it with our normal biomechanical quantification procedures. These steps generated the kinematic parameters of positions, velocities, and acceleration for the different limb segments. Several of the three-dimensional “stick figures” generated from the raw data are shown on the next page:
The results revealed that, although David was faster and stronger in his ability to hit the ball, Hillary was faster in anticipating where the ball would go as soon as David hit it. On the other hand, David waited for the ball to hit the wall before making his move. What this meant for David was there was a time delay in his reaction to the ball. He waited until the ball hit the wall before he moved into a position where he could hit it. Hilary’s technique involved greater prediction regarding where the ball would hit the wall and where she should intercept it for the return volley. She moved into position before the ball hit the wall and had ample time to deliver a return volley. This anticipation was presumably based on her experience although it could be a natural talent upon which she was able to capitalize. Hillary was able to interpret her opponent’s body movements and began to react early enough to be in the correct position when the ball hit the wall. Because she was able to anticipate where the ball was going to hit the wall, Hillary was ready at the proper location in time to make her shot. David always had to wait for the ball to hit the wall or the ground and this defensive strategy was too slow to beat Hillary.

After we had completed our research, we contacted David Letterman’s staff to let them know that we were ready with the results. Shortly after that, I was scheduled to appear on “The David Letterman show” with Hillary and Dave.
I was able to explain that our evaluation demonstrated how a player who is physically smaller and weaker can overpower an opponent who possesses superior levels of force and speed. Implementation of the correct strategy allows a player to overcome weaker physical characteristics by utilizing skillful techniques. In this way, Hillary demonstrated anticipation of ball movement that allowed her to make more efficient return shots. David was more powerful in speed and strength but hindered by having to wait to make shot decisions. Some of the films of the data collection were shown with the two players engaged in the game. We illustrated with the different biomechanical results how Hillary was more efficient in her game strategy and how Dave was more powerful with his strokes. The recommendations were that David could focus on his strategy and significantly improve his game. However, this would require hours of practice. Hillary, as a professional, could continue utilizing her athletic talent and would always find new and more effective ways to improve her game. Any changes that Hillary would need to make would probably be small and subtle.

After the work with David Letterman and Hillary Hilton, we had the privilege of providing thousands of analysis for athletes at our Coto Research Center. We were involved with many Olympic activities in this rich sporting environment. Then, we were approached by WGBH, a PBS television station in Boston, to do a series on different athletes and their sports. The show was called Future Sport and consisted of thirteen episodes. Vic Braden and I were the hosts and interviewed the athletes and described the biomechanical analysis of their individual sports. A list of some of the athletes who appeared in these episodes were:

Frank Shorter, 1972 Olympic Gold Medalist in the Marathon  
Kate Schmidt, 1972 and 1976 Olympic Bronze Medalist in the javelin  
Rolf Benirschke, San Diego Charger football placekicker (1978-1986)  
Al Oerter, 1956, 1960, 1964, and 1968 Olympic Gold Medalist in the discus throw  
Hal Connolly, 1956 Olympic Gold Medalist in the hammer throw  
Edwin Moses, 1976 and 1984 Olympic Gold Medalist in the 400-meter hurdles  
Scott Tinley, triathlete and 1982 and 1985 Ironman Gold Medalist  
Bob Seagren, 1968 Olympic Gold Medalist in the pole vault  
Franco Columbu, 1976 and 1981 Mr. Olympia  
Sharon Shapiro, 1970s eight-time National title holder on U.S. National gymnastics team  
Ken Norton, 1977 and 1978 world heavyweight boxing champion
Some of the athletes executing their sports are pictured below:

Fencing, Sprinting, Archery, and Rolf Benirschke, San Diego Charger Kicker
Making this “Future Sport” series was one of the most exciting and fun things that I did in my career. I was able to interact face to face with many of my childhood idols, some of the greatest athletes of the era, and individuals who possessed unbelievable athletic talent. It was a truly enjoyable and stimulating time. It has been many years since we filmed this program during which I have traveled around the world presenting at conferences and visiting universities. Not infrequently, I can be walking down a hallway and hear the “Future Sport” theme music. Every time I heard this unique musical introduction, when I looked into the classroom or auditorium, on the screen would be one of the episodes of “Future Sport.” I am always honored and humbled by its universality.
My next television appearance began in Seoul, Korea in 1988. I was in Seoul to present research findings at the International Olympic Scientific Congress meeting. I was accompanied by a close and dear friend, Mr. George Dales. Also, Mr. Dales and I were organizing to film as many of the track and field competitions as we could arrange at the Seoul Olympics.

During this time in Seoul, I was euphoric to meet a familiar face from our days in Amherst, Mr. Tom Brokaw of NBC. Mr. Brokaw and I chatted for a time, and he described a topic of a new NBC Special that he was hosting called “Black Athletes: Fact and Fiction.” We discussed this issue as well as the enormous sensitivity that the topic provoked in America. Tom wanted the program to be factual, objective, and as scientifically based as possible. He was determined to present facts rather than myths or biased opinions and was convinced that this would be an interesting and valuable program.
Tom and I met several times to discuss how I could conduct objective, scientific tests to compare athletes within the population that NBC would provide. One of our planning sessions was in my hotel room where I was able to update Tom with examples of our biomechanical technique and some suggestions of what test parameters would most appropriately answer his questions. Tom was familiar with the biomechanical analysis since we had analyzed him and Bill Rodgers in 1976 and was presented on the “Today” show that he hosted. Here in Seoul, some twelve years later, I was able to demonstrate our newer, more modern, sophisticated programs. I was also able to demonstrate a three-dimensional “stick figure” that we could rotate on the screen and combine motion analysis

I explained to Tom that the entire discussion, or lack thereof, in America regarding Black and White athletes was incomprehensible to me. Since I was born and raised in Israel, this issue of race was nonexistent in my country or culture. Israel had been a land of immigrants long before I was born in 1939. There were Jews from every continent in the world living in Israel. The country was a blend of languages, skin tones, and Jewish heritages that every immigrant brought with them. This mixture of Jews from around the world was especially prevalent in Hadassim where I spent so many years. My roommates, for example, were from Argentina, Rumania, and Iraq. Another classmate was the fastest runner in Hadassim named Miriam Sidranski. She had been brought by her father from the Belgium Congo after the death of her mother so that she could grow and learn in a Jewish-Israeli environment.

Miriam was an Olympic sprinter with me at the 1964 Olympic Games in Tokyo. In the 1964 Tokyo Olympics, Sidranski competed in two track and field events for Israel. In the 100-meter sprint, she finished sixth in her preliminary heat with a time of 12.1 but did not advance because only the top five finishers from each heat ran in the next round. Unfortunately, Miriam missed advancing by 0.1 seconds. She then ran in the 200-meter sprint, finishing in 24.68 seconds but did not advance past the preliminaries. Officially, she finished in 21st place.

Outside her Olympic experiences, Miriam was one of Israel's best female sprinters in the 1960s. In the Tokyo Games, Sidranski had broken the Israeli record (24.68) in the 200-meter event. As of June 2001, it was still the eighth best individual result in Israeli history. Miriam was also very successful in the 100-meter, breaking the national record with a time of 11.7 seconds (hand-timed) in September 1964. Miriam and I have been friends for more than 50 years, and the issue of skin color or country of origin has never been an issue. I believe that this is the prevailing attitude among Israelis in general. I
had no experience with racial prejudice until I arrived in the United States. This bias and controversy have baffled me since I arrived in America in 1963 and there seems to be no resolution to the situation.

Tom planned to interview scientists in different areas, including sociology, physiology, and psychology regarding this issue. My strength was biomechanics and, as I explained to Tom, how the athlete moves depend on physics. The mechanics of the movement may be affected by psychology or physiology or sociology, but the movement itself depends on the athlete’s physics. Any athlete with good psychology and bad physics results in a happy loser. An athlete with bad psychology and good physics can still win. Human physics is quantified using biomechanics.

All movement is produced by contraction of muscle fibers. Muscle can function in only one direction, that is, they contract. When skeletal muscles contract, they pull bones towards each other. For example, bending your arm at the elbow is caused by muscular contractions that move the bones of the forearm towards the one in the upper arm. All athletic events, running, jumping, swimming, etc., depend on the movement of bones that result from forces generated by the muscles. Each muscle has its composition of fibers that contract at various speeds to generate the forces. There are different types of muscle fibers, known primarily as “red” and “white”, and they produce responses consistent with the number of each fiber type. NBC had worked with a specialist in muscle fiber typing to describe this aspect of the movement.

Tom Brokaw during the discussion session and after the show.

http://arielnet.com/ref/go/1239
With regard to the biomechanical quantification, NBC arranged for a population of accomplished athletes consisting of ten black and ten white basketball players. This is a very small sample size and could in no way represent all members of groups, which number in the millions. However, we concentrated our efforts, so that the results of the study, using first-class technology, would be scientifically objective for the athletes involved.

The basketball team played from the University of California at Irvine, California were filmed doing several activities, including jumping from a height onto a force platform and utilizing the computerized exercise machine to measure forces and velocities at various resistances.

We performed a very extensive study on this population of athletes, ten black and ten white men. Of course, this is a very limited study of the scope of the population since the number is so small. However, the technology to conduct this study was first class.

Mr. Brokaw wanted to have the study as objective as possible. Therefore, we devised a strategy, which is known in the scientific community as a double-blind study. That means that when the data was collected, only an unbiased observer nominated by NBC marked the data with a code indicating whether the athlete was black or white. That individual was the only person who could identify the coded data stored on the computer.

A few days after the data was collected, Tom and the NBC staff put me in the computer room to analyze each data set belonging to each participating athlete. My task was to examine the forces and other measurements and, based on the data, label the file as “B” for black or “W” for white. The force platform data for some of the athletes repeatedly revealed a distinctive pattern of rapid and explosive forces followed by a gradual decline of the force. Alternatively, in the other group of athletes, there were force platform results which produced a slower, more gradual force generation but without the rapid peak force observed in the first group. These were the only two patterns produced by these players.
The NBC staff member who maintained the data identification code was able to group the findings. For all twenty cases, the data showed that the group labeled by me as “B” was associated with the fast, explosive force patterns and the group labeled as “W” consisted of the slower more gradual force development. In other words, there was an obvious difference between the two groups with regard to the pattern of force development.

We then examined the different exercise results performed on the computerized exercise machine. In general, the results were consistent with the force platform findings. The individuals who demonstrated an ability to rapidly extend their legs were found to be in the “B” group and the ones who were less quick were in the “W” group. There was some overlap in the actual strength measurements with a number of athletes labeled as “W” demonstrating force production equivalent to those coded as “B”. But in general, there were clear differentiations between the two groups of athletes.

These results convinced NBC that biomechanical analysis was significantly objective from a scientific standpoint to include in the program.
These results would be presented alongside the findings of other scientists on this subject. In general, the black athletes performed better in producing vertical forces on the plate, and recruitment time on the machines. These biomechanical findings clearly demonstrated that the black athletes were athletically superior to their white compatriots.

Of course, this show generated criticism. Unfortunately, in America a discussion of this nature is politically incorrect. Rather than allowing an unbiased examination of the facts and permitting scientific enquiry, to answer the questions, any examination that involves race is perceived to be tainted and discriminatory. For example, Dr. Brook Johnson, the head coach of Stanford University track team, dismissed the results and attributed them to social issues and coaching only.

As a non-native American, I feel disappointed and frustrated in my adopted country when it comes to science and race. I am well aware of the long and unfortunate history of bias and discrimination against Black people here. However, I believe that a fresh examination from a scientific point of view would be helpful in moving this bias into a healthier perspective. If anyone had ever told me that Israelis could run or throw the discus farther than another group of athletes, I would have been ecstatic, and certainly I come from a population which has also suffered cruel and painful discrimination.

During the NBC program, I participated in the open discussion following the filmed presentation of the various scientific inquiries. Jon Entine, author of the book, Taboo: Why Black Athletes Dominate Sports and Why We Are Afraid to Talk About included one of my answers from the open discussion.

“I know that the American System is very sensitive to statements of Black and White. But you cannot defy science. You cannot just say that day is night and night are day. These are facts. And I think it’s to the advantage of the black athletes to be proud that God was on their side.”

Gideon Ariel
Biomechanist, former Israeli Olympic Athlete

(Scan QR Code on the left for more information: “Breaking the Taboo on Race and Sports”)

Coach Johnson (left) argued the results with Tom Brokaw (right)
http://arielnet.com/ref/go/1240
Perhaps my favorite part of the NBC program, however, was personal. I was so pleased to have been able to spend time with Mr. Tom Brokaw again. It had been a fun and exciting time to analyze his running technique and compare it to the premier marathon runner of 1976, Mr. Bill Rodgers. To meet him again in Seoul, Korea at the Olympic Games was another treat. Finally, to have the opportunity to participate in an NBC special program such as the “Black Athletes: Fact & Fiction” with Mr. Brokaw was quite a rewarding highlight for me. Mr. Brokaw is a wonderful and delightful person, and it has been my great fortune to have had the opportunity to spend time with him.

Amidst the research projects, television shows, and continued work on the Computerized Exercise Machine, we were lucky to receive a surprising new burst of enthusiasm from an unexpected source. Because we were adjacent to Vic Braden’s Tennis College, we frequently were asked by Vic to give demonstrations of our motion analysis system to his class members. Ann and I normally followed the same format. I would be the orator and described what we filmed and how the results were generated on our computer. Ann followed my lead and demonstrated the digitizing and showed the three-dimensional stick figures. Our two-man team was operated smoothly because Ann could anticipate what I would describe in our step by step demonstration.

One day following our presentation, one of the guests at his Tennis College asked what computer system we used. I explained how we had converted our original software from the room-sized Honeywell computer to the Data General minicomputers that we were currently using. The gentleman asked whether we thought it would be possible to operate our analysis on an IBM computer. He expressed more interest and asked more sophisticated computer questions than did most of the Tennis College participants. I, being naturally effervescent about our motion analysis program, was happy to discuss the system and answered his questions. In response to the question about IBM, I told him that I did not know, but could think of no reason we could not. Since, we did not have an IBM system to try, I could not say more.

At this point in the discussion, the Tennis College participant explained that he was Don Estridge and that he was an IBM vice president of manufacturing. More importantly, one of his pet projects and brainchild was the Personal Computer or PC as it became more commonly called.

Philip Donald Estridge (June 23, 1937 - August 2, 1985), known as “Don,” led the development of the original IBM Personal Computer (PC), and thus is known as "father of the IBM PC." His decisions dramatically changed the computer industry, resulting in a vast increase in the number of personal computers sold, thus creating an entire industry of hardware manufacturers of IBM PCs.

Don’s education was a bachelor's degree in electrical engineering at the University of Florida. He worked in the Army designing a radar system using computers, IBM, and finally at NASA’s Goddard Space Flight Center until he moved to Boca Raton, Florida in 1969.

His efforts to develop the IBM PC began when he took control of the IBM Entry Level Systems in 1980 with the goal of developing a low-cost personal computer to compete with increasingly popular offerings from the likes of Apple Computer, Commodore International, and other perceived IBM competitors. To create a cost-effective alternative to those companies’ products, Estridge realized that it would be necessary to rely on third-party hardware and software. This was a marked departure from previous IBM strategy, which centered on the in-house vertical development of complicated mainframe systems and their requisite access terminals. Estridge also published the specifications of the IBM PC, allowing a booming third-party aftermarket hardware business to take advantage of the machine's expansion card slots.

The competitive cost and expandability options of the first model, IBM PC model 5150, as well as IBM's reputation, led to strong sales to both enterprise and home customers. Estridge was rapidly promoted, and by 1984 was IBM Vice President, Manufacturing supervising all manufacturing worldwide. Steve Jobs, renowned for his empire at Apple, offered Estridge a multi-million-dollar job as president of Apple Computer. Estridge turned him down.
For my company and me, this fortuitous meeting had an enormous impact on our motion analysis business. From the beginning of our company, we had developed our software to operate on many computers. We had grown from the massive Honeywell at Dartmouth College to the Control Data computer at the University of Massachusetts. Each of the changes meant new language translations of our software. The next major transition was to the smaller, more compact Data General minicomputer that entailed another software program. Now, if we were able to run our system on an IBM Personal Computer, this would take our software and company to a whole new level. If we could write our software to operate on this smaller, more compact PC, we would be able to sell the hardware with our software licensed on it directly to our customers. This would allow the customers to perform their biomechanical analysis from the filming at the beginning to the data transformation at the end. We would be out of the processing loop completely.

By selling our biomechanical analysis system to the customer, we would have more time to develop new features for the software. For the customer, this would provide complete control of their data that was particularly important to corporations who were uncomfortable having their secrets outside of their walls. Universities could provide students more time and flexibility to pursue projects. For IBM, despite our obvious smallness in consumer sales numbers, we were precisely the time of affiliate they were attempting to attract. We were an outside third party software developer, and they could use our uniqueness in marketing.

During our subsequent meetings with Mr. Estridge, he asked whether we could have our software programs operational on the PC during the 1984 Los Angeles Olympic Games. We assured that we would be able to meet that deadline. I knew that we would have to work deep into the night to accomplish the task, but this would not be the first time that we had to produce under pressure.

IBM sent us ten new PC prototype computers for our work on the project. One of our initial challenges was the lack of a hard disk in the computer to store the program or the data produced. Instead, those original computers utilized floppy diskettes. We had experience with floppy diskettes previously with the Radio Shack, so we plunged into the project. The project was for $100,000.00 with a bonus if we could successfully demonstrate our motion analysis system on the PC before the 1984 Olympics. The bonus was double the price of the project. We were so excited to be working on this project with IBM, that Ann and I confessed to each other that we would have probably had done it for free. The money would be nice, but, at that time, IBM was bigger and more realistic than OZ. For us, IBM was the top of the mountain, and we were thrilled to be working with Mr. Estridge.

Our programmers, Jeremy and Alan, were assigned 100 percent of their time to achieve our target completion date. The programs and implementation were finished in 1983 which was ahead of schedule.

Because we had finished with time to spare, IBM decided to launch our Biomechanical application on their Personal Computer at a special marketing meeting at their home site in Boca Raton, Florida. The idea was to have the Women’s Volleyball Team play “matches” for the sales staff while introducing an application that would run on their new “darling”, the PC. They flew the entire Volleyball team as well as my staff and me to Boca Raton for this major company meeting to present the APAS system on the IBM PC.

The Volleyball competition was held in a large gym, with hundreds of marketing team members divided into four color-coded groups. The volleyball team engaged in an exhibition tournament exchanging uniform
colors so that each group could cheer for their “team”. What an amazing experience to watch the cream of the IBM marketing team as well as some of their executives cheering exuberantly for their “team”. The entire two days in Florida was an incredible experience and a lot of fun. I have thought about this meeting periodically and wondered if those men and women followed the U.S. Women’s Team as they won the Silver medal in 1984.

Sadly, Don Estridge died in a plane crash, along with his wife, Mary Ann, on August 2, 1985. He was only 48 years old. At the time of his death, IBM ESD (which included the development and manufacturing of the IBM PC, PC DOS, PC LAN and TopView) had nearly 10,000 employees and had sold over a million PCs. IBM's president and chief executive officer John F. Akers said at the time: "Don Estridge was a man of vision whose skill and leadership helped guide IBM's personal computer business to success. He had a very bright future in our business. He and Mary Ann will be greatly missed by all their friends and colleagues."

We converted all our software operation and research projects onto the IBM personal computer. This conversion changed our life at the Coto Research Center. We could perform the same complicated analysis that we used to do on the expensive Data General equipment in our office or home. Companies did not need to pay us to do the job. The companies could buy an IBM PC, use our software, and do their analysis in-house which they liked much better for security and development reasons.

Several photographs showing our PC system, at the time, are shown below:

We were improving our Computerized Exercise Machine, advancing our software capabilities, and expanding our technologies to fit the times. By 1987, we reached a point of new challenges and changes for our company.
My first association with NASA was when I met Captain James Lovell. This was an amazing experience for me since my Israeli background in sports had never included an opportunity to meet an actual NASA astronaut. I came from the background of Israel, where we had our heroes in the Air Force, but no Astronauts in a Space Program. Meeting such an accomplished Astronaut as James Lovell was both awe inspiring and slightly intimidating.

When I returned to Amherst after my first committee meeting with Captain Lovell, I immediately began to research his background. James Arthur "Jim" Lovell, Jr. (born March 25, 1928) was selected as a NASA astronaut in 1962 after having served as a captain in the United States Navy.
Lovell was selected as a backup pilot for Gemini 4, which put him in a position for his first space flight three missions later as pilot of Gemini 7 with Command Pilot Frank Borman in December 1965. This flight set an endurance record of fourteen days in space. Lovell was later scheduled to be the backup Command Pilot of Gemini 10, but after the deaths of the Gemini 9 prime crew Elliot See and Charles Bassett, he replaced Thomas P. Stafford as backup commander of Gemini 9A. This positioned Lovell for his second flight and first command of Gemini 12 in November 1966 with pilot Buzz Aldrin.

Lovell's two Gemini flights gave him more time in space than any other person as of 1966. However, his career was far from finished at that point. Lovell was originally chosen as the Command Module Pilot (CMP) on the backup crew for Apollo 9, planned as a high-apogee Earth orbital test of the Lunar Module (LM), along with Neil Armstrong as Commander and Buzz Aldrin as Lunar Module Pilot.

Delays in construction of the first manned LM prevented it from being ready in time to fly on Apollo 8 which was planned as a low Earth orbit test. It was decided to swap the Apollo 8 and Apollo 9_prime and backup crews in the flight schedule so that the crew trained for the low-orbit test could fly it as Apollo 9, when the LM would be ready. The original Apollo 9 medium Earth orbit test was replaced with a lunar orbital flight, now Apollo 8. Borman, Lovell and Anders were launched on December 21, 1968, becoming the first men to travel to the Moon.

As CM Pilot, Lovell served as the navigator, using the spacecraft's built-in sextant to determine its position by measuring star positions. This information was then used to calculate required mid-course corrections. The craft entered lunar orbit on Christmas Eve and made a total of ten orbits, most of them circular at an altitude of approximately 70 miles (110 km) for a total of twenty hours. They broadcast black-and-white television pictures of the lunar surface back to Earth, and Lovell took his turn with Borman and Anders in reading a passage from the Biblical creation story in the Book of Genesis.

They began their return to Earth on Christmas Day with a rocket burn made on the Moon's far side, out of radio contact with Earth. The two tensest moments of this first lunar mission were these lunar orbit insertion and trans-Earth injection burns. When contact was reestablished, Lovell was the first to announce the good news, "Please be informed, there is a Santa Claus." The crew splashed down safely on Earth December 27.

Lovell was backup commander of Apollo 11 and was scheduled to command Apollo 14, but he and his crew swapped missions with the crew of Apollo 13, as it was felt the commander of the other crew, Alan Shepard, needed more time to train after having been grounded for a long period.

Lovell lifted off aboard Apollo 13 on April 11, 1970 with CM Pilot Jack Swigert and LM Pilot Fred Haise. He and Haise
were to land on the Moon. However, an unbelievable and potentially catastrophic event occurred on April 13th. During a routine cryogenic oxygen tank stir in transit to the Moon, damaged the electrical insulation on wiring created a spark and started a fire inside the tank. Liquid oxygen rapidly turned into a high-pressure gas, which burst the tank and caused the leak of a second oxygen tank. In just over two hours, all onboard oxygen was lost, disabling the hydrogen fuel cells that provided electrical power to the Command/Service Module "Odyssey". It was during these pressure-packed moments that the calming voice of Captain Lovell infamously reported to Ground Control, “Houston, we have a problem.”

Clearly, the situation required an immediate abort of the Moon landing mission and to focus on safely return the crew to Earth. The three astronauts and Earth-bound scientists went into emergency planning mode.

Using the LM as a "lifeboat" providing battery power, oxygen, and propulsion, Lovell and his crew re-established the free return trajectory that they had left and swung around the Moon to return home. Based on the flight controllers’ calculations made on Earth, Lovell had to adjust the course two times by manually controlling the Lunar Module's thrusters and engine, using his watch for timing. Apollo 13 returned safely to Earth on April 17th.

Lovell is one of only three men to travel to the Moon twice, but unlike John Young and Eugene Cernan, he never walked on it. Remarkably, he is one of only 24 people to have flown to the Moon, the first of only three people to fly to the Moon twice, and the only one to have flown there twice without making a landing. Lovell was also the first person to fly in space four times.

Lovell accrued over 715 hours of space flight and had seen a total of 269 sunrises from space on his Gemini and Apollo flights. This was a personal record that stood until the Skylab 3 mission from July through September of 1973. It is also probable that Apollo 13’s flight trajectory gives Lovell, Haise, and Swigert the record for the farthest distance that humans have ever travelled from Earth. Lovell is a recipient of the Congressional Space Medal of Honor and the Presidential Medal of Freedom. He retired from the Navy and the space program in 1973. After he had retired from NASA, Lovell and Jeffrey Kluger wrote a book about the Apollo 13 mission, Lost Moon: The Perilous Voyage of Apollo 13. This book was the basis for the Ron Howard movie Apollo 13. In the film, Lovell has a cameo appearance as the captain of the U.S.S Iwo Jima, the naval vessel that led the operation to recover the Apollo 13 astronauts after their successful splashdown. Lovell can be seen as the naval officer shaking Hanks' hand in the scene in which the astronauts come aboard the Iwo Jima. Filmmakers initially offered to make Lovell’s character an admiral aboard the ship. However, Lovell stated "I retired as a Captain and a Captain I will be", so he was cast as the ship's skipper, Captain Leland E. Kirkemo.

Lovell visits colleges and universities where he gives speeches on his experiences as an astronaut and businessman. He strongly urges students to get involved in science and the space program and he credits NASA in the 1960s with bringing much of the country together for a common goal. As I write this book in 2015, I reflect on his inspirational messages of the 1970's and hope his goals will be achieved.

Captain Lovell and I served together on the Scientific Committee of the Health and Tennis Corporation of America in 1973. At that time, in the years before fitness centers became ubiquitous, the Health and Tennis Corporation of America was the largest health club chain center in the U.S. and probably in the World. The committee members included leading international scientists in the field of human performances. Some of the noteworthy scientists were Bruno Balke, the pioneer in using lactic acid as an indicator of fitness level; Dr. Frank Katch, a leading Physiologist and nutritionist; and Dr. Thomas Cureton one of the most well-known Exercise Physiologist. It was an honor for me to be able to work and share ideas with this amazing group of scientists.

While Jim and I were members of this committee, I had many discussions with him about the fitness level of astronauts for the space mission. The lack of gravity and its effect on the bone structure
were significant factors for consideration at NASA. At that time, the primary goals for astronauts in Space were: (1) achieving maximum fitness levels before launch and (2) maintaining adequate fitness levels in micro-gravitational situations. Another question of major concern was the length of time that astronauts could remain in micro-gravitational environments with no deleterious effects.

I described to Jim the Computerized Exercise Machine which I was developing in my lab in Amherst, Massachusetts and that it was gravity independent. I also described our Biomechanical Motion Analysis system and how it could be used to analyze Astronauts in space. Jim’s response was to enumerate the many purposes that he could imagine how such a system could be used in NASA. For example, astronauts have to execute many movements in challenging gravitationally-compromised environments. One situation occurs during the thrust of takeoff when the ability to move the arm requires tremendous strength and it is awkward in that condition to retain the ability to execute fine motor skills. On the other hand, in micro-gravity, movements are less exhausting requiring little strength to accomplish many tasks. However, countermeasures are necessary to replace the human’s physiological need for gravity particularly on maintenance of the structural strength and integrity of the skeletal bones. Captain Lovell explained that the ability to quantify the movements of the Biomechanical analysis system and to develop an appropriate fitness regimen for Astronauts was of great interest at NASA.
Captain Lovell and I continued our discussions during the years that we served together on the Scientific Advisory Board of the Chicago Health and Tennis Club. I believe he was instrumental in arranging for subsequent contacts between me and some of the other individuals at NASA.

The First Astronaut to visit the Research Center in Coto De Caza was Gordon Cooper.

Leroy Gordon Cooper, Jr., also known as “Gordo” Cooper, (March 6, 1927 – October 4, 2004) was an engineer and American astronaut.

Gordon Cooper graduated from high school in 1945 only to learn that the Army and Navy flying schools were not taking any new candidates. He decided to enlist in the United States Marine Corps and left for Parris Island as soon as he graduated. Since World War II ended before he could get into combat, he transferred his commission to the United States Air Force in 1949. He was placed on active duty and received flight training at Perrin Air Force Base (AFB), Texas and Williams AFB, Arizona.

In 1956, Cooper completed his Bachelor of Science degree in Aerospace Engineering. He was then assigned to the U.S.A.F Experimental Flight Test School at Edwards Air Force Base in California. After graduation was posted to the Flight Test Engineering Division at Edwards, where he served as a test pilot and project manager testing the F-102A and F-106B. While there, he corrected several deficiencies in the F-106 that saved the U.S. Air Force a great deal of money.

While at Edwards, Cooper was intrigued to read an announcement saying that a contract had been awarded to McDonnell Aircraft in St. Louis, Missouri to build a space capsule. Shortly after that, he was called to Washington, D.C. for a NASA briefing on Project Mercury and the part astronauts would play in it. Cooper went through the selection process with the other 109 pilots and was accepted as the youngest of the first seven American astronauts.

Each of the Mercury astronauts was assigned to a different portion of the project along with other special assignments. Cooper specialized in the Redstone rocket. He developed a personal survival knife, the Model 17 "Astro" from Randall Made Knives, for astronauts to carry. He also chaired the Emergency
Egress Committee which was responsible for developing emergency launch pad procedures for escape. Cooper served as capsule communicator for Alan Shepard's first sub-orbital spaceflight in Mercury-Redstone 3 (Freedom 7) and Scott Carpenter's flight on Mercury-Atlas 7 (Aurora 7). He was a backup pilot for Wally Schirra in Mercury-Atlas 8 (Sigma 7).

Cooper was launched into space on May 15, 1963, aboard the Mercury-Atlas 9 (Faith 7) spacecraft, the last Mercury mission. He orbited the Earth 22 times and logged more time in space than all five previous Mercury astronauts combined. He was the first American astronaut to sleep not only in orbit but on the launch pad during a countdown.

Like all Mercury flights, Faith 7 was designed for fully automatic control that was a controversial engineering decision. In many ways, fully automatic control reduced the role of an astronaut to that of a passenger and prompted Chuck Yeager to describe Mercury astronauts as "Spam in a can".

Toward the end of the Faith 7 flight, there were mission-threatening technical problems. During the 19th orbit, the capsule had a power failure. Carbon dioxide levels began rising and the cabin temperature jumped to over 100 degrees Fahrenheit (38° C). Cooper turned to his understanding of star patterns, took manual control of the tiny capsule and successfully estimated the correct pitch for re-entry into the atmosphere. Some precision was needed in the calculation, since if the capsule came in too steep, g-forces would be too large, and if its trajectory were too shallow, it would shoot out of the atmosphere again, back into space. Cooper drew lines on the capsule window to help him check his orientation before firing the re-entry rockets. "So I used my wrist watch for time," he later recalled, "my eyeballs out the window for attitude. Then I fired my retrorockets at the right time and landed right on the carrier." Cooper's cool-headed performance and piloting skills led to a basic rethinking of design philosophy for later space missions.

Cooper was selected as backup Commander for the May 1969 Apollo 10 mission. He hoped this would place him in position as Commander of Apollo 13, according to the usual crew rotation procedure established by the Flight Crew Operations Director, Deke Slayton. However, by May 1969, when another grounded Mercury astronaut, Slayton's assistant Alan Shepard was returned to flight status, Slayton replaced Cooper with Shepard as Commander of this crew. Loss of this command placed Cooper farther down the flight rotation, meaning he would not fly until one of the later flights, if ever.

Disappointed by the reduced chances of commanding a Moon landing flight, Cooper retired from NASA and the Air Force on July 31, 1970, as a Colonel, having flown 222 hours in space.

Spending time with Cooper in California and learning all of the amazing things that he had accomplished in his life evoked even greater amazement than I had about NASA and the people who were involved there. Before my contacts with James Lovell and Gordon Cooper most of my heroes had been Gold Medal and World Champion athletes. Meeting these awe-inspiring Astronauts presented entirely new and exciting adventures that were previously unknown to me. Hearing the stories in personal, face-to-face renditions provided an opportunity to share, vicariously, the thrills of adventure that these amazing Astronauts had performed. All of
my staff was equally enthusiastic and more than ready to begin work with NASA.

Apparently, after Gordon Cooper’s visit to the Research Center and his familiarization with the capabilities of both the Biomechanical analysis and the Computerized Exercise machine, he passed the word about our technology to other people at NASA. Not long after his visit, I received a telephone call from two other famous Astronauts: Astronaut Dave Walker and Dr. William Thornton.

I was amazed to receive this call from the American public, at that time, was presented with Astronauts as heroes who were isolated and protected from outside interference. I was, even more, thrilled when they asked if they could come to our lab and discuss potential projects. Obviously, I responded that they were welcome at any time, so we set up a meeting for two weeks from then.

The first thing I did was begin research about these two individuals. Specifically, who were they and what were their areas of expertise. I felt that greater knowledge about their backgrounds and areas of expertise would help me to tailor my presentation to address their current interests.

The first person I researched was William Thornton. Following graduation from the University of North Carolina and having completed Air Force ROTC training, Thornton served as officer-in-charge of the Instrumentation Lab at the Flight Test Air Proving Ground. He later became a consultant to Air Proving Ground Command.

As chief engineer of the electronics division of the Del Mar Engineering Labs at Los Angeles from 1956 to 1959, he also organized and directed its Avionics Division. He returned to the University of North Carolina Medical School in 1959, graduated in 1963, and completed internship training in 1964.

Dr. Thornton returned to active duty with the United States Air Force and was then assigned to the U.S.A.F Aerospace Medical Division, Brooks Air Force Base, San Antonio, Texas where he completed the Primary Flight Surgeon’s training in 1964. It was during his two-year tour of duty there that he became involved in space medicine research and subsequently applied for and was selected for astronaut training. Dr. Thornton developed and designed the first mass measuring devices for space, which remain in use today.

Dr. Thornton was selected as a scientist-astronaut by NASA in August 1967. He was physician crew member on the highly successful Skylab Medical Experiments Altitude Test (SMEAT) -- a 56-day simulation of a Skylab mission enabling crewmen to collect medical experiments baseline data and evaluate equipment, operations, and procedures. Dr. Thornton was also the mission specialist on SMD III, which was a simulation of a Spacelab life sciences mission.

Dr. Thornton was a physician and a member of the astronaut support crew for the Skylab 2, 3, and four missions. He was also the principal investigator for Skylab experiments on mass measurement, anthropometric measurements, hemodynamics, human fluid shifts, and physical conditioning. He first documented the shift and loss of fluid changes in body posture size and shape, including an increase in height and the rapid loss of muscle strength and mass in space flight.

As a member of the Astronaut Office Operations Missions Development group, Dr. Thornton was responsible for developing crew procedures and techniques for deployable payloads as well as for maintenance of crew conditions in flight. He developed advanced techniques for, and made studies in, kinesiology and kinesimetry related to space operations.

During Space Shuttle operations he continued physiological investigations in the cardiovascular and musculoskeletal and neurological areas. He developed the Shuttle treadmill for in-flight exercise and several other on-board devices. His work concentrated on the space adaptation syndrome.

Dr. Thornton flew on the STS-8 Challenger (August 30 to September 5, 1983). This was the third flight for the Orbiter Challenger and the first mission with a night launch from Kennedy Space Center, Florida, followed by a night landing at Edwards Air Force Base, California. During the flight, he made almost continuous measurements and investigations of adaptation of the human body to weightlessness.
especially of the nervous system and of the space adaptation syndrome. This was a continuation of his previous work in these areas. Much of the equipment used was designed and developed by Dr. Thornton.

Subsequently, Dr. Thornton flew on STS-51B/Spacelab-3 Challenger (April 29 to May 6, 1985). The Spacelab-3 science mission was launched from Kennedy Space Center, Florida, and returned to Earth at Edwards Air Force Base, California. During the 7-day flight, Dr. Thornton was responsible for the first animal payload in manned flight and other medical investigations.

Amazingly, Dr. Thornton holds more than 35 issued patents that range from military weapons systems through the first real-time EKG computer analysis. Space-related items include the first in-flight mass measurement devices, shock and vibration isolation systems, an improved waste collection system, an improved lower body negative pressure (LBNP) apparatus, and others.

Dr. Thornton continued his work in space medicine while awaiting his next flight opportunity. He worked on problems about extending mission durations in the Space Shuttle, in Space Station, and in space exploration, and designed the necessary exercise and other hardware to support such missions. He continued analysis and publication of results from studies of (1) neurological adaptation, (2) neuromuscular inhibition following flight, (3) osteoporosis in space and on Earth, and (4) post flight orthostasis. He completed designs for exercise and other countermeasure equipment for the Extended Duration Orbiter (EDO), and for Space Station Freedom, including improved treadmills, rowing machines, isotonic exercise devices, and a bicycle.

After my investigation of the career of Dr. Thornton, I wanted to learn more about Dave Walker. David Mathieson Walker (May 20, 1944 – April 23, 2001), was a United States Navy officer and a NASA astronaut flying aboard four Space Shuttle missions in the 1980s and 1990s.

Walker graduated from the U.S. Naval Academy and subsequently received flight training at the Naval Air Training Command at bases in Florida, Mississippi, and Texas. He was designated a Naval Aviator in December 1967 and proceeded to the Naval Air Station Miramar, near San Diego, California, where he flew F-4 Phantoms aboard the aircraft carriers U.S.S Enterprise and U.S.S America. David was one of 35 candidates selected by NASA in January 1978 for the new Space Shuttle program; Walker became an astronaut in August 1979.

A veteran of four spaceflights, Walker logged nearly 725 hours in space. He was the Pilot on STS-51-A Discovery (November 8–16, 1984) which was launched from and returned to land at Kennedy Space Center, Florida. During the 4-day mission, the crew deployed two satellites, Canada’s Anik D-2 (Telesat H), and Hughes’ LEASAT-1. In the first space salvage mission in history, the crew also retrieved for return to Earth the Palapa B-2 and Westar VI satellites.

Dave was the Commander of STS-30 Atlantis (May 4–8, 1989) which was launched from Kennedy Space Center, Florida. During the 4-day mission, the crew successfully deployed the Magellan Venus-exploration spacecraft, the first U.S. planetary science mission launched since 1978, and the first planetary probe to be deployed from the Shuttle. Magellan arrived at Venus in August 1990 and mapped over 95% of the surface of Venus. Also, the crew also worked on secondary payloads involving fluid research in general, chemistry, and electrical storm studies. Following 64 orbits of the Earth, the STS-30 mission concluded with the first cross-wind landing test of the Shuttle Orbiter at Edwards Air Force Base, California.

The STS-53 Discovery (December 2–9, 1992) was launched from the Kennedy Space Center, Florida and returned to land at Edwards Air Force Base, California. During 115 Earth orbits, the five-man crew deployed a classified Department of Defense payload DOD-1 and then performed several Military-Man-in-Space and NASA experiments.

STS-69 Endeavour (September 7–18, 1995) was launched from and returned to land at Kennedy Space Center, Florida. During the mission, the crew successfully deployed and retrieved a SPARTAN
satellite and the Wake Shield Facility. Also, on board were the International Extreme Ultraviolet Hitchhiker payload, numerous secondary payloads, and medical experiments.

Walker was in training to command STS-61-G, scheduled for a May 1986 launch when the Challenger disaster forced NASA to suspend all Shuttle flights. In 1989, while piloting a NASAT-38 to Washington, D.C. for ceremonies honoring the crew of STS-30, Walker came within 100 ft. (30 m) of striking a Pan Am jetliner. That encounter and other infractions of NASA flying rules caused him to be grounded from July to September 1990 and prevented him from commanding STS-44.

Dave was extremely interested in our system and perceived it as a tremendous resource research tool for NASA which made our visits and worked together a special thrill. It was with profound sadness when we learned later, after we had completed our work with NASA, that our good friend, Dave, died of cancer in 2001. He was only 56 years old.

Having studied the biographical information of these two Astronauts who were scheduled to visit the Coto Research Center, Ann and I planned our presentation specifically for them. When I spoke with Dr. Thornton on the phone, he had mentioned some of the ideas they hoped to explore with me. My excitement and enthusiasm to work on some of the ideas that Dr. Thornton described on the phone grew with each passing day. I was more than ready for their visit.

Finally, the day arrived when Dr. Thornton and Dave Walker met me at the research laboratory in Coto De Caza. I gave them a tour of our facility including a detailed presentation of the biomechanical analysis. Ann and I demonstrated the digitizing processes and the three-dimensional results that they produced. We also demonstrated the Ariel Computerized Exercise System and showed them how the U.S. Women’s Volleyball team used it for training.

After we had completed our demonstration, Dr. Thornton gave me a special plaque. It recorded his take off mission from Cape Canaveral which was the first night mission to space. I was thrilled to receive this memento and it still hangs on my wall. I sent him a thank you letter which can be seen in our website. The plaque is shown on the right:

Following our demonstration, we all adjourned for lunch. During the meal, Dr. Thornton and Dave Walker explained the most pressing need that they currently had at NASA. The most immediate and significant dilemma involved the joint research projects that the U.S. had with Russia. They explained that NASA and the Russian Space Authority had an agreement to share research. Each country would record space missions and then exchange the 16mm films collected during the flight. The cooperative goal was to illustrate the various functions performed in the mission capsules during the Earth orbits.

Dr. Thornton began the meeting by explaining the difficulties of maintaining human functional health in micro-gravitational environments. These health issues included muscular strength and bone density. On Earth, running, walking, working with resistive weights are among some of the tasks that can provide the necessary stresses to the bones and muscles to maintain good functional health. Unfortunately, in micro-gravitational environments, there are negligible stresses on bones and muscles. In this environment, the body reacts to the environment with a response that “understands” that these heavy bony structures of our skeleton are unnecessary and, thus, begins to remove calcium from the
bones. Were this situation to remain uncorrected, Astronauts would return to Earth with devastating osteoporosis. For this reason, the Americans had devised various devices aimed at stressing the bone structure to abate the deterioration.

One of the devices which the Americans had designed was a treadmill and built by Dr. Thornton. Surprising, I learned that this was the same Astronaut Thornton who was standing in front of me. Dr. Thornton explained that to jog on the treadmill, the American Astronauts were connected to the treadmill with bungee cords around the waist and torso. Also, they always had to grip the handle bar with their hands to maintain an upward position. If the American Astronauts did not support themselves by holding the front handle bar, they would rotate while running and lose balance. The bungee cords provided sufficient elasticity for the Astronauts to have to push with great effort to “run” on the treadmill. The effort exerted to push the legs and “run” on the treadmill had been demonstrated to be effective in stressing the lower limbs thus reducing the calcium loss in the legs. However, they had to hold the handle bars.

The most recent films provided by the Russians showed their Astronauts running on a treadmill during conditioning exercises on a Shuttle mission. Surprisingly, the Russians were able to run without holding on to the front handle bars. In fact, they did not appear to need handles at all. NASA’s difficulty was interpreting the treadmill data given to them by the Russians from this most recent Space mission. The question was posed to us whether we could evaluate the films and explain this unique treadmill running the Russians demonstrated.

My first question was whether NASA could provide us with the films of the Russians running on the treadmill. Dr. Thornton replied in the affirmative so I explained what I thought we could analyze. Using the Ariel Performance Analysis System (APAS), we could digitize the Astronaut and calculate all the kinematics and kinetics parameters. I felt confident that this would provide a clue about how the Russians were able to accomplish this feat of not spinning while running. Dr. Thornton indicated that he would send us copies of all the films so that we could begin the analytic process. Thus began our first project for NASA.

In fact, our analysis was most likely the first biomechanical study of Space exploration. The idea was to compare running on the ground with running in space. Comparison of running on Earth with the films of the Russians running in micro-gravity would allow us to determine the mechanical differences between the two environments. We hoped that the results would illuminate how the Russians had become so advanced compared to the Americans. What had they learned and how were they able to balance their run on the treadmill in space without needing to use their hands and arms on the handles to counterbalance the gravitational spin. Dr. Thornton agreed to send us copies of the original data for the Americans and the Russian Astronauts that we could analyze using our three-dimensional biomechanical system.
As soon as the film data arrived from NASA, Ann began digitizing. There were hundreds of hours of films. The bungee cords attached to the body looked very similar to those used by the U.S. but, the Russian astronauts did not hold on to the handlebar. Stick figure representations of each country’s Astronauts’ are illustrated below.

Initial findings of our Biomechanical Analysis provided no clues concerning what the Russians were doing differently compared with the Americans. From their body angles and movements of the legs, according to our calculations in micro-gravity, the forces should have tilted them backward. Why and how were they able to defy the laws of physics? We struggle with these questions for weeks.

One afternoon Ann was digitizing the images on the screen. Since I was standing behind her and at an angle to the screen, I suddenly noticed a little dot moving down in the film image. Looking at it more carefully, it appeared to be a drop of sweat dropping from the face of the Russian Astronaut who was exerting great effort in his “run”. Immediately, I asked Ann to digitize this apparent sweat droplet. “Are you crazy, Gideon! You seriously want me to digitize sweat?” Ann asked. “Yes, I want to calculate the acceleration of that sweat droplet.”

This was the “eureka moment” for the NASA scientists and us! The acceleration of the drop of sweat was measured at 9.8 meters per second per second. This meant that the sweat drop was falling at the same gravitational acceleration as all things experience on Planet Earth. This gravitational acceleration rate cannot and does not occur in microgravity. The Russians had sent the NASA film purporting to be in micro-gravity but were collected at 1G. They were running on the Earth, not on a Vehicle revolving around the Planet in micro-gravity!

Needless to say, this finding allowed the NASA scientist to breathe a big sigh of relief. They requested that we not to reveal this information. Their rationale was that if the Russians were less than honest with us, we should maintain
silent. We could proceed with our scientific efforts and not let them know that we knew that they are being less than truthful. It also provided an opportunity for on-going dialog with the Russians and, as long as we were able to scientifically validate their data, this could serve us well in the future. To use our more modern phrase, “no harm, no foul”.

This American-Russian treadmill running study gave us significantly scientifically objective standing at NASA. Not long after we had completed the Russian Treadmill test, I received a call from another NASA scientist, Dr. Mike Greenisen. He was in charge of the Counter Measures Research Laboratories at NASA and wanted to meet me to discuss some potential studies for collaboration between our two groups. He would be bringing another engineer, Mr. John Probe, with him. Naturally, I agreed, and we set a date for their visit.

Several weeks later, there was a knock on the office door which I answered. Standing there were two gentlemen wearing coats and ties as though they had just stepped out of a fashion magazine. I laughed and told them to lose the coats and ties and come back looking comfortable for a day of work in a California laboratory. They seemed stunned at this request but have assured me throughout our long association that it was a fantastic beginning to a successful relationship.

Dr. Greenisen began the meeting by explaining the current perspective at NASA. When Americans reflect on the space program, two events stand out more prominently than others: The first moon landing and the Challenger disaster. On July 21, 1969, an Apollo spacecraft carried Neil A. Armstrong, Edwin E. Aldrin, and Michael Collins to the moon. Armstrong became the first man on the moon. When Neil Armstrong touch his foot to the moon's surface he said, "That's one small step for man, one giant leap for mankind."

The second event, the Challenger disaster, took the lives of seven astronauts, including the school teacher Christa McAuliffe, when the rocket boosters of the space shuttle exploded 73 seconds after lift-off on January 28, 1986.

Neil Armstrong fixed the ultimate significance of his deed by what he said; Christa McAuliffe did the same by who she was. Armstrong, in the midst of a historical event, had the vision to say the right thing. McAuliffe, although a non-professional astronaut, had the vision to become part of the quest.

Dr. Greenisen continued that those facts were not new but where we were in today’s world was different because of those two events. He characterized NASA’s position as standing before a frontier of apparently infinite proportions and challenging us to the ultimate quest. To proceed with this exploration, NASA has focused on developing
the most sophisticated and rapidly expanding technologies the world has ever known. Previously, authentic heroes helped us to understand that "the right stuff" must be complemented with "the right reasons" when we undertake such a task.

With Dr. Greenisen’s background in physiology and John Probe strength in engineering, they were focused on accomplishing the "right stuff" by developing the best equipment for the tasks to be performed. One of their biggest challenges was the human physiological machine. Man, having evolved as an upright, bipedal animal, cannot consciously take the rapid onset of acceleration that would be required for long distance space travel. Additionally, the physiological adaptations of a microgravity environment were poorly understood and it was argued that long-term weightlessness resulted in the significant post-flight deleterious changes that might cause permanent debilitating results.

Dr. Greenisen and his laboratory were thus tasked with developing appropriate countermeasures to solve the situation. The objectives of his current project were to minimize the effects of deconditioning during spaceflight using individualized exercise "prescriptions" and in-flight exercise facilities combine with extensive biomechanical analysis of movement in microgravity.

Dr. Greenisen elaborated many of the physiological, anatomical, and biomechanical needs which we had previously discussed with Dr. Thornton and Dave Walker. He described that one of the ways the human body reacts to the reduced physiological and mechanical demands of microgravity was by deconditioning of the cardiovascular, musculoskeletal, and neuromuscular systems. This human deconditioning produces a multitude of physical changes such as loss of muscle mass, decreases in bone density and body calcium. It is also responsible for decreased muscle performance, strength and endurance, orthostatic intolerance, and overall decreases in aerobic and anaerobic fitness.

Deconditioning presents operational problems during spaceflight and upon return to 1-G. Muscular and cardiovascular deconditioning contribute to decreased work capacity during physically demanding extravehicular activities (EVAs); neuromuscular and perceptual changes can precipitate alterations in magnitude estimation, or the so-called "input-offset" phenomenon; and finally, decreased vascular compliance can lead to syncopal (fainting) episodes upon reentry and landing.

Mike explained that extravehicular Activities (EVA) were the most physically demanding tasks that astronauts perform on-orbit. Space Station Freedom and manned Lunar and Mars missions would greatly increase the number, frequency, and complexity of EVA's within the next 10 to 20 years.

Dr. Greenisen’s task was to develop countermeasures to eliminate or reduce the severity of these problems by interrupting the body's adaptation process. Effective countermeasures would enhance mission safety, maximize mission success, and maintain crew health.

Results from experiments on the Gemini, Apollo, and Skylab missions suggested that regular exercise was helpful in minimizing several aspects of spaceflight deconditioning. In fact, exercise was determined to be the only countermeasure that could potentially counteract the combined cardiovascular, musculoskeletal and neuromuscular effects of adaptation.

Biomechanics in space was considered fundamental to understanding the work performance capabilities of humans in space. Biomechanical projects, as conducted by NASA, had the primary goal to conduct operationally-oriented research focusing on maximizing astronaut on-orbit performance capabilities.

The laboratory focus under Dr. Greenisen’s leadership was to provide biomechanical analysis in space and develop a program of exercise countermeasures to minimize the operational consequences of microgravity-induced deconditioning. Biomechanical analysis of movement in space would provide individualized exercise "prescriptions" for each crew member to optimize required tasks in a microgravity environment. The analysis would characterize the tasks requirement of the musculoskeletal and neuromuscular systems induced by microgravity, develop training protocols to address deconditioning in these systems, and use this information as the basis for training prescriptions.
To achieve these training protocols it was necessary to develop flight exercise hardware and associated software related to biomechanical measurement devices. He presented a list of some of the critical questions to be addressed by his laboratory:

1. What type of exercise devices such as weight training, bicycling, rowing, swimming, running, etc. are necessary to train all of the organ systems affected by deconditioning?
2. Which indices are the most reliable indicators of changes in fitness?
3. Which reliable indicators of changes in fitness best describe the changes caused by deconditioning?
4. How does training in microgravity differ from training in 1-G?
5. What are the differences between training that include impact forces and training that uses non-impact forces?
6. Can an artificial intelligence expert system be developed to aid in monitoring, controlling, and adjusting prescriptions?
7. How does in-flight exercise training affect the adaptation process?
8. Which muscle groups are critical to the performance of egress, landing, and EVAs?

The extensive software was required to accomplish all these and more functions. Our programmer Dr. Jeremey Wise developed these software functions.

Dr. Greenisen and John Probe then described their most immediate projects. These were related to our previous Russian Treadmill project. They wanted to develop and test appropriate treadmills for use on Earth and in microgravity that would effectively and efficiently address the many physiological and anatomical needs previously discussed.

There were two projects related to treadmill running. One project involved developing and testing the actual treadmill hardware focusing on the vertical impact forces. The second study was to compare the performances of four Astronauts running on that specific treadmill in both microgravity and Earth, or 1G, gravity. These were very technologically complex studies. I quickly learned that NASA studied and researched each and every apparently facet of Spaceflight down to and including a minuscule detail. They were committed to performing excellent research but, more importantly, to flying humans into Space and returning them safely to Earth.
As part of this study, a rigid body dynamic model of the astronaut and the treadmill system had been evaluated. I have presented them here to give better insight into the measured forces. The idea was to incorporate the force platform, the interface plate, and the treadmill to better describe the differences in One-G and Zero-G experiments.

The forces existing between the force plate and interface plate are considered to be applied at a known point on the force plate (point 0) as shown in the free body diagram. The force plate was initialized without the subject.

Dr. Moore the Astronauts medical physician, Bob Wainright Dr. Jeremy Wise, Dr. Ann Penny and I, were designed the workspace on the Space Shuttle.
Free Body Diagram of Force Plate on KC-135

One digitized frame on the treadmill with bungee cords
http://arielnet.com/ref/go/1247
The following force equations show the forces along the x, y and z axes (Note: \{\} denotes one-G only):

\[
F_x = F_{ix} + F_{hx} \\
F_y = F_{iy} + F_{hy} \\
F_z = F_{iz} + F_{hz} + \{mg\}
\]

The moments about point O in the x, y and z directions are as follows:

\[
M_{ox} = (d_z F_{hy}) + (d_y F_{hz}) + M_{hx} \\
M_{oy} = (d_x F_{hx}) + M_{hy} \\
M_{oz} = (d_x F_{hy}) + M_{hz}
\]
If no forces or moments were exerted by the hands, it would be possible to use these equations to calculate the reaction forces at the foot (or feet) of the subject. Since there are typically forces at the hands, it would be necessary to add instrumentation to resolve the actual foot contact forces fully.

Following the design and mechanical calculations needed for the treadmill device, the next step was to test the system. This would require evaluation on Earth at One-G as well as in the simulated microgravity, or Zero-G, in the KC-135 experimental aircraft. These two steps were required before including the device on a shuttle mission.

The project had two purposes. One was to measure and evaluate the vertical impact forces in both One-G and Zero-G environment using the force plate. The second was, incorporating the use of the force plate and/or bungee instrumentation, to determine if a subject's One-G weight could be replicated in Zero-G by adjusting the bungees to elicit the proper load. The magnitude of the impact loads generated in One-G on the shuttle treadmill for the given walking, jogging and running velocities (1.1 G, 1.7G, and 1.726 respectively) were not observed in the Zero-G environment. However, for the higher Zero-G jogging and running velocities (3.5 mph and 5.0 mph) greater than 1 G loads were seen (1.2G and 1.5G). Thus, the issue becomes "How much impact is enough?"

As a part of the system, it was necessary to incorporate a data collection instrument. NASA designated our biomechanics analysis system to serve as the data collection device. Using this system, data was acquired from all data input channels at a rate of 250 samples/channel/second. A ruggedized hardware cabinet had to be obtained to encase this system and the other associated electronics equipment before they could fly on the KC-135 aircraft. A KC-135 floor to cabinet interface plate, a back plate, and cabinet insertion plates had to be designed and created for mounting the equipment inside the hardware cabinet. The cabinet backplate and the hardware insertion plate are shown in Figure 435. The assembled hardware cabinet system is depicted in Figure 435.
In a seemingly unrelated step, we had to formalize our relationship within an appropriate legal format in order for the scientists and engineers to work with us at NASA. Our company signed the legal documents necessary to formalize this relationship and we were then able to continue work with NASA. This documentation can be found by scanning the QR Code below.

My Systems on the KC-135 before flight
http://arielnet.com/ref/go/1250
It was now necessary to develop and fabricate the instruments and hardware necessary to quantify the vertical impact forces (Fz) imparted to the space shuttle passive treadmill during human locomotion in a three-dimensional zero-gravity environment. The shuttle treadmill was instrumented using a force plate (Kistler) to measure vertical impact forces. The current passive treadmill system employed a harness/bungee device as a means to restrain an astronaut in zero G. Force links (Kistler) were employed to measure the bungee cord loading. The hardware was designed so that it would meet crash loading requirements for experiments flying in the Reduced Gravity Aircraft (KC-135). The impact force and bungee cord data were to be collected and analyzed using a biomechanics performance analysis system.

To verify that the instruments and hardware were functional, they had to be tested in the Anthropometry and Biomechanics Laboratory (ABL) at the Johnson Space Center. The KC-135 reduced gravity aircraft was used to determine if the system could operate successfully in a three-dimensional zero-gravity environment. This study would be the first time that I would be among the NASA scientists collecting data on the KC-135.

Before I would be able to test this hardware on the KC-135, I would need to be qualified for this flight experience. All participants must be thoroughly trained for space flight which consists of “De-Compression” testing; performance under low oxygen environment; an awareness test simulating the micro-gravity environment, and additional medical tests. The evaluation sequence involved 3 days of test performances and written work. There were eight astronaut candidates in the group as well as some other research scientists that train to fly in the KC-135.

I was pleased and proud when they informed me that I had successfully passed all of the required tests to qualify for participation aboard the KC-135 experimental aircraft. NASA issued a certificate which indicated that I was officially qualified for the initial testing of being an Astronaut. Although I was not actually planning to become an Astronaut, receiving this certificate was, none-the-less, an exhilarating moment. Despite the passage of time, I am still very proud of this achievement which qualified me to participate in additional tests for NASA aboard the KC-135. My certificate is shown below:

![Flight Certificate](image-url)
The NASA Reduced Gravity Program began in 1959 and the KC-135 was the perfect aircraft for this Astronaut training. The Boeing four-engine turbojet Stratotanker was originally designed for aircraft in-flight refueling and later as a 707 for commercial flights. Further modified to meet NASA's needs, the KC-135 is used to understand the role of gravity in humans and hardware in space. The KC-135 aircraft has provided NASA with an opportunity to simulate a "Space-like" environment. A reduced gravity aircraft is a type of fixed-wing aircraft that provides brief near-weightless environments for training astronauts, conducting research and even making gravity-free movie shots. Versions of such airplanes, officially nicknamed "Weightless Wonders", have been operated by the NASA Reduced Gravity Research Program. The unofficial nickname "Vomit Comet" became popular among those who experienced their operation.

The KC-135 aircraft is used to train astronauts in zero-g maneuvers since they are given about 25 seconds of "weightlessness" out of the 65 seconds that each repetition of the parabolic pattern of flight provides. The typical session for KC-135 flight tests is 2 to 3 hours in length consisting of 40 to 60 parabolic cycles. Unfortunately, during weightlessness, even the most seasoned astronaut may experience the stomach-turning effects. In about two-thirds of cases, this motion produces nausea due to airsickness, especially in novices, giving the plane its nickname. The astronauts seem to take it in stride...
without discussing who was or was not sick. For them, they realize that this experience is all part of a
day's work.

The initial study we prepared was designed for human subjects running on the instrumented force
plate treadmill. The objective was to compare the performance of subjects (astronauts) running on a
treadmill in a zero-gravity environment (Space) to the same subjects running in the normal gravitational
environment of earth. A photo of one of the Astronaut subjects preparing for a KC-135 treadmill run
sequence is presented below:

Some of the instrumentation
for the force plate and the
treadmill can be seen taped to the
floor in the foreground of the
picture. The young man in the
foreground is Mr. John Probe,
who was one of the NASA
engineers with whom we worked
closely. While he worked at
NASA, John flew more than 30
flights on the KC-135 and never
had to use an airsickness bag! On
a personal level, John is a
wonderful person as well as a
friend and colleague for many
years.

To collect EMG and force
platform data on the KC-135, we
had to prepare all of the
equipment in the aircraft so that
none of it floated away. The
following photo shows some of the sophisticated computer equipment as well as one of the most
important contributions to scientific experimentations---duct tape:

Another important NASA personnel
we worked with was Dr. Tom Moore who was
focused on the medical needs and solutions for
Astronauts. He worked closely with all of us to
design the appropriate tests so that the medical
staff could evaluate Astronaut performances on
Earth as well as in microgravity. Dr. Moore is
shown below during a land-based test of the
treadmill, bungee cord apparatus, and the force
plate. Also shown is a close colleague of mine,
Mr. Robert Wainwright, who worked with us
on several projects.

The following figure shows an original
pencil drawing of the schematic of the
Astronauts running on the treadmill and a
photograph of one of the astronauts running on
the Treadmill.
Mr. John Probe was the leader for the research for both the force plate and treadmill data collection. John had flown much mission that enabled him to anticipate when we had to begin data collection and for the duration of each data collection segment. These testing segments had to be carefully timed within the parabolic flight segments so that the astronauts would run during the period that was deemed “zero G” or “weightless”. It was critical that we start and stop the running sequences on time and John was attentive and precise so that every collection cycle was perfect.

My participation had begun days before when Mike Greenisen, John, and I had prepared the sequences in their Biomechanics Laboratory. We had discussed and planned for what data would answer the biomechanical questions that NASA had asked. John, Mike Greenisen, and I determined, before the flight, exactly which parameters were deemed the most necessary and appropriate. Mike was not going to fly with us so we needed to make all of our decisions, prepare the equipment, and secure the instrumentation in the aircraft ahead of time.

Despite my many years of air travel and my training for the KC-135 flight, it was an experience that can only be understood by actually flying on one of these missions I accompanied Mr. John Probe on two KC-135 treadmill running data collection flights. However, the first flight was the most interesting, exciting, and memorable experience, to say the least. At the beginning of the flight, all of the scientists and engineers sat in normal airline seats with the seat belt fastened. At that point, the naive participant, which included me, has no realistic understanding.

On the day of the test flight, John and I sat in normal appearing airline seats. We buckled ourselves into them as though on any routine flight. However, I soon discovered that the normalcy and routine airline passenger experience did not last very long on the KC-135.

Once we were airborne, John and I worked in harmony to coordinate the equipment and the astronaut running on the treadmill. Between sessions, we had to save all of the data and prepare
for the next cycle. The Astronauts were connected to the bungee cords, ran as hard as they could during the short moments of “weightlessness”, and John and I quickly fell into a routine. We had to trigger the force plate before and after the simulated “weightless” condition. We had to store the data into the computer with appropriate information so that when retrieved in the lab we would know to whom it belonged. We had to synchronize the cameras and the force plate data for each trial. This is just a short list of some of the details which we had to attend to on each parabola. There was one other situation unique to data collection on this aircraft, remember the name? Yes, indeed, there were some participants that had to use the airbags which frequently triggered sympathetic responses in others. It was quite unusual for me to be in a laboratory environment and have to dodge airbags or other particulate floating the air. This entire mission was quite an experience to say the least.

Once the KC-135 had executed all of the parabolic sessions, we were once again seated and buckled in as though we had morphed back into normal airline passengers. After we had landed, Mike Greenisen met us and helped John and I remove the treadmill, computers, cameras, and force plates. We returned all of the equipment to the lab so that we could begin data analysis in the morning.

The flight and data collection aboard this experimental aircraft was very intense but stimulating. There are no words to describe the sensation of “weightlessness” or the scientific drama associated with working on this research flight. There is a special thrill of Olympic competition but the exhilaration of simulated “Space” flight is indescribable.

I am proud to have been awarded another certificate. This honorary membership is to “the Society of Interplanetary Free Floaters” and was awarded by the Zero G Test Director. The certificate is shown in the figure below:

After the flight on the KC-135, John Probe and I processed the data we had collected. When we digitized the motion from the supplied film, we produced many stick figures to illustrate the results. An example of one of these figures is illustrated on the right:
Following the completion of the treadmill studies at NASA’s land-based center and aboard the KC-135 flights, we were able to establish the appropriate procedures for future Space exploration about fitness for the Astronauts. We determined the timing and extent of training to provide Astronauts with sufficient stress on the bones and other bodily systems. These stressors were essential for Space exploration since the body’s adaptation to microgravity would adversely impact their healthy return to Earth. These projects were designed for and were successful in determining what human beings were able to do to counteract micro-gravitational effects.

Needless to say, there were many factors to evaluate for humans to successfully fly into Space and return safely and healthy. Following our involvement with the treadmill studies, we were asked to help assess various movements required by Astronauts. Among some of the questions that NASA needed to answer included:

1. Focus studies to examine the functions of upper extremities during space flight.
2. Examine the use of power tools to enhance performance and reduce fatigue of the crew members.
3. Compare the use of a robotic hand to EVA crew interaction.
4. Use of the prediction of work and tools required performing a given task.
5. Comparison of perceived target accuracy and spatial orientation to actual target accuracy and spatial orientation.
6. Comparison of gross tasks to fine motor control.
7. Quantify performance of metabolism, muscles, forces, etc.
8. Evaluation of muscle, EMG, etc. of crew members.
9. The investigation into the use of a robot glove as an extension of the space suit.

As part of our on-going relationship with NASA, we provided them with our Ariel Computerized Analysis System. Kinematics, the study of motion exclusive of the influences of mass and force, was one of the primary methods used for the analysis of human biomechanical systems as well as other types of mechanical systems.

The Anthropometry and Biomechanics Laboratory (ABL) in the Crew Interface Analysis section of the Man-Systems Division was tasked to perform both human body kinematics as well as mechanical system kinematics using the Ariel Performance Analysis System (APAS). The APAS supported both analysis of analog signals (e.g. force plate data collection) as well as digitization and analysis of video data. There were several evaluations proposed to address methodological issues concerning the accuracy of the kinematic data collection and analysis used in the ABL.

A study was conducted by Robert P. Wilmington, a NASA engineer, to evaluate the accuracy of the Ariel Performance Analysis system for use by NASA in studying Astronaut motions. The study describes a series of evaluations performed to gain quantitative data pertaining to the position and constant angular velocity movements under several operating conditions. Two-dimensional as well as three-dimensional data collection and analysis were completed in a controlled laboratory environment using typical hardware setups. In addition, an evaluation was performed to evaluate the accuracy impact due to a single axis camera offset.

The specific results from this series of evaluations and their impacts on the methodology issues of kinematic data collection and analysis were presented in detail in Mr. Wilmington’s paper. The accuracy levels observed in these evaluations were also presented. His analysis concluded that the Ariel Performance Analysis System was able to identify and produce measurable movements accurately.
One of the first studies that NASA performed after this determination of the accuracy of the APAS by Mr. Wilmington was related to Landing and Normal Egress. The focus of the study was on functions related to reentry to Earth. The ability of astronauts to exit, or egress, the Shuttle, particularly during emergency conditions, may be reduced following physiological adaptations in space. This concern is based on anecdotal information. The tasks inherent to egress must be systematically documented to identify the critical issues for subsequent study. This investigation had immediate application to crewmember safety for mission success and completion. The results would also provide information discerning critical issues facing the Exercise Countermeasures Project for the development of appropriate countermeasure protocols and hardware.

The specific purpose of this initial investigation was to document the performance of physical tasks (logical sequence of events from video recordings) for astronauts to accomplish during Shuttle landing and normal egress. The activities required to accomplish events and the timing of event sequences would be documented by kinematic analysis.

Data about Astronaut performance on tasks for Shuttle entry, landing and normal egress, would be video recorded before and after missions. Subsequent investigations would focus on emergency egress and exercise countermeasure development.

This study required video recording astronaut performance during entry landing and normal walk-out egress of the Shuttle in two phases:

1. Preflight during simulated entry is, landing and normal egress in a simulator.
2. Post flight during actual entry is, landing and normal walk-out egress.

A total of eight assigned astronauts were requested to participate in the investigation.

After training in the Shuttle simulator, crewmembers would be video recorded while performing simulated tasks specific to their flight requirements. These recordings would be during flight tasks associated with the entry, landing and normal egress. Shuttle egress would be video recorded during seat exit, orbiter exit, and walking a distance of 10 meters from the orbiter. The first four steps at ground level would be on force plates to determine force patterning for gait analysis.

After Shuttle missions, crew members would be video recorded while performing actual flight tasks associated with the entry, landing and normal egress, identical to Phase 1.
This study required using the astronauts preflight during egress training, post-flight during landing, (out of seat egress), and during normal exit from the shuttle to ground level. A total of ten astronauts were tested in addition to five pilots and five mission specialists or Payload Specialists. The test subjects were selected so that comparisons could be made on post-mission, out of the seat, and walk-out egress performance. Video cameras and force plate instrumentation were placed appropriately to record the simulated tasks associated with landing and egress during normal training in the Full Fuselage Trainer (FFT) and the Crew Compartment Trainer (CCT). After egress training and during the practice of simulated egress, crewmembers were video recorded as they performed the actual tasks that were specific to their flight duties. Normal, walk-out of the orbiter, egress was also video recorded for a distance of 10 meters from the orbiter; however, specifying that the first three to four steps on the level ground be done on the force plate for force patterning and gait analysis.

During landing, video cameras in the orbiter recorded task procedures in upper and mid decks and for out-of-seat egress. Additional video cameras also recorded normal walk-out egress from the orbiter (down the stairs) to a distance of 10 meters with the first three to four steps placed on the force plate at ground level.

This study was the first of several to scientifically quantify the forces, movement patterns, the center of gravity, limb acceleration, and force velocities of motion during landing and egress tasks. This initial investigation of normal egress would be expanded in the future to evaluate ground-based emergency egress of volunteer subjects.

One of the tasks performed during this evaluation project required a full-suited Astronauts to turn a handle from top to bottom and reverse. The photo on the next page shows this simulation:
Another evaluation of the APAS system was related to lens distortion errors. Since our analysis system was video-based, the engineers needed to determine precisely the accuracy of our measurements. Since one of the errors inherent in any video based motion analysis could be attributed to distortions introduced by the camera and the lens.

Another factor inherent to NASA studies involved wide-angle lens. The wide-angle lens was often used in environments where there was little room to position cameras to record certain activities of interest. Wide-angle lens distorts images in a somewhat predictable manner. Even “standard” lenses tend to have some degree of distortion associated with them. Lens distortions can introduce errors into any analysis performed with video-based motion analysis system. Therefore, several of the NASA engineers were assigned the task of evaluating our APAS system to determine what errors could result due to lens distortions.

Additionally, NASA utilized an underwater environment for the Astronauts to practice many of the activities that they would have to perform in microgravity. Water most nearly duplicates the sensations produced in Space. The photo shown below illustrates an underwater test with a fully suited Astronaut accompanied by one of the NASA engineers, using scuba equipment, to assist in the task to be experienced in the simulated Space environment.

After we had completed the studies introducing the APAS to some of the NASA issues, Dr. Mike Greenisen explained the need to address exercise, fitness, and deconditioning problems associated with micro-gravitational environments. For example, without successfully addressing these problems, there could never be any Space experimentation exceeding more than a few days in duration. This was similar to the situation that Dr. Thornton had explained to me during his first visit. Obviously, this was an on-going topic of concern.

At this point, Dr. Mike Greenisen requested that we implement two of our Ariel Computerized
Exercise Machines at the Johnson Space Center in Houston, Texas. We worked with the staff there to evaluate the strength and endurance level of the Astronauts on site and then retested them immediately after they returned from their mission into micro-gravity. With this type of strength and functional performance testing, better training on Earth and in Space could be prepared.

Extravehicular activity (EVA) in space requires the most physically demanding task that astronaut perform on-orbit. Therefore, it was necessary to develop exercise programs as well as an exercise device to countermeasure these effects.

Dr. Greenisen prioritized the following biomechanical research objectives for immediate research projects:

* The design of flight dynamometer
* Task analysis and efficiency of IVA and EVA
* Biomechanical countermeasures of 0-G effects

All the biomechanical analysis was to integrate high-speed videography, EMG, and force plates. Also, a computer-controlled dynamometer is programmed to provide specific exercise prescriptions for the astronauts to maximize their muscular strength and endurance to perform the require tasks. NASA used the term “dynamometer” to identify what we had previously called the “Computerized Exercise Machine.”

The initial focus for the NASA personnel in the Astronaut training center at the Johnson Space Center in Houston, Texas as to test before and after Spaceflight. They needed to have quantifiable data for each Astronaut. This allowed the doctors and physiological specialist to evaluate each person in detail regarding their specific strength and endurance status. When they returned from their time in microgravity, they were immediately retested to evaluate their condition. Then they would be prescribed training sessions to recover their strength and fitness losses due to the absence of gravitational effects on their bodies.

The Ariel Computerized Exercise System machines were essential in this evaluation process. It was the only system that could determine their strength at each point in the movement, determine if there had been any change in their force and/or movement velocity output, and record their data for other considerations. It was imperative that the individuals train on the system after Spaceflight and be evaluated on their recovery levels for strength and endurance in addition to determining the length of time needed to return to pre-flight fitness levels.

The next step for us was to develop a computerized exercise system, or dynamometer in NASA parlance, that could be used on the KC-135 flight simulator aircraft. Initially, we would design an interim dynamometer similar to our existing Computerized Exercise Machine. This interim unit would be the “Resistive Exercise Device” or RED. Before flight use, we would have to modify the frame and arm/leg mechanisms. We worked closely with Mr. John Probe to create a system that could be bolted to the floor of the aircraft as well as appropriate restraint devices for the person exercising. My friend and colleague, Mr. Bob Wainwright, was extremely helpful in working with me on this venture. Mr. Wainwright had purchased one of my first computerized exercise machines several years before this time and he and I had spent many hours modifying equipment for specific uses. Of course, neither one of us had previous experience in microgravity, so this was new and exciting work. The areas in contact with the human body had to be sufficiently well-padded so that there would be no bruising during the forceful exertions with each exercise.

I also flew my main programmer, Dr. Jeremy Wise, to Houston so he could see for himself the hardware arrangement and to discuss the specific software requirements for testing and working in micro-
gravitational situations. Dr. Wise was a nuclear physicist so the math and engineering requirements were quite straightforward for him.

Some of the requirements to in-flight 0-G exercise dynamometer were as follows:

1. The flexibility of performing exercises and diagnostics in isotonic, isokinetic, isometric, accommodating velocity at variable loads as well as accommodating resistance at variable speeds or any combination of these exercise controlled modes.
2. The ability to perform exercises and diagnostics from a pre-programmed sequence of tests and exercises stored on disk. The NASA investigator could prescribe the testing and rehabilitation programs from a library of specialized programs or create specific protocol tailored for each individual Astronaut.
3. Provide user-friendly, menu-driven software packages which can be easily learned and are simple to operate.
4. Allow data transfer to other commercial or custom software packages for graphing, data report formats, statistical analysis, etc.
5. Enable external analog data acquisition which can be correlated with acquired force curves such as E.M.G. data and load cells.
6. All dynamometer functions can be controlled or monitored either from the keyboard, hard disk storage, or a remote location, via telephone modem and satellites.
7. The ability to simulate real task activities for comparison of strength and endurance in 1 and 0 Gs.
8. All exercise program variables, such as intensity, frequency, duration, sets, workload, percent fatigue, can be controlled and changed from the control keyboard or by the remote modem.
9. The software is an artificial intelligence expert system that monitors, controls and adjusts prescriptions according to the measured output of the exercise.

Our Ariel Computerized Exercise Systems fulfilled all of these requirements which is pictured below.

The regular commercial Computerized Exercise System (CES)
At this time, a modified version, which NASA referred to as the “Resistive Exercise Device” or RED was the next step for KC=135 testing. This modified Ariel Machine had to be smaller in size and with modified arm units for it to be functional on the experimental aircraft.

In addition, suitable methods for bracketing and stabilizing the computers and screens on board had to be created. Some photos illustrating this modified RED during one of the KC-135 test sequences are shown below:

![Original prototype and sample screen image for the RED presented to NASA in 1989](http://arielnet.com/ref/go/1253)

![Astronauts Using the RED Aboard the KC-135](http://arielnet.com/ref/go/1253)
This newly developed RED and its successful performance by the Astronauts on the KC-135 were perfect. The unit performed flawlessly, each of the individuals who utilized the machine was able to do so without difficulty, and the computer functioned and stored all of the data perfectly.

Dr. Greenisen was on the landing strip when we returned from the flight and was thrilled to hear the positive responses on all levels of consideration. We memorialized the event with a photo of Dr. Greenisen and me in front of the RED on the KC-135 which is shown on the left.

Shortly after we returned to Earth, Dr. Greenisen sent us a letter of appreciation for our efforts in delivering the RED, a copy of this letter is illustrated on the left:

Shortly after we had completed our activities on the shuttle with the RED, I traveled to the Johnson Space Center (JSC) with an Israeli colleague of mine, Moshe Lahave. Moshe had served in the Israeli air force as a pilot. One of his mission involved a dangerous and challenging flight to the Iraqi nuclear plant located in Bagdad. His task was to fly over the plant, photograph it, and safely return to Israel. The mission began after months of preliminary practice takeoffs and flights near Amman, the capital of Jordan. Jordan was one of the two countries that had signed a peace treaty with Israel, the other one being Egypt. However, the Jordanians were not going to be asked for help in this adventure because of mission security and to avoid placing Jordan in a difficult diplomatic position.

Moshe took off from his airbase around midnight and quickly altered his flight pattern to fly near a Lufthansa
Ms. Barbara J. Perkins  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Johnson Space Center  
Mail Code BD 3  
Houston, Tx. 77058  

October 25, 1989  

Re: Unsolicited Proposal For Using The Ariel Dynamics Inc.,  
Exercise and Analysis Dynamometer and Software System As An  
In/Flight, 0-G, Exercise Dynamometer System.  

Ariel Dynamics Team For This Project:  
Gideon Ariel, Ph.D. - Company Chief Executive Officer, Inventor and  
Founder  
Jeremy Wise, Ph.D. - Chief Programmer and Executive Officer of  
Software Systems Development  
Robert W. Wainwright, P.T. - Clinical Applications Director for  
Medical and Sports Related Fields.  

INTRODUCTION  

This document is an unsolicited proposal to present the case for the use of  
the Ariel Computerized Exercise System [hereafter, for the purpose of  
this document, referred to as CES] dynamometer for consideration as an  
in-flight dynamometer system, for future 0-G orbiter and space station  
missions.
passenger 747 jet which had left Amman a short time after Moshe had gained the correct altitude. Unbeknownst to the pilot, crew, or passengers, Moshe flew his jet closely behind and below the Lufthansa aircraft. He flew without navigational or warning lights and maintained radio silence. He needed to fly close enough to the passenger jet so that he appeared to be part of the same signal observed by ground radar trackers. It was essential to the mission that he not be detected but, fortunately, Moshe was highly skilled pilot.
He flew this highly irregular flight plan, accompanying his passenger jet “host”, all the way to Bagdad. When he reached Bagdad, he had to increase his altitude to the maximum capacity of his aircraft. Then, he had to turn his engines off, so that he could take the photographs necessary for the mission. The engines had to be turned off to reduce as much vibration as could be achieved so that the camera would acquire the pictures in sharp focus. The year was 1981 and the camera he had to use was much less sophisticated and technological capable as even small cell phone are today in 2015. The camera lens had a one-meter diameter and was extremely heavy.

After taking all of the necessary photographs, his task was to return safely to his air force base in Israel. This was, by no means, as easy feat. By that time, he had been detected by radar and, under normal flight plans, he would have to fly through defensive ballistic fire from the ground as well as attacks by fighter jets. However, Moshe’s plane had been stripped of all its guns or protective gear had been replaced with the large camera and extra fuel. These changes to his aircraft meant that he had to use other piloting skills to return to base.

With the distance he needed to cover to his target and return home safely would require all of his piloting skills and tremendous luck. Moshe again changed his flight altitude and flew as close to the ground as could be achieved without actually hitting anything. He had to fly below radar detection, in broad daylight, as well as outrun and out maneuver the Iraqi fighter jets. If everything went as planned, Moshe would probably be flying on fumes when he returned to base. Fortunately, Moshe was one of Israel’s best pilots and was able to execute the return flight successfully. The camera had functioned perfectly, as well, and the data proved extremely useful in the days that followed. (After the Israelis successfully destroyed the Iraqi Osirak nuclear plant on June 7, 1981, Saddam Hussein did not rebuild it to the relief of many.)

Another example of Moshe’s superb flying skills was on one of his flights in an F-4 fighter jet. As he was returning to his base following a mission, a missile knocked off one of the wings on his F-4 fighter jet. For most pilots, losing a wing means crashing the plane while hoping that the parachute correctly deploys before the plane’s impact. Moshe, however, immediately shut off all of the automatic equipment. Using his hands and feet to guide the critically compromised aircraft as well as manipulating the power thrusts and manual guidance mechanisms, he was able to land the plane with one wing. (As of this book’s publication, I am aware of only one other pilot, with the U.S. Navy, who has successfully flown an F-4 safely back to base after losing a wing.)

For years, Moshe had nagged me to take him to NASA to see the technologies there. However, there was a policy in NASA regarding non-American visitors. I discussed the matter with my friend Mike Greenisen and he told me to bring Moshe. Mike told me that when we arrived at the entrance and

Moshe Lahav
were asked identification, Moshe should keep his mouth closed. Mike would provide documentation for us which would be sufficient as long as Moshe remained mute as his pronounced Israeli accent would be immediately detected.

Mike met us at the entrance and began the tour of the facilities on the way to the Biomechanics Lab. But, ever the inquisitive Israeli, Moshe wandered away from us and walked into a secure area. His visitor’s badge was not coded for this area so all of the horns began hooting and the warning lights began flashing. Once again, Mike Greenisen had to clear up the security mess. He warned Moshe that he would personally usher him out of the building if he moved one step out of line or away from Mike’s side.

One of the reasons for Mike Greenisen’s interest in having Moshe visit the JSC was the subject matter of Moshe’s Master’s thesis. His thesis was investigating the multiple G-forces affecting jet fighter pilots during aerial combat flight. His experimental study had been to test Israeli pilots on the Ariel Computerized Exercise Machine. Each pilot executed a series of sit-ups. During each upward motion, four isometric contractions were elicited for 5-second durations. The system could be programmed to perform combined isotonic and isometric tasks during each segment of the movement. Moshe was able to store all of the individual data for each pilot during the six-week training sessions. The exercise sessions were conducted every other day for six weeks.

The study results revealed increased abdominal strength throughout the range of movement. More importantly, however, was the transfer of this increased strength to flight performance. Each pilot was able to contract his abdominal muscles repeatedly resulting in greater G-force tolerance levels. The ability to contract and release the muscles of the torso enabled the pilots to maintain adequate blood pressure and blood flow to the brain. With the increased blood flow and pressure, the oxygen levels in the brain were increased. Without the ability to keep sufficient oxygen in the brain, pilots faint. During combat, pilots must be able to turn, twist, and dive their aircraft frequently at high gravitation forces. Maintaining appropriate oxygen levels in the brain, allows pilots to achieve enhanced flying skills that can mean the difference in life or death. This increased abdominal muscular strength allowed improved combat skills and, thus, improved success in battle and survivability.

Mike Greenisen’s interest in Moshe’s thesis was the similarity of air force fighter pilots and astronaut skill requirements during shuttle liftoff and reentry. The increased gravitational forces were quite high during these segments so that task requirements and control devices placements of were critical for the mission and safety issues. Any factor that would impact on the physical abilities of the shuttle astronauts was of special interest to NASA.

Moshe and I spent the rest of the day working with Mike Greenisen and his assistants on setting up an experimental program for the astronauts. Since NASA had the Ariel Exercise System, they could conduct experiments on Earth as well as using the RED on the KC-135. Despite setting off all of the alarm bells at NASA, Moshe ended the day in a more favorable position with Mike.

Our next task was to work with NASA to modify our Ariel Computerized Exercise System for the Space Station. This would be the actual “Dynamometer” which had previously been the designated name and goal of a Space-based exercise unit. The goal of this proposal was to develop a computerized, feedback-controlled, portable, battery-powered, hydraulic dynamometer that can be used in normal, reduced-g, and zero-g environments. The proposed device would provide a closed-loop feedback system to measure and control various muscular strength parameters. The innovativeness of this device includes (1) the ability to measure muscular strength without the limitations imposed by traditional weight-related devices; (2) computerization of both the feedback control feature, allowing adjustment of the device to the individual rather than the individual accommodating the device, (3) customization of the diagnostic and exercise protocols with data storage capabilities; (4) low-voltage, (5) portability, and (6) compactness. The relevance of the proposed equipment for NASA was in its ability to evaluate astronaut strength and endurance levels as well as to design and follow appropriate exercise protocols in all
gravitational environments. Data could be stored for later evaluation and for use in conjunction with other medical or physiological assessments in the continual effort to identify and counter the deconditioning caused by microgravitational conditions.

Our proposal to Mike Greenisen and his technical staff at NASA was to develop equipment intended for use as an effective countermeasure tool as well as addressing several of the operational restrictions imposed by spaceflight. Utilization of a hydraulic mechanism would provide a means for adequately creating resistance thus overcoming the ineffectiveness of weight-based equipment in zero-g. The apparatus would be compact, portable, and powered by low-voltage DC batteries that eliminated the need for power necessary for the shuttle itself. These attributes were deemed necessary for easy and safe use in the restricted confines of the shuttle or on the space station.

Computerization of the apparatus would provide several important innovations: (1) Activities performed would be programmable for "individualized" diagnostic routines and exercise protocols with results stored for subsequent evaluations. (2) The feedback control afforded by rapid computerized assessment and adjustment would ensure that the equipment would adjust to the performance levels of the astronaut rather than the reverse. An individualized adjustment would assure that size and/or gender would be irrelevant for successful operation. (3) Activities would be designed bi-directionally since resistance could be provided in both directions of bar movement. (4) Graphic displays and audio cues would provide information to the individual with such items as current strength level, repetition number, and bar location. The sound cues could be modulated in proportion to the exerted force to inform the individual about his or her performance response without the need to see the computer monitor. This would simplify operation as well as provide biofeedback. One of the most important features of the proposed device concerned its functionality under all gravitational fields. Thus, medical and physiological researchers could design and test models on earth with the ability to recreate and evaluate the same models under reduced-g conditions.

The first thing we needed to do was to select a portable, battery-powered computer that has the capability of interfacing with a Controller board used for analog to digital signal processing and dynamometer control. Additional attention will focus on disk storage capacity, secondary storage mediums, and visual display characteristics.

The second thing was to select a Controller board used for analog to digital signal processing and dynamometer control that would interface with the selected computer. Additional attention would focus on disk storage capacity, secondary storage mediums, and visual display characteristics.

Thirdly, develop software on the computer-tailored specifically for the Earth and micro-gravitational activities. This software would be similar to the programs that had been tested on the previously designed RED model.

The software considerations were not trivial with several problems that had to be overcome. (1) The power requirements of the computer, the Controller board, and the transducers needed to be more efficient and with the greater capacities. The power supply would have to be independent and could not be taken from the shuttle power supply. (2) Rapid computer processing required innovative programming code to afford smooth response for real-time feedback control. (3) The flat panel monochrome displays characteristics associated with portable, built-in single monitor computers presented a unique challenge concerning the speed and aesthetic qualities for the interactive visual medium.

This was an ambitious design goal which would require frame materials to have maximum strength-to-weight ratios and the structure must be engineered with attention directed towards compactness, storage size, and both ease and versatility of operation.

Existing transducers available commercially would be utilized for the proposed exercise machine project. The function of these input devices is to supply information to the computer about the location of the bar or handle against which the individual exerts force as well as the amount of that force. This
information must be provided rapidly enough for the computer to process the input signal and respond with an adjustment, if needed, to the hydraulic valve assembly so that the internal response adjustments are undetectable by the individual using the device. A characteristic essential to the proposed equipment was that the individual was exerting force perceived only smooth operation and was insulated from any detection of hardware and/or functional adjustments. The continual exchange of data between input sensors and the regulation of the hydraulic system was one of the most crucial segments of the software programs.

We were able to use the hydraulic valve, pack, and cylinder assembly that was currently integrated with our existing, commercially available stepper motor. A stepper motor was attached to a hydraulic valve assembly which opened and closed an orifice regulating the flow of hydraulic fluid, thus controlling the amount of force needed to push or pull the piston within the cylinder. Our plan was to design a smaller and lighter hydraulic valve, pack, and cylinder assembly for the future shuttle missions.

Further consideration was to identify a flight-qualified fluid which would be more appropriate for micro-gravitational locations. Consideration of alternative resistive mechanisms has been abandoned because of the limitations imposed in zero-g conditions. Weight-based devices would have no value under reduced-g or zero-g conditions. Pneumatic resistance was rejected because of the pressure requirements, the problems associated with the compressibility of gasses, the difficulties associated with accuracy and calibration of measurements, and the need for pressurized cylinders. Hydraulic mechanisms are less affected by gravitational forces, can be regulated by low voltage, battery powered devices, can operate in both up and down stroke directions, and can function passively. Consideration of an "active" hydraulic system, which would provide conditions in which the individual would have to resist forces generated by the dynamometer, were rejected for the following reasons: (1) user safety, (2) decision against employing any motorized devices within zero-g workspaces for environmental safety considerations, and (3) more than sufficient and adequate results are obtainable with "passive" mechanisms.

The software would provide computer interaction with the individual operator and was planned to function automatically by presenting a menu of options when the dynamometer system was activated. The menu was to have included at least four options: (1) diagnostics, (2) controlled velocity, (3) controlled resistance, and (4) controlled work. For all cases, the motion would be regulated in both directions, that is, when the bar moved up and down. Each of these four options will be briefly described in the following paragraphs.

Selection of the diagnostics option would allow several parameters about that person to be evaluated and stored if desired. The diagnostic parameters included the range of motion, the maximum force, and the maximum speed that the individual could move the bar for the specific activity selected. The maximum force and maximum speed data would be determined at each discrete point in the range of movement as well as the average across the entire range. The diagnostic data could be used solely as isolated pre- and post-test measurements. However, the data could also be stored within the person's profile so that subsequent actions and tests performed on the exercise machine could be customized to adjust to that specific individual's characteristics.

The controlled velocity option would permit the individual to control the speed of bar movement. The pattern of the velocity would be determined by the person using the equipment and these choices of velocity patterns included: (1) isokinetic, which provided a constant speed throughout the range of motion; (2) variable speed, in which the speed at the beginning of the motion and the speed at the end of the stroke are different with the computer regulating a smooth transition between the two values; and (3) programmed speed, which allowed the user to specify a unique velocity pattern throughout the range of movement. For each of the choices, determination of the initial and final velocities will be at the discretion of the individual through an interactive menu. The number of repetitions to be performed
could also be indicated by the person. It would be possible to designate different patterns of velocity for each direction of bar movement.

The controlled resistance option would enable the person to control the resistance or amount of force required to move the bar. The alternatives include: (1) isotonic, which provided a constant amount of force for the individual to overcome in order to move the bar; (2) variable resistance, in which the force at the beginning of the motion and the force at the end of the movement are different with the computer regulating a smooth transition between the two values; (3) programmed resistance, which permitted the individual to specify a unique force pattern throughout the range of movement. An interactive menu enabled the person to indicate the precise initial and final values, the number of repetitions to be used, and each direction of bar motion will be independently programmed for each of the three choices.

The controlled work option allowed the individual to determine the amount of work, in Newton/meters or joules, to be performed rather than the number of repetitions. Also, the person was able to choose either velocity or resistance as the method for controlling the bar movement. As with the previous options, bi-directional control will be possible.

Needless to say, our chief programmer, Dr. Jeremy Wise, was well known to Mike and his NASA staff. Jeremy had worked previously with them on several software modifications so that our systems functioned in the manner required by NASA. He would be an integral part of the new dynamometer and its software needs.

Among those software needs was the accuracy of measurement. This was an essential factor since data had to be collected in one- and zero-gravitational fields. This function was deemed as one of the most important considerations in the software development. Calibration of the proposed exercise device would be possible under dynamic conditions and was a unique feature that the computerization and the feedback system were allowed. Calibration would be performed using weights with known values and would be executed on Earth before any reduced gravitational environmental activities. The actual calibration procedure allowed the individual to place known weights at the starting position and, when released; force data would be sampled until the ending position was reached. The calibration procedure was performed in both up and down directions. This type of calibration is unique in that the accuracy of the device can be ascertained throughout the range of motion.

We continued to work with Mike Greenisen and his NASA staff over the years with the on-going dynamometer development as well as other projects. I was both fun and challenging work to be involved with these various projects at NASA. Mike Greenisen and his able staff of engineers were wonderful colleagues to work with and share ideas. It was a unique environment of immersion in the exciting frontiers of space exploration and the need to develop tools so that humans could successfully and safely explore horizons beyond the Earth.

We continued to work with NASA over the years. In addition to the work with Mike Greenisen, we also moved to a new laboratory in our beautiful Coto Valley. This exciting development will be covered in the next chapter.
“Times they are a’changing” was a line from a popular song in 1964 by Bob Dylan but it seemed to be appropriate for our situation in 1987. The introduction of the personal computer had a profound effect on the world as PCs seemed to arrive and overwhelm instantaneously and ubiquitously. Many of our clients, such as Wilson, Spalding or AMF, could buy their own in-house computers and pay for our software license. This would allow them to process their own research without the concern that the information could leak to competitors.

Although we had derived great enjoyment being involved in projects we had executed, the thrill of developing new software on newer hardware had an intoxicating appeal. Nothing could replace the Olympic athletes and their enthusiasm. There was no replacement for analyzing a violinist, or calculating forces on three-wheeled recreational vehicles, or evaluating the science of behavior of sporting equipment. But the vast majority of companies wanted to keep their secrets to themselves while, at the same time, we had discovered a vast new horizon of computer technologies ripe for exploration.

From this new, smaller computer world perspective, our own corporate needs no longer required a large dedicated computer room with special air conditioning and elaborate hardware. The Woman’s Volleyball team had left after their Silver Medal victory in 1984. As I mentioned before, most of our corporate clients were more interested in licensing our software for in-house use thus our need for extensive space was eliminated.

Ann and I decided that now was the time and the opportunity to make a big move. We could focus on improving our software and hardware for the IBM PC and continue software enhancements for the Ariel Computerized Exercise Machine. The time seemed right to conclude our co-venture with the Coto De Caza Corporation for the Research Center and settle the financial ownership to everyone’s satisfaction.

Fortunately, the Coto De Caza Corporation had been successful at selling properties to new owners for a hefty profit so they had already sold most of their real estate holdings. As a real estate corporation, they were no longer needed athletes or corporate executives to visit the Research Center as this unique advantages had served them well from a business point of view. At this point, they cared only about was selling the few lots and houses which remained. Our existence, from their point of view, had been a unique advertising and news-worthy part of selling and advertising property.

I had fulfilled my promise to Mr. Palmari to bring the Olympics to Coto De Caza and this had helped to sell thousands of homes and real estate property for them. However, the current administrators of the Coto de Caza real estate company were not particularly interested in the Olympic ideals. (To my
continuing amazement, the owners of Coto De Caza have never used the Olympic Rings symbol in their restaurant or the arrival gate. They have the right to use the rings for their marketing since Coto de Caza was an official Olympic site just as Squaw Valley has been using this designation for years since the Winter Olympics were held there. I would have assumed that they would enjoy the notoriety of this designation as well as pride it their achievement, but I guess my thinking differs from theirs.) Essentially, our needs and those of the Coto de Caza Development Company had been completed and it was in the best interests of both parties to conclude the Joint Venture. Fortunately, we were able to complete this dissolution quickly and amicably.
Now we began our search for a new, smaller, more modernly-appropriate facility for our corporate focus. Ann and I explored the areas around Coto de Caza and even drove as far south as northern San Diego County. We examined office spaces available in the newly expanding community of Rancho Santa Margarita which was adjacent to our little Coto valley. Everywhere we looked had wonderful choices but none was as perfect as our special Coto de Caza valley so we started to search closer to home.

I had a small Honda motorcycle that I used to ride between our condo and the Research Center. I suddenly had an inspiration that sent me on a “sight-seeing” adventure riding around Coto to explore some of the newer housing developments. After a while, I found a brand new section with four models in a cul de sac. The real estate company sign was in front of one of the model houses, so I parked my Honda in the driveway and went into the office.

I walked into the real estate office in my normal Coto attire----shorts, T-shirt, and flip-flops. There were two women sitting at desks in the reception area both very well dressed with perfect makeup and hair styles. When they asked if they could help me, I responded that I needed to purchase two houses side-by-side. I am sure they imagined that I was either a prankster or from a gag TV show. I obviously did not look as though I was a serious home buyer nor was my request for two adjacent houses a normal one.

They did politely inform me that the only two houses available that were adjacent to each other were two of the models.

“I’d like to buy these two homes immediately,” I said, running my hand through my hair.

The two realtors looked at each other and then at me in my shorts and flip flops, a man who had just parked his little Honda motorcycle next to their office. They looked me over suspiciously. “Well,” one lady said, “Would you like to see what they look like inside?”
“Not really,” I answered, “I am sure they are perfect or you wouldn’t have built them in Coto de Caza.”

“You will have to make a down payment of $50,000 on each house.” the second lady told me presumably thinking that this crackpot would be discouraged and leave.

“That is no problem” I replied. “What is the next step?”

“You will need to complete this form,” the realtor said, “and we will need the down payment.” At this point, I am sure they were no longer certain if I really was crazy or just extremely eccentric.

“Can I use your phone to call my girlfriend? “I asked since this was in the days before cell phones.

I dialed our phone number and said “Ann, please bring a check for $100,000. We are buying two houses here, one beside the other.”

“What?” was the response.

However, Ann was used to my eccentricities and trusted my hunches. She drove from our condo in our 1971 Chevrolet with the checkbook. Once she arrived at the real estate office, I was relieved that the two agents had become a little friendlier and perhaps slightly less confused by my behavior. I had spent the interim telling them about my background as well as our search for a new research center.

When Ann arrived, the ladies told her that inspecting the two houses was of no interest to me. As always, I am the visionary or dreamer and Ann is the more practical. I, therefore, was not surprised when Ann assured them that she most certainly wanted to see what the buildings looked like inside. The ladies escort us on a brief tour of each house and we agreed that they would suit our purposes. Then Ann and I conferred and decided that she and I would reside in the smaller, one story unit and use the large two-story building for our research.

Not only was Ann the practical one, but she was also completely prepared to take the time to fill the necessary forms and write the checks for each of the houses. Then she waited for the agents to make duplicate copies of our records. I could image the wheels turning in her head as she prepared for the next steps of organizing and moving.

The two real estate agents must have thought that I was totally crazy because of the way I was dressed and the manner in which I was attempting to purchase two houses. However, my assumption was that you could not make a housing mistake in Coto De Caza. For years, our Valley had been described as “Shangri-La” or the “Best Kept Secret in Orange County” among other accolades. The real estate “decedents” of Victor Palmari had maintained a tight control over the builders whom they had selected to develop the area. Therefore, all of the houses were well-suited for the lot upon which they were built and their interior architecture and floor plans were well conceived. While many of these homes
were most likely priced at double what a comparable house outside this gated community would have
cost, the uniqueness of living in this gated community in a scenically lovely valley more than justified
the price….at least to those who purchased houses here.

To get a sense of some of the residents who came to live in this community, you would have
needed to watch a television series called “House Wives of Orange County”. This program was
developed and filmed in Coto de Caza.

The creator and director of the show were Mr. Scott Dunlap who has been a friend for many years.
He worked with me from time to time and I met him with his brother, Mr. Doug Dunlop, who was the
attorney for the US Olympic Committee when I worked with them. After the first few shows had aired,
we happened to be having dinner with Scott and his beautiful wife, Gayle. Ann asked Scott how this
television show was conceived and the answer was quite astonishing. Scott described going to a local
restaurant with his wife and another couple. While they were waiting for their meal, the wife of their
friend ordered a sour apple martini. When the drink arrived, she requested one of the small cocktail
straws used to stir drinks. She then used the straw to sip her martini to the amazement of Scott and his
wife.

“Why are using the straw to drink your cocktail?” was Scott’s stunned question.
“I don’t want to mess up my lipstick” was the answer.

This true event was one among many of his tales of people they experienced among their friends
and acquaintances living in Coto de Caza. Some were even more bizarre but there were enough to form
the core around which Scott was able to create an entire season of stories.

They even interviewed me for this incredible program (Show number 7). I was the local
biomechanical expert who lived in Coto de Caza and could perform an analysis of the
baseball pitching motion of the son of a baseball professional
who lived in Coto. The wife and
mother of this young man were
one of these “housewives”.
Needless to say, after I watched
the first episodes of the show, I tried to get out of my segment, but could not. Since Scott was my friend,
I did it for him. (Ann was and continues to be outraged and embarrassed that people would think that she
was like any one of those television portrayals. But I have assured her that they are more unique than
flying sharks would be.)

Now that we had purchased our new home and research facility, we were ready to move. This
was more convenient than our previous journey from the East Coast to California, but it was still an
arduous task.

Our new research building was located in a residential area but only a few of our personnel stayed
during the day, so there were no problems with the neighbors. Our business had evolved into software
development and internet-based, thus, we only needed desks and computer connections. There would be
no manufacturing on site nor big trucks picking up and delivering merchandise. In addition, we no longer
needed a large facility for athletes. In fact, most people in the community had no idea what activities
went on inside of either of our houses. The company which manufactured our exercise machines was
located approximately 20 miles away, so very little traffic went in and out of the office-research house.
The time came to dismantle the Coto Research Center. It was heartbreaking to watch all our inventions and equipment, which had been significant vehicles for our achievements, reaching a point of uselessness. However, we could no longer use them since they had all become obsolete. The Data General computers were big and slower than the IBM PC. The Megatek Graphic unit had been state-of-the-art when we first began to use it for three-dimensional display. Now we could use a smaller, faster desktop computer to accomplish the same display techniques. The special room with its raised floor and dedicated electrical circuitry and air conditioning to maintain the Data General computers were no longer required. Now, for a few thousand dollars, we had as many PCs as we wanted which functioned on a desk anywhere in the building without temperature control needs. When a computer went bad, it was cheaper to replace it with a newer model than to fix it.

This phenomenon of needing to change computers to obtain increased size and speed was not surprising to those involved with the computer world of that time. One reason was consistent with “Moore’s Law”. “Moore's law” is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years. The observation is named after Gordon E. Moore, the co-founder of Intel and Fairchild Semiconductor, whose 1965 paper described a doubling every year in the number of components per integrated circuit and projected this rate of growth would continue for at least another decade. In 1975, looking forward to the next decade, he revised the forecast to doubling every two years.

Moore’s prediction proved accurate for several decades and the law was used in the semiconductor industry to guide long-term planning and to set targets for research and development. Advancements in digital electronics are strongly linked to Moore's law: (1) quality-adjusted microprocessor prices, (2) memory capacity, (3) sensors and (4) even the number and size of pixels in digital cameras.

Digital electronics have contributed to world economic growth in the late twentieth and early twenty-first centuries. Moore's law describes a driving force of technological and social change, productivity, and economic growth. The period is often quoted as 18 months because of Intel executive, David House, who predicted that chip performance would double every 18 months (being a combination of the effect of more transistors and the transistors being faster).

"Moore's law" should be considered an observation or projection and obviously not a physical or natural law like gravity or magnetism. Although the rate held steady from 1975 until around 2012, the rate was faster during the first decade. In general, it is not logically sound to extrapolate from the historical growth rate into the indefinite future. For example, the 2010 update to the International Technology Roadmap for Semiconductors, predicted that growth would slow around 2013. In 2015, Gordon Moore, foresaw that the rate of progress would reach saturation.

However, for our needs and experiences from the 1970s through into the late 1980s, this growth and development within the computer industry had been volatile. The explosion of computer parts, software, and displays had been nothing short of awe-inspiring. We were akin to children addicted to sugar being released in a candy factory. No sooner had we developed our codes for one type of computer, another more exciting and revolutionary one was introduced. It was a fantastic new world for us and our products.

We also engineered all of the new technologies available at that time in both houses. There were no new technologies that we did not have especially with communications tools. In the early 1970’s, I
had realized that on-line communication, which today is the Internet, was the future and we would always have to concentrate on mastering and using it.

While we were preparing our new lab and home for the technological advancements that were currently available. Ann reminded me that during our graduate study years, I insisted that getting in a car and driving to a classroom to listen to a professor was a ridiculous, medieval educational concept. My thinking was that education should be available in your own home or office through computer connections the same way that we were able to currently communicate via modems. In today’s world, universities all over the Earth provide on-line classes, Khan Academy helps students with understanding concepts, and there is a myriad of educational opportunities available at the fingertips of anyone with a computer and an internet connection regardless of where you are on our planet so now my idea seems obvious. But in the 1970s, most people thought I was describing a science fiction movie.

I am sure that the modern reader of this material wonders at these tales of ancient history in the same way that I thought King Lancelot and his knights were ridiculous. But, these “archeological” descriptions are accurate for those times. I was also convinced that television choices should be available when the consumer wanted to view the shows not just at the time that the network broadcast it. In the 1970s, for example, American families’ television options were limited to only 3 or 4 stations. There were the “regular” network stations of CBS, ABC, and NBC with the occasional Public station or an independent channel. Those were the days when television signals were picked up with antennas usually sitting on top of the set. Many a home had “flags” of aluminum foil attached to these “rabbit ears”. The stations operated with limited hours of broadcasting and had sign-off hours, usually about one in the morning followed by hours of static on the screen until the station returned around five or six in the morning with the next day’s programming. That was it! None of the 50 to 100 channels currently available. There were no cable networks or web streaming stations. These were the pioneer days of visual broadcasting. But I wanted to be able to watch the evening news when I got home even if it were midnight. I was confident that it was possible to enjoy this freedom of selected viewing if only I could find a way to tap into a broadcasting system and develop a delivery mechanism similar to how I was able to communicate with the university computers via a modem connection.

It turned out that I was not the only fellow who imagined the concept of education on demand, in your own home or office. In 1953, the University of Houston had offered the first televised college credit classes via KUHT, the first public television station in the United States. The live telecasts ran from 13 to 15 hours each week. Most courses aired at night so that students who worked during the day could watch them. By the mid-1960s, with about one-third of the station's programming devoted to education, more than 100,000 semester hours had been taught on KUHT. The problem, from my perspective, was that the classes were just as time dependent as driving to the lecture. The student had to take the class when the teacher gave it. I wanted education to be as available as selecting an option presented on a computer.

Some improvement had been made by 1959, when the University of Chicago first produced “Sunrise Semester”. This was a series of courses delivered via broadcast television which was moving in the right direction from my point of view.

However, an even better system was developed in 1960 which was PLATO (Programmed Logic for Automated Teaching Operations). This was a system developed at the University of Illinois at Urbana-Champaign. One of the primary developers was Donald Bitzer. The PLATO system featured multiple roles, including (1) students, who could study assigned lessons and communicate with teachers through on-line notes, (2) instructors, who could examine student progress data, as well as communicate and take lessons themselves, and (3) authors, who could do all of the above, plus create new lessons.

Another important development in 1960 was called Project Xanadu, the first known attempt at implementing a hypertext system, founded by Ted Nelson. In 1962, the initial concept of a global
information network should be given to J.C.R. Licklider in his series of memos entitled “On-Line Man Computer Communication”. However, the actual development of the internet must be given to Lawrence G. Roberts of MIT.

Telesecundaria, a system based on satellite TV for secondary students in rural areas, was set up by the Mexican Government. Initially, over 6,500 students were served in 304 classrooms, each one equipped with a satellite dish and a black-and-white TV set. The system is still in use, but now reaches over a million students in 16,000 rural facilities in Mexico and several Central American countries.

An IBM 1500 system was installed at the University of Alberta, where on-line courses included cardiology training for the University's medical school. This system was finally taken out of service on April 10, 1980, after twelve years of operation. Over 20,000 people had used the system in that interval and programming was available for 17 university courses. The instructional operating system of the IBM 1500 had a registration system, bookmarking, authoring, and progress reports all built-in.

Of course, by 1969, The US Department of Defense commissions created ARPANET (and thus the Internet as we know it today). At the same time, Stanford University broadcasted 12 Stanford engineering courses on two channels via the Stanford Instructional Television Network (SITN). Patrick Suppes, the professor at Stanford University, developed computer-based courses in Logic and Set Theory that were offered to Stanford undergraduates from 1972 to 1992.

The Learning Research Group was formed at Xerox PARC in Palo Alto, California. It was led by Alan Kay, who advanced the idea of a graphical user interface (GUI) by inventing icons for folders, menus, and overlapping windows. Kay and his group envisioned a computer for teaching and learning that they called the "KiddiKomputer", to be programmed using the Smalltalk language they had developed. While Kay could see many educational uses for this computer, he had four initial projects in mind: 1) teaching thinking skills, 2) teaching modeling through the simulation of systems, 3) teaching interface skills, and 4) tracking what children would do with the computer outside school hours, when left to their own devices. Second level projects for teaching children with a computer included (1) Computer evaluation and (2) Iconic programming, especially for children under eight. Kay and his colleagues started teaching programming to children and adults in 1973.

These dedicated educators of the past were ahead of their time but relentless in their efforts to provide educational opportunities to both young and old people. Another requirement for computer-at-a-distance learning was that it should be available whenever it was wanted regardless of the time of day. Although I had not personally developed an on-line delivered educational system, I had insisted and promoted the concept for years as the only program that made sense. I was quite gratified that there were educators and universities able to create the systems that we use today.

My idea about television shows available on demand nearly materialized during our Amherst, Massachusetts days in the 1970s. I met Mr. Robert Block who owned a broadcast station in Milwaukee, Wisconsin who visited our laboratory. I described my ideas to him and he was extremely excited about them. We made several trips back and forth to Milwaukee to try to develop the concept for watching a television program whenever the consumer requested it. Unfortunately, the telephone lines had insufficient “bandwidth” to convey the audio and visual signals. Again, technology lagged behind an idea.

Another one of my ideas was to develop a way for students to learn on the computer. I realize that current students think it is quite an ordinary concept to attend a university and receive a degree “online”. But in 1974, this was not only unheard of but was scorned and ridiculed as a ridiculous concept. However, I was never one to shirk from trying and my Cyberspace University concept from the early 90’s can still be found on my website.
Another one of my ideas stemmed from the frustration with the slowness of interacting with customers. I hated the process of printing documents, driving to the post office, standing in line to send the package, then waiting for the transit, processing, and return documentation. Patience was not one of my virtues so I chaffed at what seemed to me to be an enormous waste of time. Once again, I was convinced that connections via a phone line between two places could be harnessed to transmit documents. It was never easy for me to have what seemed to be a terrific concept with no means to make it happen.

One day, Mr. Byron Donzis visited our office about a project for air-filled football protective gear and brought with him a large tube-like machine. Not only did Mr. Donzis want us to analyze his football gear, but he wanted us to send him the results on his “fax” machine.

His “fax” machine was a large tube-like equipment which he plugged into the wall outlet near our phone. Then he connected the phone line to his machine, pushed a button, and the center “tube” began to rotate. With a printed
document attached to the tube, the material could be conveyed over the phone line to a receiving unit in his Texas office. Imagine my amazement to see that one of my ideas was available.

Unfortunately, this early equipment was very slow and took at least 20 minutes to transmit a single typed page. With long distance phone charges ranging from 70 cents to a dollar per minute, the price for one letter on Mr. Donzi’s “fax” machine was fourteen to twenty dollars. Obviously, there needed to be a faster, cheaper solution. (For the younger readers, not only did we only have 3 television networks with limited viewing, we also had only one telephone company, AT&T or “Ma Bell”. Unlike today when we consumers can choose our carrier, select the “plan” that fits individual needs, and usually are not charged for long distance services except to foreign countries. This luxury was non-existent at that time, so people always had to be aware of the cost and time for telephone calls.)

Of course by 1987, “Moore’s Law” was affecting our lives in many ways beyond televisions and telephones. The Internet revolution had brought many things closer to the consumer, not just communication and education. We installed computers, printers, and telephones in every room of each house. We created the most modern, up-to-date technologies available.

Another of the futuristic developments that we incorporated onto both of our new buildings was to install solar power. We were probably the first people in Coto de Caza to be totally independent of power delivered by the electric company. With solar panels on our roof, we were able to watch our electric meter rotate backwards since we sold our excess electricity to the electric company. We were connected to the electric company through a system called “net metering” which kept us on the electricity grid. This system allowed us to sell our excess electricity to the company during the day time and buy electricity from them during the night time hours. For us, it was a silly little game for entertaining visitors to show them our electricity counter rotating backwards.

Besides the fun of watching the wheel turn backwards, for our business needs it was a logical and necessary advantage. During those years, much of California frequently experienced “black out” and “brown out” periods of electric delivery service. We were concerned that
our business could be adversely impacted were we to lose electricity, so we decided to be independent of the grid. When all of the other houses on the street went totally dark with the loss of power, we were able to continue working. It has proven to be a valuable asset over the years and we frequently congratulate ourselves for having this foresight.

One of our initial projects in our new lab involved improving our biomechanical software. The introduction and growth of video cameras presented many opportunities for quicker and faster biomechanical processing. The new video cameras provided immediate “films” without having to wait for development time as well as providing the opportunity to review the activity before advancing to the next step. It eliminated the step of filming today and waiting until next week to learn if the camera was focused and the frame had not cut off the subject’s head. This development was akin to our constant challenge of improving the software on newer, faster computers, but now the need was to leap forward with the visual portion of the biomechanical program; however, the advancement of video camera technology for our system was through several difficult transitional steps.

The speed of the recording device was critically important for the success of our biomechanical processes. When watching a movie, we are actually seeing a successive number of frames flipping by one after another and our eye works with the brain to stitch them together to create motion. Historically, movies were filmed at 24 frames per second. This speed allowed the brain to interpret the activity as a smoothly progressing activity rather than appearing to be discrete frames or with a jerky movement. For biomechanical quantification, we had found 24 frames to be too slow. We had to film at higher rates ranging from 100 frames per second and even as high as 10,000 frames per second depending on the application. When video technology was introduced, therefore, we were again presented with a problem regarding recording speeds. A video camera which, while it has a shutter, is dealing not with a single image, but with dozens upon dozens of single images strung together. The speed at which these frames are moving must be both constant and fast enough to create correct looking, full-motion video when played back.

A significant difference between the older film and the new video technologies were the methods which each system used. A film consisted of a sequence of individual frames captured sequentially. However, television and video technologies use a “raster scan” which is the rectangular pattern of image capture and reconstruction. Imagine the pattern of lines left by a rake when it is drawn straight across a soil garden. These lines left in the soil resembles the parallel lines of a raster. This line-by-line scanning is what creates a raster. It is a systematic process of covering the area progressively, one line at a time. Although a video scan travels a great deal faster, it is similar in the most general sense to how one's gaze travels when reading lines of text.
A video image is captured as a series of lines starting at the top of the screen and, line by line, moving down to the bottom of the screen. The horizontal scan lines of each complete frame are treated as if numbered consecutively, and captured as two fields: an odd field (upper field) consisting of the odd-numbered lines and an even field (lower field) consisting of the even-numbered lines.

In the most general sense, the word "frame" refers to the smallest unit in a motion image stream which includes all of the information for a single, complete image (i.e., it contains all the color, luminance, etc., information for one image at the full resolution of the system). Ideally, it represents one temporal sample, that is, an image which is captured at one particular point in time, in a series of such images which together are used to give the illusion of motion when displayed. This last point is where the notion of a "frame" in video starts to break down, since clearly in a raster-scanned system the entire image is not captured at the same time. The term is still used nonetheless.

A "field," on the other hand, is a sub-part of a frame. The most common usage of this term is “interlaced video”. With “interlaced video”, two "fields" are produced, which are supposed to correspond to or be capable of being combined into one complete frame. In interlaced video, the two fields are generally produced as such, separately, by the camera or telecine, as opposed to actually being the result of separating the odd and even lines of an original complete frame.

At a rate of 30 frames/sec, the human eye can perceive a flicker as the screen is updated or refreshed. To minimize this phenomenon, interlaced scanning is typically used. Here, the image frame is split into two fields, one containing odd-numbered horizontal lines and the other containing the even-numbered lines. Then the display is updated one field at a time at a rate of 60 fields/sec. This update rate is not detectable by the human eye (remember that AC lighting operates at 60 Hz).

For some high-speed applications, the display needs to be updated as rapidly as possible to detect or measure movement accurately. In that case, the update of the display is made without combining the odd and even fields into each frame. The resulting image frames would each consist of one field, resulting in an image with half the height and twice the update rate as the interlaced version. This is called “non-interlaced” video, and cameras that output signals of this type are referred to as “progressive scan” cameras.

Our initial step into the world of video technology was the discovery of a Panasonic SVHS video camera. This camera was able to record at 30 frames per second and had a variable shuttle. As with our previous experience with film cameras, the video tape speed was too slow for our normal biomechanical analysis. We were able to overcome this limitation with our software processing, enabling the use of all of the fields in each frame which produced 60 frames per second.

The variable shuttle feature of the Panasonic SVHS was critical for our use since it enabled the figure to be viewed as a sharp rather than as a blurred image. This was accomplished by adjusting the shutter speed to open and close at a rate fast enough to capture the person’s motion. The video camera
shutter fires very fast as the recording media (video tape, DVD, memory chip) is being bombarded by the light which is being converted into data by a light sensing chip. As the light is first going through a lens, physical properties such as the amount of light in the scene and how fast the shutter is going off apply here just as they do to a still or movie camera. Therefore, the faster the video camera shutter fires, the lighter is needed to keep the scene from becoming too dark.

For example, imagine the shutter opened and the person moved 3 steps. The resulting image would be quite blurred. However, if the shutter opened and closed so that each step was captured individually, each image would be sharp. The shutter, thus, had to be adjusted for each activity. Hitting tennis balls by swinging a racquet required a faster shutter speed than studying heel strike during a walking activity.

At last, we were ready to proceed with our biomechanical analysis using video rather than film. First, the activity was recorded on the analog tape in the video camera. The next step was to play the tape in a VCR and view this analog signal on a screen. After we filmed our subject with a video camera we then needed to digitize that image on the computer. We were able to view the recorded image from the VCR, but the problem we faced was how were we to digitize the image on the monitor. This step did not turn out to be as easy as we had initially envisioned.

Video technology was first developed for mechanical television systems, which were quickly replaced by cathode ray tube (CRT) television systems, but several new technologies for video display devices have since been invented. Charles Ginsburg led an Ampex research team which developed one of the first practical videotape recorder (VTR). In 1951, the first video tape recorder captured live images from television cameras by converting the camera's electrical impulses and saving the information onto magnetic video tape.

Video recorders were sold for $50,000 in 1956, and videotapes cost $300 per one-hour reel. However, prices gradually dropped over the years and by 1971, Sony began selling videocassette recorder (VCR) decks and tapes to the public.

VCR gained mass market traction in 1975. Six major firms were involved in the development of the VCR: RCA, JVC, AMPEX, Matsushita Electric/Panasonic, Sony, and Toshiba. Of these, the big winners in the growth of this industry were Japanese companies Matsushita Electric/ Panasonic, JVC, and Sony, which developed more technically advanced machines with more accurate electronic timers and greater tape duration. The VCR started to become a mass market consumer product and, by 1979, there were three competing technical standards using mutually incompatible tape cassettes.

The two major standards were Sony's Betamax (also known as Betacord or just Beta), and JVC's VHS (Video Home System), which competed for sales in what became known as the format war.
Betamax VCR and Panasonic 6300

Betamax was first to market in November 1975. It was argued by many to be technically more sophisticated in recording quality, although many users were not able to perceive a visual difference. The first machines required an external timer and could only record one hour or two hours with lower quality. The timer was later incorporated within the machine as a standard feature.

The rival VHS format was introduced in Japan by JVC in September 1976 and in the United States in July 1977 by RCA. This format had a longer two-hour recording time with a T-120 tape, or four hours in lower-quality "long play" mode.

In those pre-digital days, TV broadcasters could not offer the wide choice of rental stores and tapes could be played as often as desired. The material was available on tape with violent or sexual scenes not available on broadcasts. Home video cameras allowed tapes to be recorded and played back.

Two hours and 4 hours recording times were considered enough for recording movies and sports. Although Sony later introduced L-500 (2 hours) and L-750 (3 hours) Betamax tapes in addition to the L-250 (1 hour) tape, the consumer market had swiftly moved toward the VHS system as a preferred choice. During the 1980s dual-speed (long play) models of both Beta and VHS recorders were introduced, allowing much longer recording times. The recording length on World Wide Standard on consumer video recorders (VHS) was 8hrs with PAL color encoding and 5hs-46mins with NTSC color encoding. The total recording length on The World Wide Standard on Professional Broadcasting (Betamax) was 3hrs 35mins on PAL color configuration, and 5hrs on NTSC color configuration.

In the early 1980s, US film companies fought to suppress the VCR in the consumer market citing concerns about copyright violations. In Congressional hearings the head of the Motion Picture Association of America, Jack Valenti, decried the "savagery and the ravages of this machine" and likened its effect on the film industry and the American public to the Boston strangler. However, in the case Sony Corp. of America v. Universal City Studios, Inc., the Supreme Court of the United States ruled that the device was allowable for private use. Subsequently the film companies found that making and selling video recordings of their productions became a major income source.

Panasonic’s first VHS camcorder, the NV-M1, was developed in 1985 as a VHS video recorder with a built-in camera that allowed recording using a standard VHS cassette. In those days, there was a mounting need for a video with a built-in camera that could easily be used by anyone. Adopting a new loading system, a compact head cylinder and other brand-new technologies, the video was compact and very light, weighing only 2.5 kg.

We also needed a VCR which was more sophisticated than one merely for recording television shows. We needed a unit that we could control to “step” the image one “frame” at a time just as we had been able to do with our 16mm film camera and projector system. Unfortunately, a video signal was not separated into discrete frames, but rather was a continuous electromagnetic stream.
We found the Panasonic 6300 VCR which could function in the way we needed. We could film an activity with our Panasonic SVHS camera, remove the VCR tape, insert it into the VCR and view the image on the computer monitor. The next step was the real challenge. Although the Panasonic 6300 VCR allowed us to advance the tape one step at a time, similar to the way we had been able to advance the movie film one frame at a time, how were we to digitize the image and record the X and Y coordinates for each joint center into the computer? Fortunately, our CBA software geniuses produced the solution.

The solution was to use a video overlay card which allowed the computer to generate a mirror image of the VCR image on the monitor. We would advance the tape, one step at a time with the Panasonic 6300 and, using the mouse, place the cursor at the selected joint center and “click” to identify the X and Y coordinates. This process allowed the X and Y coordinates to be stored in a computer file. Once the activity had been digitized in this manner, the computer file of coordinates could be processed by our biomechanical software. The only change for the biomechanical system was the technique in which we were able to obtain the joint center coordinates.

This system worked perfectly for biomechanical processing, however, there was one limitation. We operated with the VCR image residing only on the monitor. The VCR had to be stopped manually and any problems with the video system meant starting the digitizing process from the beginning. We could not compare the digitized image with the taped image since it was available only on the VCR tape and not the computer. What we wanted was to have the video image stored on the hard disk in the computer so it could be examined, reexamined, digitized, or simply played from the beginning to the end without having to depend on the VCR. Another advantage to storing the image on the computer’s hard disk was its permanent availability for examination.

We needed a method to convert the video signal into a digital signal which could be on the computer’s hard disk. In today’s world of sophisticated computers and electronics, this is a simple, trivial task. But in the 1990s, this was wishing on a star or hoping that the tooth fairy would leave something under our pillow at night.

This step required both hardware and software developments. Although we no longer used our large 3-D graphic system, Megatek, I was still friendly with our contact there. During a phone call to him, I briefly described the hardware that I needed and inquired if he knew of anyone with these electronic development skills. It turned out that he had worked with a young man in San Diego, Ca, Mr. Alex McKay, who should be able to build what we needed.

I called Mr. McKay and arranged for him to come to Coto de Caza to meet me and my development team. When Mr. McKay arrived we demonstrated how our biomechanical system functioned and that we were now in a new developmental era. We needed to move from 16mm film cameras to the newer video technology but we were
experiencing a stumbling block with the analog to digital conversion. We were confident that we could write the software code for a new digital file, but we would need the hardware to convert the analog signal from the camera to the digital signal for the computer.

Alex, as he insisted on being called instead of Mr. McKay, spent several hours with Dr. Jeremy Wise, our software expert. They discussed the specifics for this conversion medium and eventually arrived at the solution. Alex would develop a video board which could be installed in one of the slots in the computer. The board would accept the analog video input from the VCR and connect through the video board in the computer and convert the analog into a digital signal. Once we had the digital signal, we would be able to see the video images on the computer monitor. Jeremy would write the software allowing us to digitize the image that appeared on the computer monitor.

Measurements from the real world are almost always analog. Image is drawing a curved line on a sheet of paper. If a graph is superimposed on top of the drawn curve, each point on the curve can be represented by two numbers, X and Y. This is the same situation with an analog film. The analog had to be represented by digital one, but computers can only use digital signals.

This was our situation. We had the real world of movement which we humans see as smooth, continuous, and flowing. However, a computer can only understand two conditions: on and off or in the binary system 0 and 1. These are the digital signals that computers can “understand”. Therefore, analog signals must be first transformed into digital signals (or series of digital signals). For example, a digital signal could only know if a door is open or not. An analog signal would cover the entire door movement from open to close. For our application, the entire movement had to be converted, a step at a time, from the analog to the digital representation. In other words, our tape had to be able to produce an accurate digital signal for each portion of the analog signal as it advanced. The accuracy of the figures we produced depended on this digital conversion from the analog image.

The explanation of analog and digital signals can be described in the following manner. An Analog signal is any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity, i.e., analogous to another time varying signal. It differs from a digital signal in terms of small fluctuations in the signal which are meaningful. A digital signal uses discrete or discontinuous values. By contrast, non-digital (or analog) systems use a continuous range of values to represent information. Although digital representations are discrete, the information represented can be either discrete, such as numbers or letters, or continuous, such as sounds, images, and other measurements of continuous systems.
### Comparison chart

<table>
<thead>
<tr>
<th>Analog versus Digital comparison chart</th>
<th>Analog</th>
<th>Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal</strong></td>
<td>Analog signal is a continuous signal which represents physical measurements.</td>
<td>Digital signals are discrete time signals generated by digital modulation.</td>
</tr>
<tr>
<td><strong>Waves</strong></td>
<td>Denoted by sine waves</td>
<td>Denoted by square waves</td>
</tr>
<tr>
<td><strong>Representation</strong></td>
<td>Uses continuous range of values to represent information</td>
<td>Uses discrete or discontinuous values to represent information</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>Human voice in air, analog electronic devices.</td>
<td>Computers, CDs, DVDs, and other digital electronic devices.</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Analog technology records waveforms as they are.</td>
<td>Samples analog waveforms into a limited set of numbers and records them.</td>
</tr>
<tr>
<td><strong>Data transmissions</strong></td>
<td>Subjected to deterioration by noise during transmission and write/read cycle.</td>
<td>Can be noise-immune without deterioration during transmission and write/read cycle.</td>
</tr>
<tr>
<td><strong>Response to Noise</strong></td>
<td>More likely to get affected reducing accuracy</td>
<td>Less affected since noise response is analog in nature</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td>Analog hardware is not flexible.</td>
<td>Digital hardware is flexible in implementation.</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>Can be used in analog devices only. Best suited for audio and video transmission.</td>
<td>Best suited for Computing and digital electronics.</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>Thermometer</td>
<td>PCs, PDAs</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Analog signal processing can be done in real time and consumes less bandwidth.</td>
<td>There is no guarantee that digital signal processing can be done in real time and consumes more bandwidth to carry out the same information.</td>
</tr>
<tr>
<td><strong>Memory</strong></td>
<td>Stored in the form of wave signal</td>
<td>Stored in the form of binary bit</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>Analog instrument draws large power</td>
<td>Digital instrument draws only negligible power</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Low cost and portable</td>
<td>Cost is high and not easily portable</td>
</tr>
<tr>
<td><strong>Impedance</strong></td>
<td>Low</td>
<td>High order of 100 megaohm</td>
</tr>
<tr>
<td><strong>Errors</strong></td>
<td>Analog instruments usually have a scale which is cramped at the lower end and give considerable observational errors.</td>
<td>Digital instruments are free from observational errors like parallax and approximation errors.</td>
</tr>
</tbody>
</table>

Several weeks after our first meeting, Alex sent the new analog-to-digital, or A/D, board to Jeremy and it worked perfectly with Jeremy’s newly written software. We now had the capability to record any activity and transfer the data for storage on the computer. From that point, we could retrieve the file anytime we needed it to review or perform the biomechanical analysis on it. The video images could now be stored on the computer. The digitized file of X and Y coordinate for each joint center would be stored in the computer file similar to the method we had used previously.
This was the first time in history that a video image could be quantified biomechanically and create three-dimensional motion. This is the basis for all of the modern computer games and movies, such as “Avatar”. It is possible with today’s more advanced technologies, to film a great tennis player hitting a ball, digitize the image, and, when playing it back, “dress” the player as a frog or a rabbit. Without the ability to convert the analog movement into discrete digital signals which can be stored on the computer’s hard disk, these fun images and games would not be possible.

Science & Vie, June 1980

APAS in 1980- the World’s first animation system
In keeping with Moore’s law, I guess, an A/D board soon became commercially available. This boards were called a “video capture card” and was better than what we had developed ourselves. It was could capture the entire tape more quickly and with significantly higher resolution. The new board produced the digital file in what was known as “AVI” format which was different from what we had been using for the digital input format.

Needless to say, we wanted to immediately adapt this board for our system, but, first our software engineers had to write the software to read and utilize this “AVI” format. Once that was accomplished, we could operate our biomechanical programs.

Another innovation which presented a very attractive time saver was the “FireWire” connection directly from the analog camera to the computer. The official name for the standard is UEEE 1394 which was originally created by Apple and standardized in 1995. A FireWire connection allows data to be sent to and from high-bandwidth digital devices such as camcorders and it is faster than a USB-1 (Universal Serial Bus). This was another fantastic time saver for our biomechanical processing since we were able to record the activity and send the data directly to the computer. We had the most sophisticated software for processing the data but were continuously searching for newer and better ways to obtain store it.

Although we were no longer in the old Coto Research Center, we continued to sell our biomechanical systems to customers around the World. Each new innovation, therefore, made our product more attractive to that consumer market. Our university contacts were usually technically adept and knowledgeable in the field of biomechanics. However, many of our corporate customers who merely wanted to test a new iteration of their basic product, were primarily interested in the quickest and most efficient method of data collection. Thus, this new FireWire technology was another step in improving and speeding up our system.

My next idea was that we should make the biomechanical system operate more smoothly and quickly. We had spent years having to digitize manually and even with our newer video system, it still operated in this step-by-step manual mode. I was convinced that there had to be a better method.

In the 1980s, we had begun to pursue a method of using markers on the body. The markers were small “balls” covered with reflective material. These markers were placed at the various body joints via adhesive stickers. Then the subject performed some task such as walking. When the acquired images appeared on the monitor, the markers were seen clearly. Examples of an individual walking and another rowing, using marker sets, are shown below:
The first step in the digitizing process proceeded normally with the user touching each of the markers with the cursor. After the first two or three frames, the computer cursor would automatically jump to the location that it predicted would be the location of the joint center. From that point forward, the computer could “digitize” the entire sequence with or without human intervention. Because human movements cannot exceed six hertz, the patterns of movement can easily be predicted by the computer program.
The marker system, while elegant in its convenience and simplicity, has several unfortunate flaws. The major drawback is that placing a “ball” on top of a body part does not accurately represent the location of the actual joint center. If you put the “ball”, for example, on the top of the shoulder to represent that joint, it is nowhere near the joint center if the arm is raised over the head. The reader can try this by taping a penny onto the area that would be considered the shoulder. Then move the arm around and observe that the penny is no longer a good representation of the shoulder joint.

A further development of marker sets was the introduction of three markers placed at specific locations were designed to correct the previously noted flaw in joint detection. However, usage of these markers sets requires the acceptance of various assumptions about the location of the joint center which can have a distorting effect on the resulting data.

Another disadvantage of the marker system is the need for special lighting which is mounted in an elaborate array in a laboratory-like setting. Such a motion system is more expensive since a minimum of five cameras are needed to collect the data. These restricted conditions are sufficient for many types of studies particularly those that are combined with force platform and/or EMG data acquisitions. But for evaluating athletic performances, these testing models cannot accurately measure the individual’s actual motion. No one can perform normally when they have wires or markers on their bodies. Most people behave differently when they are told in advance that their picture is going to be taken. A normal person will react by becoming tenser or fixing their hair or many other conscious and unconscious mannerisms. Expecting an Olympic athlete to perform normally with markers in a closed laboratory environment will not result in an accurate representation of that individual’s actual performance motion. Imagine a world class golfer wired with EMG sensors and markers on the body standing on two force plates bathed in bright lights hitting a ball in a white room. Quite unlike the golf course to put it mildly!

However, several different markers set were introduced for measuring human motion. They are basically four different markers sets which are used in all Gait Systems and are identified as:
1. Helen Hays Hospital Markers Set  
2. Helen Hayes Modified Markers Set  
3. Vaughan Marker Set  
4. Vaughan Modified Marker Set  

We decided it would be interesting to compare the results of all four marker sets using the same subject and trial. Theoretically they should all yield the same results.

In order to analyze the results comparing all marker sets, we attached all four marker sets to the same individual so we can compare the results simultaneously. Since the APAS Gait program was a video base system, we were able to make these comparisons. With other Marker Tracking systems, it would be impossible to make this comparison since there are no video sequences in their system. With video, it is simple to activate or de-activate any marker. This allowed us to make a comparison of markers for the same individual and for the same trial.

We used eight subjects and analyzed their gait. We found that the difference between marker sets was very significant. Our testing indicated that no Markers Sets are valid or reliable.
Comparison of markers sets

Data indicating variations in markers sets
Gait Analysis
Although we were not enamored with marker sets, we decided to make our biomechanical system flexible for every user whether they wanted to use markers or not in any environmental location. We had many customers around the world who used our system for studies examining different gaits. Some of these researchers focused the cameras only on the feet as the person walked across force plates. One customer used markers and EMG electrodes to study muscular coordination in rowing. Our philosophy was to make our system open and compatible with any investigation that the customer wished to pursue. It was not our intention to tell other investigators what to do or how to accomplish it.

Another feature we perfected with the digitizing process was to “teach” the computer to locate the joint center with or without using markers. The location of the joint center, after digitizing the first few frames, is relatively predictable based on human capabilities. Regardless of whether the video has been captured with or without marker sets, the person digitizing had to be careful that the computer makes the “correct” choice for the joint location. However, the computer-assisted digitizing is faster than the manual joint selection option. Also, sometimes the joint center is obscured from the camera view and this computer-generated prediction can be quite helpful in determining the location of the joint center.

We started using this technology for analyzing golfers on the Golf Course. We called it “E-Golf. Imagine a Golfer standing on the green and swinging his golf club. A video camera records this swing. The video is captured directly onto the hard disk in real time. Then a compressed sequence is transmitted automatically through a wireless modem to the local server. From the local server the sequence can be digitized at any location in the World through the Internet. The velocity of the golf club can be determined in few minutes and the results transmitted back to the server. The server automatically calls the cellular web phone which the golfer carries. He can then pick up the phone, click the web bottom, and the velocity of the club head as well as other kinematics parameters are shown on the small color screen on his phone.

Suppose that the golfer wants to retrieve a particular video frame where the impact occurred. He clicks the frame number and the video frame is transmitted from the server is then superimposed on the particular stick figure.
Of course, we were continued to have projects with NASA which were challenging. Our Computerized Exercise Machine had entered a new phase as well. We were developing new and improved software for several clients with unique applications. One of these clients worked with young people who hoped to improve their baseball skills. Another client worked with insurance companies and disability claimants. Each case may have been unique but each insurance company has their own protocols. The client wanted us to develop these protocols.

Another interesting situation occurred when I was contacted by my old friend, George Marom, who now lived in New York City. Before he moved to the United States, George had been a great sprinter in Israel running the 100 meters at a speed of 10.2 seconds. After he had moved to America, he attended Temple University where he specialized in the Physiology of Exercise.

George called and told me that he and some partners were opening the most advanced health club in the World which would be located in NYC at 2nd Avenue and 52nd Street. He wanted to incorporate my computerized exercise machines and the motion analysis system as part of the unique theme of his club. I was more than pleased to work with George and we arranged for his company to purchase several of the CES systems and the APAS as well. Nearly a year passed and finally his club was ready for the Grand Opening. George invited me to the open house of the club, “Excelsior”. Of course, I agreed and volunteered to demonstrate the equipment to all of the people who came to the Open House.

I enlisted the aid of my friend Bob Wainwright to help with the demonstrations at the Excelsior’s open House. Bob had 12 of my machines in his own club which was used primarily for Physical Therapy but he was quite skilled at demonstrating the uses of the equipment. The Club looked fantastic and it seemed that at least 300 people came to the open house while Bob and I were demonstrating the machines. The people continued to come to our section in a continuous non-stop flow.

Suddenly, I noticed the most beautiful lady walking up the stairs to join the open house. Both Bob and I were quite mesmerized by her beauty as well as her graceful and elegant manner.
While Bob and I were watching this lovely woman, she was escorted by another friend of mine over to the CES. My friend was Toby and he happened to be George’s brother-in-law. Toby introduced me to the woman as his client, Lucia Tristao, a former prima ballerina originally from Brazil. Toby explained that Lucia had been dancing ballet from a very young age, perhaps 3 or 4 years old. By the time she was twelve, she had already begun to suffer from knee problems. In spite of the pain, she had continued to dance and had performed with many companies after leaving Brazil including the Bolshoi, the American Ballet Theater, the Pittsburgh dance, and others. However, she had been forced to retire at the age of 24 because of the constant, unrelenting knee pain. Toby wanted to know if I could help her resolve any of this pain.
I told Toby that I would try and believed that there were some things that she could do both on and off the CES that should help her with her knee pain. I demonstrated the machine for her and had her perform several exercises on it so she could experience it for herself.

This was a truly unique experience for me to be involved with a prima ballerina since my experiences until then had been with athletes to improve or rehabilitate them. I was more than familiar with the stresses and strains associated with athletic performances, but this was the first occasion that I encountered what happened in ballet. Understanding the demanding work and constant pounding that the feet, legs, and joints must absorb in ballet was interesting and eye opening for me. When watching a ballet performance, the audience is transported into a world of grace and beauty. Dancers seem to float on air as they glide around the stage. However, I learned that this airy floating illusion that ballet presents masks the tremendously demanding physical price that dancers’ bodies must pay.

While Bob and I demonstrated the machine, I asked Lucia if she had any plans for dinner. Although she did have plans, she accepted my offer since her goal was to find any means possible to help with her knee pain. Lucia joined me and Bob for an important dinner meeting in an exclusive restaurant in NYC. Our meeting was with Mr. Doug Dunlop, the attorney for the U.S Olympic Committee, and Mr. Ryan, another famous New York corporate attorney. I introduced Lucia as my administrative assistance. We had our dinner and discussed our business when suddenly Mr. Ryan asked me: “how long have you and Ms. Tristao been working together?” I answered “2 hours” and the entire table burst into laughter.

In fact, I did ask Lucia to help me in the shows to sell the machines. She learned how to demonstrate the machine and assisted me at many conference meetings.

I spent most of my time in California although we did have as many trade shows as we could handle. One day, Ann and I drove to Los Angeles to meet our intellectual properties attorney, Mr. Norman Zafman. While we were there, a discussion ensued about the manufacturing and sales of our Computerized Exercise Machine with its continuously developing and evolving software. Mr. Zafman asked if we would be receptive to meeting a businessman with whom he had worked with in other companies. Mr. Zafman thought that this gentleman he knew, Mr. Herbert Lightstone, might have some interests and contacts who could help us expand our business. Because we trusted Mr. Zafman with all of our legal matters in this area and since he had always demonstrated the desire “to make a deal” not “kill a deal”, we thought the idea sounded intriguing.

Mr. Zafman made the contact and we arranged to meet Mr. Lightstone at our office so that we could demonstrate the Computerized Exercise Machine. We had experienced a similar situation in Amherst when we met Larry Graham. However, this time, we had progressed beyond just two graduate students working in the kitchen.

The day Mr. Lightstone arrived, we gave a full demonstration of the Computerized Exercise Machine and, just to impress him, we also gave him a brief presentation of the Ariel Biomechanical Analysis System. Needless to say, he was very impressed with the technology. After a lengthy discussion about how we were currently manufacturing the hardware, shipping the equipment, and managing sales, he said he wanted to think about the situation more thoroughly. He had several ideas and would call us in the near future.
About two weeks later, Mr. Lightstone called to arrange a second visit. He asked if he could bring a friend who had partnered with him previously in a business they operated in La Jolla, CA. The former partner was Dr. Don Brucker who had been an optometrist and one of the inventors of the Hard Contact Lens. I was impressed with the opportunity to meet a fellow inventor despite the differences in our fields of interest. Before Mr. Lightstone brought his friend to Coto de Caza, I researched his background and discovered an interesting person. Donald Brucker was born in 1932 and brought up in Los Angeles and became an optometrist because his brother-in-law was a Professor of optometry at the University of California at Berkeley. He graduated from there UC Berkley in 1956. His interest in the then rather primitive contact lenses began in the late 1950s. Brucker thought he could make better lenses for himself and friends and set up his own laboratory where he developed a continuous curve hard lens with a gradually flattening periphery. The design had a fairly smooth posterior surface and its success prompted him to start Continuous Curve Contact Lenses in 1960.

Before Bausch & Lomb gained FDA approval, Dr. Brucker developed his own lens design in a material devised by Maurice Seiderman. Brucker started clinical work on the new material in 1971 and gained a New Drug Application in April 1974. Hydrocurve, using Hefilcon A, was only the second hydrogel in the USA to achieve FDA approval. The cost for the approval was $1.5 million. Later the lens was made from Bufilcon material and the first 'Ultra-Thin' lenses to improve oxygen transmissibility and reduced hypoxia was introduced in the USA in 1977.

Other companies followed suit. The following year, Hydrocurve gained FDA approval for the first soft toric available in the USA. In 1982, Continuous Curve Contact Lenses was sold to Revlon which also owned Barnes Hind. Brucker continued to run both companies.

In the mid-1970s, by virtue of Hydrocurve lenses, Continuous Curve was the second largest contact lens company in the world after Bausch & Lomb and in the early 1980s they were the fastest growing company on NASDAQ. Brucker also made gas permeable hard lenses and claimed to have had the first such lenses on the market. He was an early soft lens investigator for Bausch & Lomb and also developed cold contact lens disinfecting solutions which were made by Burton-Parsons.

My conclusion was that here must be another “crazy” scientist-inventor like me. Mr. Lightstone told me that Dr. Brucker just sold his patent for 120 million dollars and, therefore, had a lot of money, time, and motivation to invest in a new venture. Dr. Brucker was not the type of individual that could still around with nothing to do so the Computerized Exercise Machine could be an interesting and provocative challenge for him.

The day arrived for the presentation of our system to Dr. Brucker and Mr. Lightstone. I demonstrated how the equipment worked and then had Dr. Brucker experience the Exercise Equipment himself. As usual, the system could sell itself and Dr. Brucker was extremely impressed. He spoke enthusiastically about what he would propose to do. He wanted the opportunity to manufacture the equipment and market it. He had experience in both areas although with different products. However, he felt sure that he could repeat his previous success with our product.

We concluded the long afternoon meeting with both parties responsible for developing detailed plans for a new future together. The details about where to execute the various tasks, who would be in
charge, where and how much money would be needed were just a few of the considerations that would have to be identified. The day ended and we agreed to be in touch.

During the next several weeks, documents cycled between us, our lawyer, Mr. Lightstone and Dr. Brucker and their lawyers. Eventually we agreed that Dr. Brucker would create a company, Ariel Life System (ALS), which would manufacture and sell our Computerized Exercise System on an exclusive basis. In addition, if the customer of the CES also wanted the biomechanical motion analysis system, ALS could sell the APAS on a non-exclusive basis. Since our company owned all of the patents and copyrights, we would receive a royalty for each CES and APAS sold by Dr. Brucker’s new marketing company. It seemed like a perfect solution for us since we had been searching for the right company to take over the manufacturing headaches. We loved to sell the CES, but manufacturing took our attention from our greater strengths which were software and technological advancements. Now we could spend more time on improving our software without the aggravation of having to manufacture it.

Our attorney, Mr. Norman Zafman, wrote a strong contract licensing our product to ALS and protecting us from any imaginable negative consequences that might occur down the road. He told us it was better to prepare for a clean, easy, and straightforward termination but hope that the protection was never needed. Our participation was simple: (1) we licensed ALS to manufacture and sell the CES; (2) ALS could sell, on a non-exclusive basis, the APAS; (3) we would receive a royalty for each of the systems sold; (4) ALS would invoice and pay our company for the CES control boards and the hydraulic pack.

All of the participants and the respective attorneys met in Coto de Caza to sign the documents. There were smiles all around the table after the many documents had finally been signed. Everyone was excited to begin this new adventure.

Dr. Brucker resided in La Jolla, California and, upon signing the contract in 1990, he threw himself into the business. He created an amazing office, fully staffed, in one of the most expensive buildings in La Jolla. As it turned out, he owned the building and also operated a French restaurant on the second floor. His wife owned and managed a day fitness, spa, and beauty treatment business on the first floor. Ariel Life System (ALS) had the top 3 floors. Dr. Brucker hired approximately 50 people including professional engineers with manufacturing experience and highly paid secretaries. In addition to the prestigiously located office complex, Dr. Brucker also rented a 10,000 square foot facility for the manufacturing, assembly, and testing of the Computer Exercise machines. The entire organization from purchasing the first piece of metal through to the sale and delivery of the CES was under Dr. Bruker’s control. He told me that the monthly overhead exceeded $300,000.
Dr. Brucker hired several experienced sales and marketing people who launched into their jobs enthusiastically. They created new brochures as well as participated in conventions and shows which catered to any professional organization related to exercise or health diagnostic needs. These marketing efforts generated sales almost immediately. We would sell at least 20 machines each month for an average price of $45,000 each and at least 10 APAS systems averaging $35,000 each. Profits were high and everyone was happy.

During ALS meetings with local residents and at trade shows, the technologies were presented as described in the brochure shown below:
The Ariel Computerized Exercise System (CES) represents the state-of-the-art in technology for medical diagnostics, physical therapy and rehabilitation, sports medicine evaluation and treatment, fitness training and research. The CES employs true, interactive biofeedback control of both effort and movement during exercise, which allows the machine to dynamically adapt to the activity being performed, rather than using the traditional approach of modifying the activity to conform to the limitations of the machine.

The CES training/rehabilitation units utilize a passive hydraulic resistance mechanism under the direction of the system’s fully programmable computer. Originally there were two models of the CES, the Arm/Leg Machine designed for single joint movements and the Multi-Function Machine designed for multi-joint movements. Many centers use both machines, which can be run off a single computer. Recently the newly-developed CES Back Machine has also been made available.

The Ariel Performance Analysis System (APAS) is the latest enhancement to the proprietary biomechanical analysis systems, developed through more than two decades of research by Dr. Ariel. This movement analysis system measures speed, acceleration and energy transfer by use of video cameras in combination with a computer. It is the most advanced and flexible system of its kind, yet is still user-friendly.

Besides assisting athletes in their self-analysis, several seminars for the APAS system have been held for those involved with the Americans with Disabilities Act (ADA) of 1990, to explain how Ariel technology will allow the industry to conform to the sweeping changes in employment screening, hiring and job task analysis that this Act requires.

Internationally, in addition to a distributor in Japan who was "inherited" from Gideon Ariel, the Company has added distributors in France, Belgium, Germany, Scandinavia and Australia.

Dr. Brucker perceived that the ALS target markets included: (1) the aging population; (2) baby boomers bent on staying young and who were experiencing spiraling health care costs; and (3) workers' compensation claims and laws such as the Americans with Disabilities Act (ADA). These areas could benefit from both technologies by utilizing many of the buzz words of the decade, such as "functionality", "risk assessment", "fitness", "prevention", and "rehabilitation".

From Don’s perspective, he saw the largest markets for Ariel Life System’s products to be the Medical community, followed by Sports, Research & Education, Fitness & Health, Aerospace & Military, and Industrial Engineering. Specifically, he saw tremendous opportunities with Physical Therapy Clinics (such as the one that my friend, Bob Wainwright, operated in New Jersey) which were on the rise since insurance prefers members using physical therapy rather than the costly expense of operations. Hospitals were a large target, also, since about 50% of these facilities had rehabilitation departments. In addition, he was convinced that Orthopedic Surgeons could use the ALS system for pre- and post-operative evaluations as well as for rehabilitation.
In addition, the product analysis capability of the APAS could be employed. The APAS could be used to analyze prosthetic devices to ensure their maximum efficiency. Industrial Medicine, Safety and Ergonomic products began examining the possibility of using Ariel systems internally. The U.S. Bureau of Mines was using APAS to develop safety standards. There were new medical markets, such as the Neurological community which could potentially utilize Ariel products for the diagnosis and treatment of conditions such as Parkinson’s, Multiple Sclerosis, and for neurorehabilitation independent of hospitals and clinics. Cardiac Rehabilitation, Geriatric, and Pediatric markets were also readily available markets.

The areas of Research and Education consisted of at least four hundred educational facilities in the United States which currently had biomechanical departments or laboratories. All of these facilities were potential users of both the APAS and the CES. In addition, though military and aerospace budgets were diminishing, Ariel technology was critical for advancement in the areas related to human performance.

Of course, there was our old reliable and familiar favorite: Sports. At that time, at least 25 million individuals played at least one round of golf in the United States. The potential market for golf analysis using the APAS to produce video cassettes of an individual’s playing was approximately ten percent of this population, many of whom would purchase repeated analysis as they progressed through a teaching program. Several hundred APAS units would be needed to meet the demand for golf analysis. Similarly, with some five million tennis players in the United States, we felt there was an opportunity for a potential 250 facilities to provide tennis analysis through the use of the APAS.

The rise of health clubs had grown to about 25,000 in the United States. With the growth of rehabilitation services in these facilities, and the expanded use of personal trainers, the potential for CES appeared to be enormous. Dr. Brucker estimated that at least 2,000 of the higher-end facilities could use the CES. I showed him some literature and pictures from the New York Excelsior Club as well as a health club in Miami, Florida which had capitalized on the name and the CES, as seen on the left.

Of course, there was the on-going appeal of the Olympic competitors. In the early 1990s, the Australian, Czechoslovakian, Finish, French, German, and Spanish Olympic facilities had Ariel
We were also informed that there were plans to equip the new U.S. Olympic training facility scheduled to be built in the San Diego area with Ariel equipment.

College and professional sports would also constitute an important market since I had already worked with many of them. The Philadelphia Eagles and the Denver Broncos had purchased our CES many years previously. We had performed biomechanical analyses for football teams, including the New England Patriots, Washington Redskins, and the Dallas Cowboys, as well as, several baseball clubs, such as, the New York Yankees and the Kansas City Royals.

Don also saw other interesting potentials which could be applied to the field of Industrial Engineering, such as, the analysis of car crashes, air bags, and related subjects. He also agreed with our previous interest in working with insurance companies and within the legal community to quantify injuries, risks, and analyze claims.

It seemed the potential for both product lines was limitless. However, Dr. Brucker’s first task was to manufacture the CES, build a sales and marketing team, and construct advantageous financial programs for potential clients.

From Dr. Brucker’s point of view, I had two major functions in the new marketing company. One was product development and the other was in sales. My responsibility in sales was to be the “genius” or “expert” that the other sales staff members would use to explain the system and to provide product credibility. My other job was to continue to develop new software options and create additional exercise machines which could address different muscle groups or were tailored for specialized fields, such as physical therapy.

One of the first things I had my software engineers tackle was adapting one of the new, smaller, six-pound notebook computers which had just introduced to the market. These new computers were as capable of operating and demonstrating the entire system as had the older computers, but these were cheaper, faster, and much more attractive. Many customers may not have been impressed with the advanced sophistication that these newer computers possessed, but they were awed and amazed by the vividness of the screens and the graphics presentations.

Another of my dreams had been to develop CES units which were for isolated muscle groups. For example, I developed a unit which allowed the person to sit on a seat and twist the upper body. Another unit was created so the person could move in three dimensions. This was extremely difficult because of the software algorithms had to process many degrees of freedom simultaneously.
A unique opportunity arrived with one project that involved my old friend, Dr. Ira Jacobs. Ann and I had first met Ira on a trip to Canada at least five years earlier when he was a professor at a Canadian university. At that time, he had a contract with the Canadian military to train their special forces for fitness in cold and cold water environments. Since he had been extremely successful with their training, the United States Navy in San Diego arranged with the Canadian government for him to work with the Seals. The goal was to improve the training, conditioning, and performance of the US Navy Seals in cold water environments.

Since Dr. Jacobs had used our Computerized Exercise Machines with the Canadian military, he also wanted to use the CES to help train the US Navy Seals at their San Diego facility. This was an especially important project for me because it was to help my adopted country of America in ways that were meaningful and patriotic. I had always loved the United States but had never had any real means to demonstrate this affection. Helping the Seals gave me some satisfaction that I was contributing to the country which had been so good and welcomed to me as a foreigner. I had been a US citizen for many years, but this was the first time that I felt like I was giving back something to my country.

Another completely different yet fun and unique project which we were involved with at ALS was working with the owner of the America3 racing boat which was to compete in the America’s Cup yacht race in 1992. The world of sailing and sailing as the competition was far from the athletic events that I had experienced in the past.

The America's Cup is a trophy awarded to the winner of the America's Cup match races between two sailing yachts. One yacht, known as the defender, represents the yacht club that currently holds the America's Cup and the second yacht, known as the challenger, represents the yacht club that is challenging for the cup. The timing of each match is determined by an agreement between the defender and the challenger. The America's Cup is the oldest international sporting trophy.
The trophy was originally awarded in 1851 by the Royal Yacht Squadron for a race around the Isle of Wight in England, which was won by the schooner "America". The trophy was renamed the America's Cup after the yacht and was donated to the New York Yacht Club (NYYC) under the terms of the "Deed of Gift" which made the cup available for perpetual international competition. Any yacht club that meets the requirements specified in the Deed of Gift has the right to challenge the yacht club that holds the Cup. The winner of the race gains stewardship of the cup.

The history and prestige associated with the America's Cup attract not only the world's top sailors and yacht designers but also the involvement of wealthy entrepreneurs and sponsors. It is a test not only of sailing skill and boat and sail design, but also of fund-raising and management skills.

The trophy was held by the NYYC from 1857 (when the syndicate that won the Cup donated the trophy to the club) until 1983 when the Cup was won by the Royal Perth Yacht Club. The Royal Perth Yacht Club, represented by the yacht “Australia II”, won the race and, with the victory, ended the longest winning streak in the history of the sport.

From the first defense of the Cup in 1870 through the twentieth defense in 1967, there was always only one challenger. In 1970, for the first time, there were multiple challengers, so the NYYC agreed that the challengers could run a selection series with the winner becoming the official challenger and competing against the defender in the America's Cup match. Since 1983, Louis Vuitton has sponsored the Louis Vuitton Cup as a prize for the winner of the challenger selection series.

The involvement of ALS with the America3 team was to work with them to assess their fitness levels and, based on the findings, teach them how to improve their physical training. I was surprised to discover how many individual yachtsmen’s sailed on the yacht. But most of the members regularly trained at the La Jolla office complex and we were able to increase their strength and endurance levels.

We also used biomechanical analysis to evaluate some of the details that they wanted to know such as the angular position of the sail and the water during certain yachting maneuvers. These specific orientations were important for control techniques during turns was the way it was described to us.

The team won the America’s Cup yacht race in 1992. Don received the following letter from the owner of the American’s Cup winner, the America-3.

Of course, ALS was involved in working with other sports including baseball. One of the salesmen Dr. Brucker hired was John D’Aquisto. John had been a professional baseball player for the Padres in San Diego but was now one of the Directors of Sales. John was a fantastic salesman since he could make the system seem exciting to everyone to whom he presented.

The staff had a coordinated presentation system so that each one could present different aspects in a polished and sophisticated manner. I was introduced to them when they needed someone to present a detailed, knowledgeable explanation about the process but they handled all of the sales presentations and details.

There were many meetings at ALS’s La Jolla office. My role was to present the scientific side of the technology. Don presented the business side of the company. During sales presentations, the
marketing staff took over at that point. When Don was presenting to potential investors, Mr. Herb Lightstone explained to these potential investors what he perceived were the important factors based on his many years of business and investment experiences.

From the beginning of ALS, sales were brisk. This was due to the extensive contact lists which we had given to them from our former customers at Ariel Dynamics, Inc. We had preserved the contact lists and the customer database and the ALS sales staff had immediately put this information to work for the new company. In addition, they had introduced ALS to the San Diego and La Jolla communities so that they were aware of the new company residing in their midst. This area was very affluent and Dr. Brucker was confident that there would be an excited and enthusiastic group of individuals and, perhaps investors, who would want to become involved.

The manufacturing site was extremely busy trying to make equipment as fast as the sales staff could sell them. The marketing staff was continuously creating new flyers and brochures describing the products as well as contacting news media so they could create interviews about the amazing new products. The sales staff traveled continuously throughout the US to trade shows and to visit individuals in their offices, hospitals, or laboratories. The results of all of these activities were amazing. ALS was producing, selling, and delivering many machines every month. They were far more productive than we had been at Ariel Dynamics.

As time passed and the marketing and sales portions of ALS grew, I continuously had to travel to shows and demonstration around the US. I was on the road more often than I was in California. Ann spent almost all of her time in Coto de Caza working on the non-ALS part of our business. She also had to deal with the orders for boards and packs which came from ALS so she was quite busy. Unfortunately, we had to be apart for more time than we would have liked. However, Dr. Brucker and the sales staff were unsympathetic about this situation so I acquiesced and continued to travel from city to city.

During one of the sales trips, I met a beautiful young woman who expressed an interest in the work I was doing. She also wanted to transfer to a California university to continue her studies. I was quite smitten by her and decided to help her in any way that I could.
Subsequently, she moved to California and attended a local college to complete her four years of undergraduate work. We lived together during this time and things progressed as they normally do between men and women. We had three daughters while she was completing her university work.

After she had finished school, she took the three girls and moved back to Texas. I continued to support them over the years and I am happy that they have done so well with their lives. At this time, the oldest girl has finished college and is working in a law office; the middle daughter is working as an RN in a cardiac lab in a hospital; and the youngest is still in college. I am proud of them and hope they will continue to do well and be happy.

Things at ALS were in some turmoil during this time as well. Despite the excellent developments in manufacturing and the burgeoning sales, I was quite concerned about the way that Don was operating the company. Although this was Dr. Brucker’s marketing company and did not affect the company that Ann and I owned, he was conducting the operation in ways that seemed excessive compared with the way that Ann and I had run our business previously. It was the surge of activity and Dr. Brucker’s apparently excessive financial expenditures that were of such concern to us. Ann and I had run our business much more conservatively. Our business plan had been to receive an order for equipment, then receive the payment, and after that, we shipped the machine. We were never exposed to any debt. ALS was operating in the manner more like what is described in textbooks. The costs before sales were to be covered when the products were sold. Ann and I understood the concept but none the less, we always told Dr. Brucker that we thought he was doing too much and too quickly.

I found it was difficult, if not impossible, to argue with Don regarding the operational side of ALS. Seemingly, ALS was profitable with no debt and the future appeared to have no limits. In addition, the man running the company as president and CEO, that is Dr. Brucker, had invented hard contact lenses and was himself a multi-millionaire. Don’s philosophy was that he had done this before and he believed he could do it again.

In order to grow bigger and faster, Don and John D’Aquisto found local residents who were willing to invest substantial amounts of money into the company. This money was used for shows, travel, salaries, and manufacturing as well as other sales expenses. The company seemed to be doing exceptionally well. Dr. Brucker believed that the stages progressed from his investment and the growth of ALS, followed by small local investors who demonstrated confidence in him and the company, would be followed by success in “going public” on the New York stock market.

After ALS had achieved a record of good sales and a promising future based on sales projections from the marketing staff, John D’Aquisto suggested to Dr. Brucker that now was the time to try to go public and raise more money. I did not like the idea, however, the others believed it was a good plan. Since the marketing company belonged to Don and not to me, I felt that these types of decisions should be his. I certainly voiced my disapproval. But Don felt that his previous experience with developing a small company and parleying it into a larger, hugely financially profitable result, was the path he was prepared to follow.

In order to secure the larger investors that he was seeking, Dr. Brucker arranged to meet and present the company to several Wall Street firms. He needed me to attend the meetings since I was the
expert as well as a fantastic “show man” in demonstrating the products. Of course, Don had to buy a nice suit and tie for me, since my California attire would be inappropriate in proper New York City!

Ann accompanied Don and me as we flew first class to New York City. Dr. Brucker and his staff had organized several meetings including one with a firm, J.P. Morgan. As soon as I had completed the demonstration of the software and hardware portions of the presentation, Dr. Brucker and his financial assistance began answering the financial questions.

Several months previously, Don had hired Price Waterhouse to evaluate the value and prospects of ALS and they had done so. Following their positive evaluation, they valued the company at forty million dollars. Since ALS was selling nearly seven million dollars of software and hardware, Price Waterhouse valued ALS at seven times the sale income. I was told that this is the normal upward evaluation.

The investors Don had found were known as “mezzanine investors”, which was a term that I was surprised to learn even existed. This level of investors provides additional capital before the company puts out an Initial Public Offering, or IPO. These investors can recover a substantial return on their investment, since they are willing to take a risk before any other investors who invest at a later date. This strategy to raise money was perfectly legal and substantiated by Price Waterhouse’s prospectuses and numbers.

I learned later that there were approximately 60 investors, most of them from San Diego and some from New York. I personally had no involvement in this process and, in fact, was unaware of what Don was actually doing in the financial area of the business. As far as I was aware, I thought the company was making a good profit on the sales. I was so busy flying around the country and giving demonstrations in La Jolla, that I naturally assumed that these efforts were generating sales. Much later I was to discover the mistake I made by showing myself so liberally to these investors as I presented the technology. My job for ALS included presenting the technologies and I was apparently even better at this than I had realized. Dr. Brucker had capitalized on my demonstrations and accomplished his goal of raising millions of dollars from the investors who met him and saw the growth potentials of the products.

I naively believed that all of my travels, presenting at trade shows, and continuously demonstrating at the La Jolla office, was a contributing factor to the growth in sales. The marketing and sales staff showed me many orders which were reflective of all of our efforts to promote the products.

Eventually Don was unable to hide the facts that things were not going as well as he had led me to believe. Even without the details, I began to suspect that something was dreadfully wrong especially when I was informed that many people had invested substantial amounts of money in ALS. Furthermore, these investors were a significant source of money, along with Don’s continuous financial contributions, which were the substance of ALS rather than product sales. I had known that Don had made necessary contributions to cover recurring cash flow difficulties. I also knew that Don had involved a few outside investors because they were important people who would be useful in the future or were past friends of Don’s. Clearly, my understanding or perhaps lack of any creditable knowledge was nowhere near the true story.

As I discovered more information about some of the things with which Don was involved, I became increasingly more concerned. At this point, I decided to call Herb Lightstone for help. Herb had been the person that my lawyer, Norman Zafman, had recommended to assist in developing and operating our CES business several years previously. He had also been involved with Don Brucker previously and had introduced us to each other. Herb was currently involved with ALS but only in a minor role. I was sure that Herb was unaware of the nature of the business in its current form. Herb drove from his home near Santa Barbara, CA to La Jolla. After a few days of research into the business activities, Herb told me that many things were very bad and things were probably going to get much worse in the near future.

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It was clear that ALS had spent too much money on various marketing scenarios. It was soon learned that systems had been sent to customers to reflect greater numbers of sales than actually existed to indicate to Wall Street that sales were booming.

To add to Don’s problems, the year was 1992 and came at the end of a period of economic recession. From November 1982 to July 1990 the U.S. economy experienced robust growth, modest unemployment, and low inflation. The "Reagan boom" rested on shaky foundations, however. As the 1980s progressed, signs of trouble began to mount. On October 19, 1987 stock markets around the world crashed. In the U.S., the Dow Jones Industrial Average lost over 22% of its value. Although the causes of "Black Monday" were complex, many saw the crash as a sign that investors were worried about the inflation that might result from large U.S. budget deficits. The American housing market presented another sign of weakness, as in the second half of the 1980s a large number of savings and loan associations (private banks that specialized in home mortgages) went bankrupt. The collapse of the S&L industry negatively impacted the welfare of many American households and precipitated a large government bailout that placed further strain on the budget.

Although the 1987 stock market crash and the S&L crisis were separate phenomena, they demonstrated the growing importance of financial markets—and associated public and private sector debt—to the workings of the American economy. Other causes of the early 1990s recession included moves by the U.S. Federal Reserve to raise interest rates in the late 1980s and Iraq's invasion of Kuwait in the summer of 1990. The latter drove up the world price of oil, decreased consumer confidence, and exacerbated the downturn that was already underway.

The recession of the early 1990s lasted from July 1990 to March 1991. It was the largest recession since that of the early 1980s and contributed to George H.W. Bush's re-election defeat in 1992. Although mainly attributable to the workings of the business cycle and restrictive monetary policy, the 1990-91 recession demonstrated the growing importance of financial markets to the American and world economies.

Although the National Bureau of Economic Research has concluded that the early 1990s recession lasted just eight months, conditions improved slowly thereafter, with unemployment reaching almost 8% as late as June 1992. The sluggish recovery was a key factor in George H.W. Bush's defeat for re-election to the U.S. presidency in November 1992.

Not only was President Bush not reelected in November, but many of the investors to whom Don had sold shares began to experience the financial pinch. Some of the investors lost a lot of money in their other investments and now needed to recover the money that they had invested with Don. Unfortunately, another reflection of Don foolishly believing that he knew what he was doing was his failure to write the investment papers to exclude the option for early demands for a return of their investment capital. When these individuals wanted their money returned, they were in a position to effect this demand.

Because Don had spent so much money during the past three years on ALS, his French restaurant, and his wife’s spa, he had exhausted his ability to repay his investors. He was over his head in debt and had spent the many millions that he earned when he sold his contact lens business. He and the company were out of money and two investors forced the company into bankruptcy.

It is surprising to me, as I look back on this time, that these investors thought that they would be able to squeeze money from an obviously empty pocketbook. If Don had been able to repay them, he would have done so. I would have assumed that these investors were smart enough to recognize the reality of the situation and wait patiently for the market to recover. Then they would get their money plus the reward when the company was opened to the public. However, I guess I did not understand their situation any more than they understood Don’s.

Unfortunately, ALS was forced into bankruptcy. It really seemed like an unnecessary result based on dreams of grandeur at least from my perspective. Ann and I had operated our business for twenty
years in a small controlled manner. We never exposed ourselves to debt or tried to do things that were outside our areas of expertise. We were small but extremely profitable. Don’s dream of a huge enterprise that would become a public company never seemed realistic to me. Whether I was right or the times were wrong is a question with no answer.

Fortunately for Ann and me, ALS had only been a marketing company created to sell our products. They never owned our patents or our business so, after ALS failed, we returned to our style of operation. The entire experience with ALS left a bitter taste but we still had the best equipment and technologies available and now we could continue on our own.

Our business site was once again in Coto de Caza with a small staff. In this environment, we were able to attract the most creative and insightful software and hardware engineers. This climate was more suitable to our personalities and nurtured the creative instincts that we all shared. Now, we could focus on improving some of our biomechanical software options.

Almost immediately, however, we were contacted by our old friend, Coach George Dales, to come to Atlanta to analyze the 1996 Olympic Game events. Ann and I flew to Atlanta where George had reserved an entire conference facility to host the International Track and Field Coaches Association meeting which would immediately precede the opening ceremony of the Games. I arranged for my old friend, Bob Wainwright, and a gifted colleague, Dr. Alfred Finch, to join us in Atlanta.

Coach Dales had secured tickets for all of us for the track and field events so that we could gather data for biomechanical analyses. Another biomechanical group had been given the opportunity to place their cameras on the field, so we were forced to adapt to the situation. The four of us arranged our locations in the viewing stands at angles to each event so that we could cover the entire throw or sprint we wanted to analyze.

After we had collected the data, we returned to our “home” and began the data processing. We were able to capture the data for each athlete, store it in our computers, and then send the data, via the Internet, to various universities around the World to process it. Then these researchers would return the results to us in Atlanta. We did not have very much time for sleep during those hectic days, but we were able to accomplish an unbelievably complicated task. A tremendous amount of the work was done by Dr. Alfred Finch and I was pleased and relieved that I had invited him to help me. Of course, Dr. Finch hardly slept at all, so he may not have been as thrilled as I was.

Biomechanical Analysis of Discus Throwing at the 1996 Atlanta Olympic Games

by

Gilteon Ariel, Ph.D., M. Ann Penny, Ph.D., and Alfred E. Finch, Ph.D.

Introduction

History was made at the Atlanta games by utilizing the Internet to provide biomechanical data immediately for use at remote sites. The purpose of the research conducted at the XXVI Olympiad in Atlanta was to expand the biomechanical applications and the interactive capabilities of the Internet to make sport performances rapidly available to everyone. Under the auspices of the International Track and Field Coaches Association, the track and field events which were performed at the Atlanta Olympics in 1996, were selected to illustrate these procedures because these activities uniquely captivate an enthusiastic world-wide audience.
However, we demonstrated that (1) we could collect video data under difficult circumstances, (2) process the video data quickly, (3) transmit the data to universities around the World, and (4) receive the processed data within twenty-four hours or less. This had never been tried before and I was so pleased to be able to show again Coach Dales that he was right to trust my ingenuity.

After the enormously successful events in Atlanta, we returned to California. I was aware of new computer and other technological innovations in hardware. In addition, I envisioned revised or improved software for our biomechanical analysis system. My staff told me that my brain was constantly buzzing with new dreams and they were always trying to keep up with my new ideas. These were not complaints since they assured me that it was a pleasure to work in an environment of creativity. My style was to describe what I thought would be a great idea and give them complete freedom to develop the concept. These software geniuses enjoyed the challenges as well as the freedom to develop it in their own way. In my experience with them, the best technique was to describe an idea and stand back and watch it become a reality.
We developed new software for the APAS system which allowed cameras to move, or “pan”, as the subject of interest performed.

In addition, we had a feature which allowed an unlimited number of cameras to be processed for a single biomechanical analysis.

Another software advancement we made was to develop a feature which we named “Renderer”. This program grew from our initial gait module which had been used extensively by the physical therapy community for analyzing patterns of walking motions. Physical therapists and university researchers were frequently confronted with patients with compromised physical abilities. Many of their patients presented problems that were most accurately diagnosed with motion analysis and force platform data.

The premise of the “Renderer” was to allow the biomechanical parameters to be presented in three-dimensional space. The limb segments would appear as cylinders and the joint centers would be round and ball-like. Since more than one camera was used to collect the data, the results generated 6 degrees of freedom, that is, X, Y, Z, and 3 other orientations. Using these results, the calculated “stick figure” of the biomechanical analysis could now be animated in 3-D. By using cylinders and balls to represent the segments and joint centers, the resulting visual effects were more pleasing to many people than had been the “stick people”. We also could present a human skeleton, rather than the stick figure, for those who preferred that image. We also allowed the researcher to present the model as an isolated image or have it super-imposed on the original video.

One of our software geniuses was Mr. Rudolf Buijs. I first met Rudolf in Boston where I had traveled to meet with Dr. Carlo DeLuca. In Dr. DeLuca’s laboratory was a wonderful Swedish researcher, Dr. Lars Oddson, with whom both Ann and I had worked at the Karilinska Institute in Stockholm, Sweden. A friend of Lars, who was pursuing his Ph.D. studies, also worked in the laboratory. This was Mr. Rudolf Buijs. We soon became friends since we shared many of the same interests in biomechanics and research. Several years pasted after that initial meeting, until one day I
received an e-mail from Rudolf describing some of his interests which he thought would be useful for our various projects. We met again several times and then he moved to California so we could work on implementing these ideas. Rudolf was the main architect for the Renderer. A picture of the two of us is shown to the right:

We worked with several university professors who specialized in gait analyses to test our new software option. They used different marker systems with some employing the Helen Hays and other using the Kit Vaughn methods. All of them were positive and enthusiastic about their results using our new “Renderer” program.

Our gait analysis program had been developed and utilized during the 1980s. With the development and incorporation of the “Renderer” program in the 1990s, our biomechanical system was made even more comprehensive. Systems, unlike ours, which exclusively relied on the use of marker sets had several limitations. These systems were restricted in where and how the data can be recorded. They are restricted to filming in a laboratory with fixed camera locations and proper lighting requirements. They cannot film out of doors or travel to the location of a sporting event such as the Soccer World Cup or the Olympic Games. Additionally, they must use markers to obtain the data which means that the subject is required to perform with all of these items attached to their body. After these companies generate their results, they are not able to integrate the video with the six degrees of freedom model which we use. In other words, when they present their model you cannot compare those results with the actual data recorded. In addition, our entire biomechanical system is the only one currently available in biomechanics for a reasonable price. There are other companies with three-dimensional analyses currently available but they are priced more than fifteen times what our costs.

Another positive aspect of the “Renderer” is that of accuracy. The model is accurate since it is based on data obtained on real human beings and is not merely a virtual representation of them. This is particularly important to our physical therapist clients since they work with real patients who experience physical difficulties. They must be as accurate as possible in their assessment of the individual’s problems and in their prescription for resolving the issue. They would not be effective practitioners if they were only able to produce “virtual” models.
An important development affecting all of our biomechanical programs was the implementation of quaternions for many of the calculations because of the need to produce smooth animation. There are many situations, not just our programs, which can result in orientation problems in three-dimensional space. For example, airplanes have encountered certain situation because the left-right, up-down, and side to side motions cannot be resolved.

I will describe an example of a problem which an airplane could experience. Imagine an aircraft pointing north and flying level with its heading and pitch are 0 degrees and 0 degrees respectively. These correlate with rotation about the “Y” and pitch which is rotation about the “X” axis. Now imagine the aircraft pitches up to the vertical. This would be zero heading and 90-degree rotation about X. This is a common “gimbal lock” configuration because if the aircraft keeps pitching up through the vertical, the heading suddenly changes from 0 to 180 degrees. If the plane actually changes that heading, the roll must change (rotation about y) instantly by 180 degrees and start reducing pitch (the roll applied in a dynamics model will handle this). It is this sudden flip of the heading as pitch flips through the vertical axis and the instant change in a derivative of pitch that causes “gimbal lock.”

In three-dimensional systems, this gimbal lock can cause issues if the application of pitch and roll are handled incorrectly. The model that does not simultaneously flip and roll correctly will rotate back up to the vertical and twist around the axis (and many other similar related mathematical errors are possible). In physical systems, the requirement to suddenly rotate through the vertical by 180 degrees can
cause mechanical problems. Just understand that with ordered vector rotations about the cardinal axis when it rotates through the vertical (in this case) the instant flip of the other rotation has the potential to result in a gimbal lock.

The same kind of flip problem can occur when analyzing human movement. Imagine an arm moved from a left to a right position while moving upward. This movement would result in changing coordinates. The angular calculation produces an extreme result which on a graph would appear to be a smooth movement suddenly interrupted by a spike with the curve continuing in a different plane.

It is not unusual to experience these types of “gimbal lock” situations in biomechanical analyses. We humans continuously demonstrate these movements in our everyday activities as well as during sporting events. Rudolf explained that the “gimbal lock” problem could be eliminated from our biomechanical results by implementing quaternions in our software.

The idea and subsequent development of quaternions were made by a remarkable Irish physicist, astronomer, and mathematician who also made important contributions to classical mechanics, optics, and algebra. Sir William Rowan Hamilton was born in 1805 and lived until 1865. His studies of mechanical and optical systems led him to discover new mathematical concepts and techniques. His best known contribution to mathematical physics is the reformulation of Newtonian mechanics now called Hamiltonian mechanics. This work has proven central to the modern study of classical field theories such as electromagnetism, and to the development of quantum mechanics. However, in pure mathematics, he is best known as the inventor of quaternions.

In mathematics, the “quaternions” are a number system that extends the complex numbers. They were first described by Sir Hamilton in 1843 and applied to mechanics in three-dimensional space. A feature of quaternions is that multiplication of two quaternions is noncommutative. Hamilton defined a quaternion as the quotient of two directed lines in a three-dimensional space or equivalently as the quotient of two vectors.

Quaternions find uses in both theoretical and applied mathematics, in particular for calculations involving three-dimensional rotations such as in three-dimensional computer graphics, computer vision and crystallographic texture analysis. In practical applications, they can be used alongside other methods, such as Euler angles and rotation matrices, or as an alternative to them, depending on the application.

William Hamilton was part of a small but well-regarded school of mathematicians associated with Trinity College, Dublin, which he entered at age 18. He studied both classics and mathematics, and was appointed Professor of Astronomy in 1827, prior to his graduation, taking up residence at Dunsink Observatory where he spent the rest of his life.
During his academic career, Hamilton made important contributions to optics and to classical mechanics. His first discovery was in an early paper that he communicated in 1823 to Dr. Brinkley, who presented it under the title of "Caustics" in 1824 to the Royal Irish Academy. It was referred, as usual, to a committee. While their report acknowledged its novelty and value, they recommended further development and simplification before publication. Between 1825 and 1828 the paper grew to an immense size mostly by the additional details which the committee had suggested. But the paper also became more intelligible and the features of the new method were now easily seen.

In 1827, Hamilton presented a theory of a single function, now known as Hamilton's principal function, that brings together mechanics, optics, and mathematics, and which helped to establish the wave theory of light. He proposed it when he first predicted its existence in the third supplement to his "Systems of Rays", read in 1832. In these papers, Hamilton developed his great principle of "Varying Action". The most remarkable result of this work is the prediction that a single ray of light entering a biaxial crystal at a certain angle would emerge as a hollow cone of rays. This discovery is still known by its original name, "conical refraction".

The step from optics to dynamics in the application of the method of "Varying Action" was made in 1827. The ideas were communicated to the Royal Society which published in their “Philosophical Transactions” for 1834 and 1835, two papers on the subject. Like the "Systems of Rays," the ideas displayed a mastery over symbols and a flow of mathematical language almost unequaled. The common thread running through all this work is Hamilton's principle of "Varying Action". Although it is based on the calculus of variations and may be said to belong to the general class of problems included under the principle of least action which had been studied earlier by Pierre Louis Maupertuis, Euler, Joseph Louis Lagrange, and others, Hamilton's analysis revealed much deeper mathematical structure than had been previously understood, in particular the symmetry between momentum and position. Paradoxically, the credit for discovering the quantity now called the Lagrangian and Lagrange's equations belongs to Hamilton. Hamilton's advances greatly enlarged the class of mechanical problems that could be solved. They represent perhaps the greatest addition which dynamics had received since the work of Isaac Newton and Lagrange.

While Hamilton's reformulation of classical mechanics is based on the same physical principles as the mechanics of Newton and Lagrange, it provides a powerful new technique for working with the equations of motion. More importantly, both the Lagrangian and Hamiltonian approaches which were initially developed to describe the motion of discrete systems have proven critical to the study of continuous classical systems in physics and even quantum mechanical systems. In this way, the techniques find use in electromagnetism, quantum mechanics, quantum relativity theory, and quantum field theory.

Hamilton knew that the complex numbers could be interpreted as points in a plane, and he was looking for a way to do the same for points in three-dimensional space. Points in space can be represented by their coordinates, which are triples of numbers, and for many years he had known how to add and subtract triples of numbers. However, Hamilton had been stuck on the problem of multiplication and division for a long time. He struggled to resolve how to calculate the quotient of the coordinates of two points in space.

Hamilton’s great breakthrough in quaternions came on October 16, 1843 in Dublin. Hamilton was on his way to the Royal Irish Academy where he was going to preside at a council meeting. As he walked along the path of the Royal Canal with his wife, the concepts behind quaternions were taking shape in his mind. When the answer dawned on him, Hamilton could not resist the urge to carve the formula for the quaternions,
into the stone of Brougham Bridge as he paused on it. (I could find no information about what his wife thought of this activity! Maybe she was familiar with the actions of a great mind at work. Had I done the same thing, I am sure that Ann would have been impressed but not surprised if I had written on a stone wall!).

On the following day, Hamilton wrote a letter to his friend and fellow mathematician, John T. Graves, describing the train of thought that led to his discovery. In the letter, Hamilton states,

*And here there dawned on me the notion that we must admit, in some sense, the fourth dimension of space for the purpose of calculating with triples ... An electric circuit seemed to close, and a spark flashed forth.*

Hamilton called a quadruple with these rules of multiplication a “quaternion” and he devoted most of the remainder of his life to studying and teaching them. Hamilton's treatment is more geometric than the modern approach which emphasizes quaternions algebraic properties. He founded a school of "quaternionists" and he tried to popularize quaternions in several books. The last and longest of his books, “Elements of Quaternions” was 800 pages long and was published shortly after his death.

Today, quaternions are used in computer graphics, control theory, signal processing, and orbital mechanics, mainly for representing rotations/orientations. For example, it is common for spacecraft attitude-control systems to be commanded in terms of quaternions, which are also used to telemeter their current attitude. The rationale is that combining quaternion transformations is more numerically stable than combining many matrix transformations. In control and modeling applications, quaternions do not have a computational singularity (undefined division by zero) that can occur for quarter-turn rotations (90 degrees) that are achievable by many air, sea and Space vehicles. In pure mathematics, quaternions show up significantly as one of the four finite-dimensional normed division algebras over the real numbers, with applications throughout algebra and geometry.

Quaternions have had a revival since the late 20th century, primarily due to their utility in describing spatial rotations. The representations of rotations by quaternions are more compact and quicker to compute than the representations by matrices. In addition, unlike Euler angles they are not susceptible to gimbal lock. For
this reason, quaternions are used in computer graphics, computer vision, robotics, control theory, signal processing, attitude control, physics, bioinformatics, molecular dynamics, computer simulations, and orbital mechanics. For example, it is common for the attitude control systems of spacecraft to be commanded in terms of quaternions.

Thus, a quaternion is a four-element vector that can be used to encode any rotation in a 3D coordinate system. Technically, a quaternion is composed of one real element and three complex elements and it can be used for much more than rotations.

Rudolf was tasked initially with developing the “Renderer”. Rudolf is one of those unique individuals who studies all of the time especially in mathematics, astronomy, and computers. He had immediately recognized the problem with human motion analysis and “gimbal lock” situations. Obviously, human arm movement is smooth and does not flip or jump in the manner that one would assume by examining a graph representing a “gimbal lock” occurrence. Rudolf explained that quaternions would easily resolve the situation since they could eliminate the problem in the same way that they had in aircraft and computer graphics.

Rudolf worked intensely for several months to develop the algorithms and software. After some time, the “Renderer” was ready for its introduction to the world of biomechanics. In order to solve this biomechanical situation, he developed a quaternion algorithm to eliminate these “gimbal lock” situations. We arranged for him to accompany us to a biomechanical trade show where we were presenting papers and demonstrating both the CES and the APAS. His paper “Visualizing Orientation using Quaternions” was well received particularly since it provided a solution for biomechanists struggling with “gimbal lock” situations. We were the first ones in the World to solve this problem in the biomechanics of human movement. In our presentation in the ISB in South Africa, Rudolf presented this software option that we had developed to solve the “gimbal lock” problem.

After the success of the “Renderer”, we were asked by many of our clinical customers to provide an application which would assist them in a uniform, repetitive work flow. For example, doctors or insurance companies frequently wanted five trials of the same activity which they could compare to each other or to the patient’s previous performance. Since the same activity was being repeated numerous times under the same conditions, it would be helpful if we could develop a method to simplify this task.

Rudolf once again sets to work to create this application. We worked with our other biomechanical staff to create special subroutines to support this new application which had been named “Wizard”. The “Wizard” allowed the user to capture the picture from either a computer monitor or a television screen. The model or template, for example the number of cameras, the scale factor, or the number of joints, could be defined. Following the biomechanical processing, the report could be standardized so that all of the trials, data points, pre- and post- activities, or whatever information was
required could be presented in the final report. The final report could be customized, in addition, with pictures, graphs, EMG, or any other results which were calculated in our biomechanical process. The idea was to help the clinician create a professional-looking report. For presentation on the computer itself, we created the ability to imbed the “stick figure” representation of the individual inside the video as the motion was viewed. Sometimes, a picture actually is worth a thousand words.

I presented the “Wizard” was at the Pre-Olympic Congress in Brisbane, Australia prior to the Sydney Olympic Games in 2000.

Another on of the advanced function in the Wizard was the ability to strob the video so the coach or viewer could view multiple frames with data attached to the video as illustrated in the figure below:
I also presented the “Wizard” technology and its application at the International Track and Field Coach’s Association meeting in Athens before the 2004 Olympic Games.
When the Olympic Games in Athens, Greece in 2004 were ready to proceed, I again had the opportunity to work with Coach Dales. We were together prior to the Games and organized filming the Shot Put. We traveled to Olympia, Greece which was the site of the ancient Olympic competitions. It was a magical experience to be involved with a modern event at the location which was the origin of all of the Olympic Games which have followed. It brought tears to my eyes to be at this beautiful location and remember that I had actually had the unique opportunity to compete in two Olympic Games.

One of our innovations had been to integrate the data collection using the Internet for analysis in any place in the World. In the 1996 Olympics in Atlanta, we already employed many of our techniques. By 2004 and the Greek Olympics in Olympia, we could use the internet even more extensively. Now, we were able to use cell phones and the Wi-Fi.
In the late 1980s and early 1990s, we developed another amazing system: Ariel Dynamics which provides a system to perform a biomechanical analysis from standard TV broadcasts. The Web, combined with Java, is an ideal platform to provide these kinds of services to a wide audience with interactive visualization demos. This web concept allows for many different types of analyses and presentations. With advanced sophistication technologies available on cell phones and wireless systems,
we developed our biomechanical system to work with these devices. The schematic diagram below illustrates this concept:

The Wireless APAS and on Hand Held Computers

Our latest Biomechanical System

The ability to collect data from the major sporting event on the television and then analyze it would allow every person watching to become a biomechanist in his or her own home. We developed a system to be able to do that:
The Virtual APAS

Imagine watching the Olympic Games on your own television set at home. It is possible to capture any activity from the TV while sitting in your easy chair at home. The next step is to accurately calculate 2D and 3D coordinates provided that the video feed was captured from different angles (which the network usually shows as illustrated above) and the dimensions of objects, such as the track width or the height of the number markers or even the size of the athlete, are known. Even if the cameras pans, zooms, or tilts, the Virtual APAS will allow calculation of the coordinates of the body's joints and analysis of the kinematics of the movement. The Virtual APAS is essentially the 21st Century in biomechanics. The next “century” will be to use your cell phone to perform these analyses.

The following are only a few of the function that can be performed:

1. Locate and download your favorite Biomechanical Data from one convenient, easy-to-use interface.
2. Software that allows users to share Biomechanical libraries with each other no matter where they are located. APAS-virtual provides a search capability for videos, 3D/2D Files capability for users to communicate in forums of like interest.
3. Each Biomechanist is a download/upload source
4. Each User Computer, when it is on, it becomes a shared directory

The procedures may follow the following scenario:

1. A user records and stores Video file in a specific folder on his or her hard disk.
2. A central directory maintained by APAS.com keeps track of which users are logged on, cataloging by title and researcher/biomechanist the activity in each user’s special folder.
3. A user searches through the APAS.com directory for a desired activity or sports. Once the activity is downloaded it can be used for further analysis or observation. This file can also be sent to another person as e-mail or attachment. Any user folder can be shared with the rest of the World.
4. APAS.com monitor and publish the catalogue of activities and sports world wide
All things considered, it had been an exciting time with all of the new technologies and software improvements we were making for our biomechanical system. It seemed that we had no sooner integrated a new camera or new VCR or some other new device and another one would become available. Of course, the newest model was more exciting than the last one, so we had to have it. I am sure every wife or mother has watched their husband or son who has to have the newest gadget which they cannot possibly live without. That was our situation and it was one of the most exciting and stimulating times of our lives. It was almost like going to the toy store every day. And all that occurred in the 1980’s and 1990’s. No cell phone, no Internet.

Real-time interactive visualizations on the web. This can be used for all types of applications, including e-sports analysis. For example, any athlete might want to compare himself to a professional or to himself before a training program. Professional visualizations can be created easily. This would allow the viewers to analyze simple questions such as “did Carl Lewis touch the line before takeoff? Could he have jumped farther? How does this jump compare to Bob Beamon’s?” There are other questions including team formation analysis, race analysis, and
comparisons of different athletic performances.

In addition to all of the software programs that we created, we continued our efforts to improve the hardware design and develop new programs for our reclaimed Computerized Exercise Machine. This had been our first “baby” and it had come home to the family that loved it. Now we wanted to manufacture it again under our control.

For the manufacturing of the hardware, we had a surprising event when a stranger knocked on our door and asked if I was Gideon Ariel. That was not the surprising part. The shock was that he lived approximately a mile from us and had been hired previously by ALS to make the valve packs that they had used on the CES in the La Jolla facility. When ALS ceased to do business, this gentleman had been left with 100 units that he could not use and had no customers to buy them. Needless to say, we quickly concluded an arrangement to purchase these units for a fantastic price. Both sides were both happy and satisfied at the conclusion of this business transaction.

In addition to these newly acquired packs, we found what seemed to be a perfect solution. We had discovered a small machine shop business, owned by an engineer and a commercial airplane pilot, which they operated for clients like us. They were for all intents and purposes a custom engineering and machine shop. Their work was meticulous and of superb quality. We were extremely impressed by the quality of their work and contracted them to make the CES for us. We were able to provide them with complete packs for 100 units, so we were on the way to recovering our CES business but on our own terms.

http://arielnet.com/ref/go/1256

We were back in the CES business as well as the further development of software for the APAS system. The additional development of unique biomechanical items makes our life even more exciting. But, twirling in my head, I had my most unbelievably surprising idea in store for Ann.
Life in Coto de Caza continued for our companies, our two continually evolving products, and ourselves. After all of the anxieties with the Coto Research Center and the debacle in La Jolla, Ann and I were enjoying the positive atmosphere of productivity and a pleasant staff of hard working individuals. It seemed that we could concentrate on the positive aspects of our work and our lives.

In the previous chapters, I described our mode of operation. We were a small corporation and tightly controlled the details of product development, manufacturing, marketing, and sales. To that end, it seemed as though I was the best person to explain to potential customers the attributes and numerous options that the two products, the CES, and the APAS, could provide. This meant that I was the one who traveled to customers and trade shows for presentations.

I was thrilled when our old friend, Tony Payne, from Johannesburg, South Africa contacted me to come for a sales and training clinic. Tony had sold several of the CES to a university in a town in the center of the country, and he wanted me to help train the university personnel, as well as Tony’s sales staff, on all of the options available with this computerized system. Needless to say, I was more than willing, and I saw that this was an opportunity to take Ann with me. Ann and I had traveled to South Africa several times in the past, and I knew how she felt about these trips. I knew how much Ann loved the wilderness bush experience and was completely obsessed with animals, in general, and African wildlife in particular. This seemed like a perfect opportunity for us to travel for business and also add some fun experiences as well. I do not believe that Ann would have let me go to Africa without her, so it was the perfect situation.

We planned with Tony for the sales and training clinics to be held in January 2014 and he was to let us know the schedule that worked the best for everyone. Shortly after that, Tony and his staff selected dates that worked for him and his customer. I told Tony that I wanted to plan at least one safari trip with Ann and that we would host Tony and his wife, Lorna, to accompany us. I told him to organize everything for his convenience and then let us know the details. Then we would make the necessary flight arrangements to and from South Africa.

We also decided that it would be a good addition to have our colleague and friend, Bob Wainwright, accompany us for the safari and to assist with the sales and training clinics. Bob, at that time, was excellent at demonstrating and training people on the details of the Computerized Exercise
Machines. Also, two of Tony’s customers were in physical therapy departments at two universities so that Bob would be especially helpful with those clients. Bob was planning a special surprise college graduation gift for his daughter, Jesse, who was to accompany him on the trip to Africa. Ann and I flew to Johannesburg about ten days before Bob’s arrival. That gave us time to meet Tony and arrange the safaris as well as other business details. While Ann worked on one project, I went with Tony to see the exercise area of another potential customer of Tony’s who wanted to meet me before he committed to the purchase of the CES.
This gave Tony and I time to discuss the upcoming meeting as well as the details about the safari which was to a new destination for us located in the Kruger Park called “Singita.” Tony’s company had customized the fitness facility there since the corporate owners had learned that safari travelers also wanted the opportunity to exercise while in the wilderness of the bush. While we were going over all of these details, we decided to have a quick lunch before the meeting.

During the few minutes that Tony and I were chatting and discussing what to eat, my mind drifted off and I had a mental video of the 35 years from the time Ann and I met in graduate school in Amherst, Massachusetts until now in South Africa.

Of course, Ann and I do not exactly look like this now, but these two infants seemed to have been destined to find each other for a lifetime. This is the girl who slammed the door in my face the first time I saw her. But I discovered that she was always the best student in our graduate classes, and as time passed, we became friends. We have studied together, loved together, worked together, traveled together and had fun together for 35 non-stop years.
Ann working as her professor’s research assistant in Coto

Gideon during the 1970s
First of all, she always impressed me with her intelligence and beauty. No matter how fast, wild or inventive I got, she was able to keep up with me. If I have a dream or idea, she knew how to make it reality or to tell me that my idea was great but not something we could realistically pursue. Whatever has transpired in the first 18 chapters of this book, Ann has been an integral and driving factor in most of it. There is nothing in my life that I have done since meeting Ann that she did not greatly influence. Whenever there was trouble, she would find a way to solve the problem. Whatever the situation, we were always able to think things through together.

There was no reason for Ann to be my girlfriend. Ever since my childhood and through my Army days in Israel, I was sort of a “playboy” who dated many girls and had even married one of them. When I met Ann in 1969 in graduate school, I was separated from my wife, Yael, and was dating other women. At that time, Ann and our friend, Jim Salidis, were the “three musketeers” in graduate school where we studied together, met in the computer center and biomechanics laboratory to work on projects, and sat together in the coffee shop to discuss our studies. We became best friends during these years. I guess the best way to describe our relationship was that we grew into loving each other. It was never the “love at first sight” but rather an incorporation of the mind and body that slowly matured into a totality of love.

One of the most amazing facts in our 35 years together is that we never had a fight. We never argued about anything and, with an Israeli, this is an amazing feat! We would discuss every detail of our business, home, travel, friends, and every other aspect but calmly and rationally. Sometimes the discussion might take days to complete because life is complex. But we could always discuss things and eventually arrive at a mutually agreed result.

For example, during elections for government officials and the referendums that we have here in California, I can be very outspoken in my opinions on how to run the country. Our discussion, however, usually ended with my asking her “Who are you voting for?” and then I would vote for that person or issue. I have complete trust in her and her judgment. Frequently, I expressed my opinion, but, in the end, I realized that her assessment of the situation was reasonable and suitable for the state or the country so I would vote the way she was voting. It reminds me of the famous joke where a man said, “In 50 years, I made the big decisions and my wife made the small decisions. I make the big decision such as whether we should declare war on China or build new submarines. My wife makes the small decision such as where we live or how we spend our money”.

Our laboratory in Coto
How Ann was able to do all these things is beyond my comprehension. No matter how strange and complicated I made my own personal life -- women, stress at work, or business -- nothing affected my love for Ann or Ann's love for me. We traveled around the world and did what we like to do. Some of our travel pictures show a few of our experiences over the years:

At NASA in Texas

Guadeloupe
Biomechanics conference in Hong Kong with beautiful Ann

River trip in Guilin, China

Historical fort in Turkey
Bangkok, Thailand  
Jerusalem, Israel  
China with John and Shelia

Platagonia  
http://arielnet.com/ref/go/1257

And always in love
Ann had remained my girlfriend, in spite of having watched a parade of other women pass through my life. For some reason that I will never understand, she stayed with me and the other women eventually left. She recognized that those other women fulfilled some need I felt a need of validation for my perceived shortcomings. Sitting in the restaurant with Tony in Johannesburg, South Africa, I finally recognized what should have been obvious to me for all of the years we had shared. There were a heart and soul connection between us. She had stood behind me and been my rock of comfort and dependability. Her focus and love had always been me. As this all became more and more clear, I felt like the biggest idiot in the world. What could I do about it?

Suddenly, out of the blue, I blurted out loud to Tony, “What if I ask Ann to marry me in Singita?” Tony was initially as shocked and surprised as I was to have this thought suddenly pop into my consciousness. Tony thought it a fabulous idea. As we discussed the idea and became more excited and enthusiastic, we realized that this would have to be a closely guarded secret. This was a secret that we could not share with anyone except Tony’s wife, Lorna since we would need her to divert Ann’s attention periodically. I was not even going to reveal the exciting idea to my good friend, Bob Wainwright. Keeping a secret at all can be a challenge and this event would be an enormous shock to everyone. The most difficult task would be to make sure that Ann did not have even a hint that there was something going on in the background.

At this point, we realized that we had to have an engagement ring before we left for Singita. Tony told me about his good friend, Michael Solomon, whom he had met in a yoga class. He assured me that Michael would be a perfect jeweler, so we left the restaurant and drove to see his friend. Michael came from a long, convoluted family of jewelers. One of his ancestors had been a jeweler in France but who had fled from there many, many years before. In fact, Michael suspected that his family was forced to flee from prosecution as he believed that his forbearers had been Jewish and, hence, his family name of “Solomon.” No one knew for sure and after so many years had passed, by the time he had been born and raised in South Africa, the family were Christians.

I wanted to design a special ring for Ann. Before we had left California bound for South Africa, she told me that she would love to have some piece of jewelry with a beautiful blue stone called “tanzanite.” We had seen these lovely blue gemstones on previous trips to Africa and she had talked about them for years after we had first seen them. Tanzanite was discovered in the Mererani Hills in northern Tanzania in 1967. The gemstone is noted for its remarkably strong trichroism which means that a substance appears to have different colors when observed at different angles, especially with polarized
light changes. In other words, tanzanite can appear as sapphire blue, violet, and burgundy depending on the crystal orientation. Tanzanite can also appear differently when viewed under alternate lighting conditions. The blues appear more evident when subjected to fluorescent light and the violet hues can be seen readily when viewed under incandescent illumination. Tanzanite is usually a reddish brown in its rough state, requiring artificial heat treatment to bring out the blue violet of the stone. The mineral was named by Tiffany & Co. after Tanzania, the country in which it was discovered. Ann, however, she was obsessed with the blue ones.

Tony and I watched with amazement as Michael sketched several suggested ring styles. We were watching an artist at work, to be sure. Eventually, we decided that the most beautiful design consisted of three small bands of white gold inlaid with diamonds with the bands joined at the bottom. I wanted 35 diamonds since that was the number of years that we had been together. Across the three bands was a large rectangle of tanzanite. The design was beautiful and quite unique. The three of us agreed that this ring was the best and would be perfect for Ann. Tony explained to Michael that we had to have the ring before we left for our safari. He promised us that he would have it by the time we had to leave on our trip.

Now Tony and I discussed the proposal and the setting. Tony described how Singita was arranged about the lodge, restaurants, rooms, and lounge areas. His thinking was that we could have the staff set up something out in the bush perhaps when we stopped in the morning for the coffee break or in the afternoon when the Land Rover stopped for Sundowners. Another option was the large lounge area which would have all the sound systems for our music, a bar for after dinner beverages and comfortable furniture for relaxation after dinner. Tony assured me that any of these locations were perfect for a marriage proposal. However, once we got there, I could make my final decision.

The day arrived for our departure from Johannesburg to Singita. All of us were so excited about the safari. Tony, Lorna, Ann, and I were accompanied by our friend, Bob Wainwright, and his daughter, Jesse. This trip to South Africa was her college graduation gift and she had been enjoying the experience. The flight was in a small plane for 15 people and, after an hour of flying over the amazing terrain of South Africa, we arrived at Singita’s private airstrip. Waiting for us was one of their rangers with a land
rover to transport us to the main lodge. To everyone’s joy, we passed a herd of zebra and some giraffe on the drive. The staff at the Lebombo Lodge met us with warm hand towels scented with lemons and a cool fruit drink to refresh us from our dusty ride.

The setting of the Lebombo Lodge was inspired by the eagles’ nests built into the cliff face of the river bank. Each of the 15 loft-style suites is glass-walled as romantic hideaways leading outdoors onto elevated wooden viewing decks. There is a swimming pool in the main lodge area, spa and gym facilities, boutique and gallery for African art. The restaurant is a covered area with open sides for interaction with the outside scenery. The long lounge area is open on all sides where the game could be viewed from dawn until dusk.
The most important aspect of Singita is its location within the Kruger National Park. The Kruger National Park is larger than the country of Switzerland and stretches across three countries, Zimbabwe, Mozambique, and South Africa. The concession has a unique advantage in the Kruger Park since it is located in an area which is quite a distance from the normal tourist roads. This affords game-viewing only from the vehicles belonging to Singita. Normal traffic through the Kruger Park is restricted to their roads only. In addition, none of the vehicles can leave the road to drive closer to see some game, for example. Within the Singita concession, their vehicles can approach as close to the wildlife as can be done safely and without disturbing the animals. The wildlife includes elephants, lions, leopards, wildebeests, giraffes, hyenas, impalas, and many different types of other antelopes. Monkeys, gorillas, hippopotamus, and crocodiles are prevalent in and around the river that traverses the property. Birds are everywhere as well. With the vegetation and animals, it is truly a magnificent opportunity to experience African wilderness.
Pictures of some our “friends” in Singita

The King of Singita
Each couple was shown to their individual “room” which was, in fact, an entire bungalow overlooking the river below and the hill opposite. From our balcony, we could see two crocodiles sunning themselves on the river’s edge while a small herd of impala were munching on the greenery around the trees on the hill. Our room had a bedroom, living area, two showers with one outside under the canopy of the tree and the other one inside in the bathroom. We were provided with a well-stocked refrigerator with wine and snacks. The one rule was to be vigilant in locking our doors when we are inside the room or left to go anywhere on the property. The reason was to keep our room safe from the inquisitiveness and thievery of the baboons! They are notorious for “visiting” a room, opening the refrigerator and enjoying all of the snacks and food. Unfortunately, they are very messy guests.

Since this was our first visit to Singita, Ann and I were enamored with its uniqueness, beauty, and serenity. Our bungalow was on the side of the hill overlooking the river, so the first thing we did was to sit outside on our porch and listen to the sounds of the bush. We could hear the most interesting sounds which were so unlike anything you would ever hear in California!

We changed clothes for the evening game drive, gathered our photographic equipment and then strolled up to the restaurant to meet our friends for a quick lunch before departing on the Land Rovers. The restaurant was unique with what seemed to be an outdoor environment but with an overhead roof and nearly transparent “walls” which could be opened or closed depending on the weather at that moment. The sensation was that you are outside and inside at the same time. The lunch was delicious. Afterward, we collected our photo equipment, jackets for the cool African evening, and headed to the Land Rovers.
Although this was not our first evening safari, the one thing that we had learned about the African bush is that every game drive is unique. You can never plan for what you will see. The expression “expect the unexpected” is a perfect way to prepare. That evening was no exception. We drove around watching the herds of impalas settling down for the night, the crocodiles sliding back into the river as the sun faded, and the hippopotamus beginning to peek out of the water in anticipation of their night of foraging on the grasses near the river. We stopped the Land Rover to stretch our legs and enjoy the traditional “Sundowner” which meant having a drink of coffee, tea, or more potent beverages. Then we drove back to the main lodge for dinner.

The next morning began at 4:30 am! I know how much Ann loves these morning safaris because she is not a morning person. Normally she goes to bed at two o’clock in the morning and gets up between 9 and 10 the next morning. But if Africa, she is a changed person. She is ready to go as early as possible and wants to have the game drive last for as long as possible.

All of the people going on the game drive met at the lodge for tea, coffee, and early morning snacks. Everything was delicious as we had discovered all of the food at Singita was. Then we went out to the Land Rovers, climbed aboard the open-air vehicle, and drove off in search of wildlife just as the sun was peeking up over the hill.

The day preceded as a normal safari day. The morning snack before the game drive followed by a big breakfast. Then the day was relatively open with options including relaxing around the swimming pool, exercising in the well-equipped training facility, selecting one of the many massage choices at the Spa; shopping in extensive and expensive, shop; partaking of a delicious lunch, or napping in the bungalow. Since Ann and I normally skip lunch, we went workout in the gym. Because the Lodge is
situating in the home of the animals, with no fences to protect it, we were required to have staff members accompany us from the main lodge down a small hill to the gym. (One day, the staff was unable to take us since there were four lions sleeping in front of the Spa). Since Tony’s company had designed and furnished the fitness facility, it was a wonderfully complete. We worked out together for about one and a half hours and then returned to our bungalow to get ready for the afternoon game drive.

The afternoon game drive usually leaves the lodge about four o’clock. Again, there was a quick snack and then off into the bush in search of more wildlife. After the Sundowner, we watched for many of the game that is only seen at night. For example, the adorable little bush babies with their bright red reflective eyes which are usually found only in the evening. Then we drove back to the lodge for dinner.

By dinner time, my emotions were building and my pulse was racing. I had never felt like this, but Tony patted me on the back telling me to calm down and everything would go well and be fantastic. After another delicious meal, we all adjourned to the lovely lounge to enjoy the African evening. The evening sounds included bird calls and infrequent animal calls. The weather was delightful and our friends were all around enjoying after-dinner beverages.

I had arranged for the Singita staff to play an ABBA disk which I provided. Ann and I had become obsessed with ABBA in London in 1998 when we saw the musical “Momma Mia.” We had never heard of ABBA before that since their popularity as a musical group had been during our years in graduate school. We had barely been aware of even earth-shaking news during those years, so musical groups were well outside our knowledge.

We were all sitting and enjoying the ambiance. Bob and his daughter, Jesse, as well as Tony and wife, Lorna, were there. Tony and I made eye contact after some time and Tony went to tell the staff to start the music. The ABBA music began and just as some beautiful, graceful giraffe sauntered by on the hill, I turned to Ann and invited her to come dance with me.

Ann’s response was confusion. “Dance? We haven’t danced for years since I am so good and stepping on your toes. Let’s just sit and enjoy the music.”
Of course, I insisted that we go dancing and promised to keep my toes out of her way. “Ann please, one dance. Look at the animals. They would love to see us dance” was my special plea that I hoped would work.

That did it. Ann could never say no to animals and sure enough, she agreed. We began a nice slow dance.
The ABBA music continued playing. I had hidden the ring in my pants pocket in a small box. I was worried that Ann would notice I had something in my pocket and want to know what it was. My heart was pounding and I remembered having experienced a similar crescendo of emotions before I walked into the stadium at the Rome Olympics carrying the Israeli flag. Ann and I continued our dance while I waited for the song “I do I do” to begin. There were a few other guests sitting in the lounge where we were dancing and they all seemed to enjoy watching us. I suppose people enjoy seeing an older couple sharing a romantic moment.

Finally, ABBA launched into “I Do I Do” and when they sang that phrase of the song, I went down on my knee, took the box from my pocket, and, as I opened it, held up the ring and said:

“Ann, will you marry me?”

“What are you doing?” she said, turning around looking at the people sitting nearby. “You are embarrassing me, stop it!”

“Ann, I mean it. Will you marry me?” I insisted.

“Gideon please, stop with the jokes.” she pleaded.

Of course, by this point, she was correct that everyone was watching this scene of me on my knee holding up the ring.

“Ann, please say ‘yes’ because my knees are killing me…” I said.

“Okay I will marry you. Now get up.” Ann replied with a shocked smile and utter disbelief on her face.

I got up and kissed her on the cheek. Tony had dutifully photographed the entire tableau as it unfolded.

In addition to Ann’s shock, my words and images finally penetrated the jetlag-induced fog of our friend, Bob Wainwright. He lurched into a sitting position on the comfortable sofa amid a swarm of pillows and in a loud voice announced “Holy Shit!!!” I guess he finally understood that the scene was real and not a crazy dream.
Some of the other guests, who were in Singita for their safari experiences, were also crying and joined the group to congratulate us. Bob and Ann were both in shock for the rest of the time we spent in Singita.

In addition to the fun of the wedding proposal, the entire trip to South Africa was a wonderful experience, with viewings of many different animals. We thoroughly enjoyed the time together amid the wildlife. Now, however, we had to travel home and plan the wedding.

After we had returned to California at the end of January, the first determination we made was that we were fat, with a capital “F” and that we would have to lose weight before any marriage could take place. Our travels had included delicious food and lots of it so we eaten like pigs and each of us gained at least 20 pounds or 9 kilos. Regardless of your measurement system, we were quite porky and would have to lose the weight.

Following this important, yet necessary, decision, Ann began to research for the best date and place for the wedding. We had decided that October would probably be a good time, in addition to allowing ample time to lose weight and arrange for wedding attire to fit. Now we needed to select the appropriate date. Ann searched several databases for the best date for an outdoor, ocean setting. The Department of the Navy had the most comprehensive schedule for days and forecasts and we found that between Oct. 5 and 20th the average, historical rainfall was .01 inches at Dana Point, CA. There had been no rain on these dates for 30 consecutive years, so we decided to take our chance. We agreed that it is always best to apply science to any situation. We were closing in on our exact date. Next, we needed the place.

We looked at several locations near Laguna Beach, but none of them were beautiful or provided the ambiance for which we were searching. We did not know exactly what we wanted, but at each place we looked, we know that was not the place for us. Then we visited the Ritz Carlton in South Laguna Beach and discovered the perfect place for our wedding. It is, for sure, one of the most beautiful hotels in both inside and outside spaces. We could have an outdoor ocean-bluff wedding and the indoors settings, with the lovely interior rooms, were perfect for all of the other wedding activities. After conversations with the hotel staff, however, the only date that they could accommodate for our wedding was October 17th, so we agreed. After all, it was within the window we had selected.
Now we had to have the most important member of the wedding itself, the Rabbi. Without the Rabbi, we would not be having a wedding! Ann visited our Rabbi, Stephen Einstein, whom we had known for about thirty years.

He was more than happy to officiate at our wedding which he smilingly assured her was an event that he had been waiting to perform for many years. Unfortunately, he explained there was a problem. Rabbi Einstein told her that he would be leaving to begin his Sabbatical year on Oct. 15. We wanted to marry at the Ritz Carlton but they could not accommodate us before October 17th. Ann held her breath while thoughts raced through her mind about alternatives. We had to have Rabbi Einstein, so she was trying to make other modifications in her head. Fortunately, she need not have worried so much. Rabbi Einstein was so happy to participate with us that he willingly and happily delayed the beginning of his Sabbatical until Oct. 18th. Now we had established the three most critical components that we needed for our wedding: the date was October 17, the place was the Ritz Carlton in South Laguna, CA, and our Rabbi Einstein would be there.
The next step was for us to travel to Israel and one of the main reasons was to see my dear friend and mentor, Yariv Oren. Yariv had given me purpose in life when I was 16 and traveled to Holon to learn how to be an assistant, physical education instructor. At that time, I was extremely shy and had absolutely no confidence in myself. Yariv recognized something in me and, like a shriveled and dying scraggly plant, he did everything that he could to nourish, cultivate, and create the athlete, student, and scientist that I became. Everything I am today and all that I have are because of Yariv. Yariv offered me an opportunity to train at his athletic camp and suggested that I try throwing the discus since I seemed quite strong for my age. From that moment forward, I tried everything he recommended and one day I timidly inquired whether he thought I could ever make the Israeli Olympic team. “If you try, anything is possible” was his answer. For me and everything I have accomplished in my life grew from this man and his belief in my potential.

We traveled to Israel to announce to Yariv our plans and to make sure that he and his wife, Aviva, would come to our wedding. It was a long, fourteen-hour flight but we were excited about sharing the good news with him. We arranged to visit him the next day and I was nervous but confident that he would say “yes” since I knew how much he loved both of us. We met him at his lovely home and, as expected, he was very excited about our news. His wife, Aviva, was as enthusiastic as Yariv since she...
had known both of us for many years. He was pleased about our wedding and immediately and eagerly agreed that he and Aviva would travel to California to share our wedding joy together. We told him the date in October and decided that in the future we would work out the timing and flight details for him and Aviva to come to California. After all, they would need time to see us and to recover from jetlag.

We also asked Yariv to help us find a particular weaver in Jerusalem who could make a handwoven tallit for us. A “tallit” is a prayer shawl worn by Jews during weekday morning services, on the Sabbath, and on holidays.

The tallit was developed as an outer garment on which fringes could be worn in obedience to a Biblical command. The original tallit probably resembled the "'abayah," or blanket, worn by the Bedouins for protection from sun and rain, and which has black stripes at the ends. The tallit is normally made of wool and has special twined and knotted fringes (tzitziot) attached to each of its four corners and, thus, is sometimes called the “arba kanfot” or "four corners."

The term “tallit, for some people, can be a little confusing. It can refer either to the "tallit katan" (small tallit), an item that can be worn over or under clothing and commonly referred to as "tzitzit", or to the "tallit gadol" (large tallit), which is a Jewish prayer shawl worn over the outer clothes during the morning prayers and worn during all prayers on Yom Kippur. The term "tallit" alone usually refers to the “tallit gadol”.

Traditionally, the tallit is made of wool or linen, based on an understanding that reference to a "garment" in the Bible in connection with a commandant refers specifically to wool and linen garments. The “tallit gadol” is traditionally draped over the shoulders, but during prayer, some cover their head with it, notably during specific parts of the service such as the Amidah and when called to the Torah for an aliyah.

The “tallit gadol” is usually woven of wool. “Tallitot,” which is the plural form, may be of any color but are usually white with black, blue, or white stripes along the edge or white with twelve colored stripes. The all-white and black-and-white varieties have traditionally been the most common, with the blue-and-white variety, in the past said to be in remembrance of the blue thread or tekhelet,
Sizes of tallitot vary and are a matter of custom and preference. Some are large enough to cover the whole body while others hang around the shoulders. It must be long enough to be considered a garment (defined by the Code of Jewish Law as that which is large enough to cover "a small child able to walk"). The neckband of the tallit, sometimes woven with silver or gold thread, is called the “atarah” which literally means “crown” but is often referred to as the “collar.” The “tallit gadol” is often kept in a dedicated pouch or cloth bag (often of velvet) which can be quite simple or ornately decorated.

The Bible does not command the wearing of a unique prayer shawl or tallit. There are no religious specifications for the tallit itself and it can be made in a variety of sizes, materials (wool, silk or rayon) and decorated with a range of artistic patterns. The tallit is simply the garment that displays the divinely-ordained fringes and is not sacred in itself. Instead, it presumes that people wore a garment of some type to cover themselves and instructs the Children of Israel to attach fringes (תִּיצִית tzitzit) to the corners of these shawls or garments (Numbers 15:38), repeating the commandment in terms that they should "make thee twisted cords upon the four corners of thy covering, wherewith thou coverest thyself" (Deuteronomy 22:12). These passages do not specify tying particular types or numbers of knots in the fringes. Nor do they specify a gender division between men and women, or between native Israelite/Hebrew people and those assimilated by them. The exact customs regarding the tying of the tzitzit and the format of the tallit are of post-biblical, rabbinic origin and, though the Talmud discusses these matters, slightly different traditions have developed in different communities. However, the Bible is specific as to the purpose of these tzitzit, stating that "it shall be unto you for a fringe, that ye may look upon it, and remember all the commandments of the LORD, and do them; and that ye go not about after your own heart and your own eyes, after which ye use to go astray; that ye may remember and do all My commandments, and be holy unto your God" (Numbers 15:39-40).

In some Jewish communities a “tallit gadol” is given as a gift by a father to a son, a father-in-law to a son-in-law, or a teacher to a student. It might be purchased to mark a special occasion, such as a wedding or a bar mitzvah. At Jewish wedding ceremonies, a “tallit gadol” is often used as a “chuppah” or wedding canopy.

Typical “Chuppah” or wedding canopy
In our case, we wanted to have a tallit made especially for me and which we could use as the chuppah for our wedding. A “chuppah” is a canopy under which a Jewish couple stands during their wedding ceremony. Our Rabbi’s wife, Robin, is a gifted and creative individual who had shown a tallit for her children during each of her pregnancies. She had discovered a woman living in Jerusalem who weaves the cloth following the Biblical requirements and who was able to accommodate the specifications that Robin had for each of her children. She gave the name and address of this weaver to us and, with Yariv’s help, I was confident that we could find her.

Yariv was not completely surprised that we were going to be married since he had secretly hoped for this event for many years. He was a slightly taken aback about going to all of the extra efforts to make a tallit. However, since we were making it especially for our wedding, he was more than willing to assist us in our quest. He called the weaver from his home in Hod Hasharon and we set an appointment for the next afternoon.

The next day was warm and beautifully sunny. We drove with Yariv to Jerusalem and, of course, managed to get lost in the warrens of shops and streets near the Old City.

It was actually quite enjoyable driving through the small streets, peering into the small, recessed shops whose storefronts presented the type of goods sold there. Finally, after many turns and retracing of our steps, we found the small shop, Shizre Kodesh.
The weaver, Carine Kleiman, was working at her loom which we could see in the rear section of the shop. It looked like a lovely setting for her work with lots of natural light and open on the side for the breezes. Her husband, Robert Kleiman, is in charge of all of the business aspects such as prices, taxes, insurance, and shipping.

After the introductions, we explained what we wanted. They showed us several tallitot which had been previously woven. However, none of these, although beautiful, were quite what we had envisioned, so we sat with the weaver herself to design my tallit. Carine was very creative and we quickly decided on the size, colors and material, the style of the crown, and, most importantly, would she be able to finish the task in time for a wedding date. She assured us that there was sufficient time. We concluded all of our business there and with smiles all around, drove away.

We spent the rest of the afternoon at an Arabic restaurant where Yariv had spent many hours during his time as Minister of Sport for Israel. In fact, he and the proprietor had known each other for more than 40 years. Needless to say, the food was delicious and, of course, we stuffed ourselves on
hummus, pita, tahini, falafels, eggplant dishes, olives, and many other traditional Middle Eastern foods. So much for our diets! Ann and I laughed and, as each of us ate another falafel, promised ourselves that we would be better behaved tomorrow.

Our trip to Israel had been wonderful. We saw many of my friends and schoolmates, as well as my sister and her family. The days passed quickly and then we had to return to California. Our last meeting was on the afternoon of our flight. We went to visit Yariv and Aviva at his home in Hod-Hasharon. We had a lovely time sharing Aviva’s homemade cake and cookies with coffee and tea. We discussed some of the memories of my exploits as Yariv’s athlete and of the memorable competitions we had experienced together. He was almost as happy that afternoon in Hod-Hasharon when we talked about the time in Greece, as he had been in Athens in the ancient marble stadium when I broke the Israeli record which qualified me to go to the Rome Olympic Games. We reminded each other about various track meets or cities, countries, or athletes that were part of our background of Coach and athlete.
Also, the four of us laughed about some of the things we had experienced on our trips together. We recalled the scene in Fairbanks, Alaska when a moose moseyed down the street towards us apparently without a care in the world. Each of us had been flabbergasted at this unusual sight which, at least for us with no previous experiences in the wilds of Alaska, was astonishing. Since Yariv and Aviva had been traveling from Israel for about 36 hours, they were sure they were either in a trance or a dream. Most assuredly there are no moose in Israel!

Two days later, we had zipped over the edge of a glacier in a helicopter, rose up over the clouds to see the sun-drenched peak of Mount Denali, and flew over a grizzly bear with two cubs. Another day, we sailed up to the edge of the glacier and watched it “calf” some huge blocks of ice. We flew over the Brooks Range, where we were as high as some of the mountain climbing Dall sheep. The ones we saw, at nearly eye-level, looked back at us with disinterest. We landed beyond the Arctic Circle and “awarded” our certificate for crossing this demarcation.

From the miracles of the land near the Arctic Circle, we moved our memories to the southernmost state, Hawaii. We remembered our trip to Hawaii with its warm, beautiful beaches and delicious fruits. One of our adventures was to the national park on the big island of Hawaii which, at that time, was experiencing a lava flow from one of the active volcanos which had erupted. In those days, the park service carefully monitored visitors near the coastal area where the lava flowed to the ocean. We were allowed to walk on the black, newly-cooled hard lava where it was possible to look down into the cracks in the lava and watch, in fascination, as hot molten lava flowed two feet below. It was an amazing experience to be a place where the Earth was being changed and recreated before our eyes and under our feet.
On the last morning, Aviva, Ann, and I were waiting in the lobby for Yariv, only to discovered that he was still in his bathing suit swinging in a hammock. None of that high-pressure suit and tie experience in Hawaii for him! It was with sincere regret that we had to leave that tropical paradise.

Although we were enjoying sharing these memorable moments of times and trips, eventually, the time came for Ann and I had to leave for the airport for our flight to America. We said our “goodbyes” and Yariv walked out to our rental car with us. As we drove up the small hill away from him, Yariv stood on the sidewalk and waved to us. We had our hands out of the car windows and were waving and blowing kisses to him in return.

After we had returned to California, we began to learn that everything up until now had been the easy part! The real adventure of the “Wedding” was just beginning. The first thing we discovered was that the Ritz Carlton required all weddings to be administered by a “wedding coordinator.” None of the bride and her mother running the show. I guess the Ritz Carlton must have had some horror stories in the past for them to require a professional wedding coordinator. We were quite puzzled since we had never been in this situation. What is a wedding coordinator and where do you find such a person, we wondered?

We asked the hotel if they could recommend anyone and from their list, we asked who they felt would be the best person for them and us to work with on our wedding. They suggested Ms. Barbara Wallace, who
had an office in Corona del Mar which was not far from where we lived. We contacted her and agreed to meet at her office.

At our first meeting with Barbara, she showed us some examples of weddings that she coordinated. We told her that we had already decided on the Ritz Carlton and had selected a 5:00 pm time. We needed her for everything else including, invitations, flowers, and all of the other details. We decided that she would work with Ann on the details about food, flowers, invitations, etc. and that I would be in charge of the entertainment and photography including video. At that time, Ann and I were completely oblivious to the amount of work and the details that went into a wedding. In hindsight, we were perfect examples that “ignorance is bliss”.

At the end of the meeting, Barbara asked me if I had any more questions. So, I said, “Yes, I have one request. Could we change the glorious view of the Pacific Ocean in the background to a cemetery instead?” For a moment she was quiet and you could imagine the thoughts whirling in her brain as to how to handle this crazy request. Then, we all burst into laughter.

Beautiful scenery at the Ritz Carleton

There were many things to do. Initially, Ann wanted a unique wedding design or logo with a heart and a Jewish star. The plan was to use that logo on all of our printed materials, such as the
invitations, the wedding booklet, and any other materials that we needed. Fortunately, her brother-in-law, George Lentz, is an artist. So Ann told him her idea and left it to his imagination to create it. He designed several different logos, but we chose the one shown below:

We used this simple but elegant design for nearly everything associated with our wedding.

Another issue which we had discussed with Barbara Wallace was wedding gifts. We were certainly not going to give gift bags filled with candy or some other nonsense which has become the currently fashionable thing to do. All of our guests were older, intelligent, and had no need for candy or silly things. We decided to give each attendee a gift bag with a book, chosen for them specifically, and a coffee mug with our wedding logo glazed on it. Our idea was that after the wedding, each guest could sip their beverage of choice while reading their book, and remember us and the wedding.

The next step in the wedding adventure, then, was to create coffee mugs with this logo on them. Ann and her sister, Barbara, searched for a potter in North Carolina who would be willing to create coffee mugs with our logo on the side of each one.

They found Kovack Pottery in Seagrove, North Carolina, which advertised that all of their pottery was hand-made on site. The potter, Michelle Craig, was reluctant initially to take on the project. Her concern was what she would do with the rejected mugs which had some flaw or imperfection. She would have to make more than the 50 we had requested since the nature of hand-made pottery included some errors. It would cost her money for these mistakes. She was a perfectionist and insisted that to have 50 perfect mugs; she would have to produce at least 75 and that we would have to buy the extra ones. After all, she explained, no stranger driving around the area looking at pottery by local artisans would come into her shop and buy a mug with our logo on it. We understood her logic completely. Additionally, we did not want random people drinking out of our special wedding mugs. Ann told her that we would buy everything she made, including the mistakes. As long as we could have 50 good ones before the wedding date, we were happy.

Michelle finally agreed to “throw” coffee mugs with our logo painted on them. She promised to have the mugs completed in time for the wedding since she had a few months during which she would need to experiment with selecting the clay, throwing and molding the mug, replicating the design on the sides, glazing and baking them in the kiln. After Michelle had perfected the necessary steps, she could create them on a regular schedule for production. The finished production of all of our wedding mugs arrived three weeks before the wedding.
Another of Ann’s tasks was to select a book for each of the wedding guests based on their specific interests and personalities. It was quite a task since each of our friends had their individual interests and passions. The interests ranged from golf to history and from gardening to biographies. It turned into an enjoyable quest trying to find the perfect choice for each of our friends. The idea was that each person could spend time after the wedding, reading a book and enjoying a beverage with unique reminders of Gideon and Ann and their wedding.
During the time that Ann was working on her tasks, I had my list of things that needed to be completed. One of these was a dual task: broadcast the wedding in real time and copy everything onto backup audio-visual disks. The second task was to combine a photo slide show with pictures of our lives and create a musical accompaniment of my favorite Israeli music.

Barbara Wallace located a professional videographer to record the entire wedding. Since I am interested in this area as an integral part of our software applications as well as a personal interest, I was aware that Microsoft had introduced the Multimedia Version 10. I explained to the videographer about this software and described to him how it was possible to stream video directly to the net if you had an IP address. All we needed was a T1 line and I could program the video to a specific IP.

The fellow that Barbara had found was Adrian Collins, who owned his company, Highland Pictures. We met and I described my idea that in addition to filming and recording the wedding, I wanted to broadcast it live so that all of our friends around the World could “participate” in our wedding even if they were unable to attend in person. Adrian was quite excited about this concept since he was young, enjoyed new technology, and could anticipate interesting future business possibilities for himself.

We requested a T1 line from the Ritz and were pleased to learn that they had quite recently had one installed. The technicians at the Ritz were very helpful although they were unfamiliar with the application that I intended on using. Hotels traditionally only needed to provide audio and/or visual aids at business meetings or loudspeakers for weddings or bar mitzvahs. Although they did not completely understand why I needed it, they were very helpful in working with me and the videographer. Adrian and I spent time and effort to develop and perfect the application. Hardware and software people are more than familiar with the many difficulties that arise in spite of what the manufacturer describes as “simple and easy to use”. It usually requires time and ingenuity in large doses. It was fun to listen to Adrian talking to his mother in Quebec, Canada as we “tested” our wedding broadcast. His mother was excited to be included as one of our out-of-town wedding guests. Eventually, we were able to “debug” the systems and were able to broadcast our wedding, the first one ever, and share our happy events with friends in Israel, South Africa, Peru, Switzerland, Denmark, Japan, and one “adopted” mother in Quebec. It was amazing, in the days and weeks after our wedding, to receive e-mail messages from friends around the world who had watched on-line. Most of them were happy but astonished that we had finally done this!

Ann had many meetings with Barbara Wallace. Another early activity was with Ms. Zoe Bachelor, who specialized in printing receptions and wedding invitations. Zoe would need to incorporate the logo on the invitation, the reply card, the Ufruf announcement, and the envelopes. She would also need to print the “booklet” that the Rabbi and his wife, Robin, had suggested would be helpful for people attending their first Jewish wedding. Ann, Robin, and the Rabbi spent many hours accumulating interesting facts and descriptions so that our guests would be able to understand many of the customs within a Jewish wedding. This booklet is presented in by scanning the QR Code on the right.
The Ufruf and Ketubah signing events

Ufruf

During Friday night Shabbat services
Rabbi Stephen Einstein will offer
a special blessing for the bride and groom
You are welcome to join us
for this occasion

Friday, the fifteenth of October
at a quarter past eight o’clock in the evening
Congregation B’nai Tzedek
5669 Telburt Avenue
Fountain Valley, California
714-963-4611

We wish to share with our family and friends
the happiness that the two of us,

M. Ann Penny
and

Gideon B. Ariel
give to each other

We invite you to join us in the joy of our wedding
on Sunday, the seventeenth of October
Two thousand and four
2 Cheshvan 5765
at three quarters past five in the evening
at the Ritz-Carleton
One Ritz-Carleton Drive, Dana Point, California

Rehearsal and reception to follow
Black tie optional

Our wedding invitation in Hebrew and English
Another meeting involved a “sampling” and selecting the food choices at the Ritz Carlton. Ann, Robin, and our dear friend, Neani Johnson, were able to taste and decide which salad to have, what entrees would be the most appropriate, types of wine, table cloth and chair choices, and so on. By the time that we had reached these steps in the details of wedding planning and decisions, Ann and I were both on sensory overload. Neither of us I had ever imagined the minutiae that is involved with wedding planning.

Although Ann and I had known each other for many years, had traveled around the World for business and pleasure, and had friends and acquaintances everywhere, we decided to have a relatively small wedding. We wanted the event to be fun for everyone and, if there are too many people, the event becomes unmanageable rather than enjoyable. We decided that the perfect number would be thirty-five.

In spite of having grown up in Israel and participating in many Jewish traditions at my school and with my friends, my father had not raised me with any synagogue-based practices or knowledge about them. I was a typical secular Israeli Jew. However, I wanted to demonstrate respect for my heritage and both of us wanted to have a traditional Jewish wedding.

In traditional Jewish literature, marriage is actually called “kiddushin,” which translates as "sanctification" or "dedication." "Sanctification," indicates that what is happening is not just a social arrangement or contractual agreement, but a spiritual bonding and the fulfillment of a “mitzvah” or a Divine commandment. "Dedication," indicates that the couple now has an exclusive relationship, that involves total dedication of the bride and groom to each other, to the extent of them becoming, as the Kabbalists state, "one soul in two bodies."

To understand Jewish weddings, it helps to understand the differences among Jews and Jewish observances. Within the world’s Jewish population, which is considered a single self-identifying ethnicity, there are distinct ethnic divisions, most of which are primarily the result of geographic branching from an originating Israelite population, and subsequent independent evolutions. Jewish people divide themselves into Ashkenazi Jews (descended from Eastern European Jews), African Jews (Ethiopian, Nigerian, Ugandan Jews), Sephardic Jews from Iberia (Spain and Portugal), Indian, Bukharan, Persian, Iraqi, Yemenite, and Mizrahi (Eastern or Middle Eastern Jews [not of Spanish/Portuguese or Sephardic origin]). Each group has very different customs which are evident in the celebration of holidays and life cycle events like weddings.

Another element of Judaism to understand is the division into three basic groups: Orthodox, Conservative, or Reform. Weddings are also influenced by whether the customs are Ashkenazi or Sephardic.

With all these differences, Jewish weddings still have much in common. The Rabbis who wrote Jewish law, Halakha, made it easy for couples to marry with minimal requirements. A Kosher Jewish wedding may consist of the following: the bride accepts an object worth more than a dime from the groom, the groom recites a ritual formula of acquisition and consecration. These two acts are witnessed and that is it. Everything else is a custom including the canopy (“Chuppah”), the seven wedding blessings, the breaking of glass, and even the presence of a Rabbi.

For example, the wedding invitation may be a two-sided text. The left side of the text will be in Hebrew and the right side in English. The Jewish invitation often does not “request the honor of your presence” but to “dance at” or to “share in the joy of.” The invitation reflects the celebration of marriage and the participation of the guests. In recalling the tradition of giving to the poor during times of personal joy, some couples may include a note indicating in lieu of a gift for themselves that a donation be made to a charity. Very often the wording includes biblical text.
The marriage document called a “Ketuba,” is the contract, written in Aramaic, which outlines the bridegroom’s responsibility for and to the bride. In ancient Arabia, it was the custom of providing the wife with a dowry to protect the wife in the event of her becoming widowed or divorced. This written obligation entitles her to receive a certain sum from his estate in the case of his death or the case of divorce. At that time, a minimum obligation was two hundred silver denarii at the marriage of a virgin and one hundred at the marriage of a widow.

Despite its testimony that the groom has "acquired" the bride, the ketubah is all about the bride's rights and her willingness to take part in the marriage. In fact, the ketubah belongs solely to the bride and is hers to keep as proof of her rights and the groom's responsibilities to her under Jewish law. The ketubah is signed by the bridegroom and two witnesses. Although this custom continues, the document has little legal significance in many countries.

After the ketubah is signed, the Rabbi, the bridegroom, and guests participate in the “Badekan” (veiling) ceremony. This custom comes from the biblical story of Jacob, who worked for seven years to marry Rachel, only to discover her father had substituted the older, blind Leah, under heavy veiling, as the woman he actually married. Because of this ancient trickery, bridegrooms come to look at their bride before the ceremony and physically place the face veil over her. Once the bride is veiled, the ceremony is ready to begin.

The order of the procession is the Rabbi comes down the aisle followed by the groomsmen, one at a time, usually standing to the left of the chuppah (canopy). The “chuppah” is a decorated piece of cloth held aloft as a symbolic home for the new couple. Weddings are frequently held out of doors, under the stars, as a sign of the blessing given by G-d to the patriarch Abraham, that his children shall be "as the stars of the heavens." However, even wedding held indoors incorporate the chuppah for its symbolic reason.

The chuppah can be supported by four poles in stanchions or held by four men during the ceremony. The chuppah seems to have been derived from the canopied litter which in ancient time was occupied by the bride during the procession. It symbolically establishes a house in public to represent that their lives will be spent together.

Following the Rabbi, the best man walks down the aisle alone and goes under the chuppah on the left. The bridegroom follows and goes under the chuppah to the left of the best man.

The bride comes down the aisle next, escorted by her parents. They stop just before the chuppah and take their seats. The bride takes three steps on her own, symbolizing her decision to enter the marriage, and the bridegroom comes to escort her under the chuppah. The bridegroom turns as he joins her, so she is on his right.

When the couple first enters the chuppah, the bride circles the groom seven times, representing the seven wedding blessings, the seven days of creation, demonstrating that the groom is the center of her world, and symbolizes the fact that the bride and groom are about to create their own "new world" together.

The kiddushin (betrothal ceremony) takes place under the chuppah. It begins with greetings, a blessing over the wine, and a sip taken by the bride and groom. The next step is “something of value”. In ancient times, "something of value" often was a coin, but today it usually is a ring. The ring must be solid with no stones or gems, and it must, at the ceremony, be the bridegroom’s property. Only one item of value or ring must be given to the bride by the groom as required by Jewish law. This ring represents
the wholeness achieved through marriage and a hope for an unbroken union. The ring may be engraved inside.

The groom recites an ancient Aramaic phrase as he places the wedding band on his bride's right index finger -- the finger believed to be directly connected to the heart. The bridegroom declares, “Behold, thou art consecrated to me with this ring, according to the law of Moses and Israel.” In a double-ring ceremony, the bride also places a ring on the groom’s index finger while repeating a feminine form of the Aramaic phrase, or a biblical verse from Hosea or Song of Songs. After the rings are given, the ketubah is then read aloud in English and Aramaic.

The next step is the “sheva b’rachot”. The “sheva b’rachot”, or seven blessings, consist of praise for God, a prayer for peace in Jerusalem, and good wishes for the couple.

At the conclusion of the ceremony, the Rabbi will ask the best man to place a wine glass, wrapped in a white cloth under the bridegroom’s right foot. There are nearly as many interpretations of the meaning of the breaking of the glass as there are Rabbis. The breaking of the glass symbolizing, among other things: the destruction of the temple in Jerusalem; a representation of the fragility of human relationships; that even in the midst of the happy occasion, we should not forget that sorrow and death are also ahead; and a reminder that marriage changes the lives of individuals forever.

After the glass is broken, the guests shout “Mazel Tov,” clap their hands, embrace and sing as the couple departs. (The shattered glass may then be kept as a keepsake in a velvet pouch.) The bride and bridegroom will kiss immediately after being declared “man and wife” and then run up the aisle into a “Yichud.”

The Yichud is a brief seclusion where the couple can spend a few moments together before joining their guests. For couples who have fasted until the ceremony, this would be their opportunity to break the fast with a small meal of their favorite food. Even couples who have not fasted appreciate the few moments along in what is usually a hectic and emotionally packed day.

Because of this brief seclusion, Jewish weddings usually do not have receiving lines. After the Yichud, the bridal couple is introduced as husband and wife. They may be greeted with a toast or a shower of rice.

These Jewish wedding traditions were important to both Ann and I. We proceeded with the planning so that we could enjoy and fulfill each part of these traditions. As October came closer, we had successfully solved each task. Barbara Wallace was a fantastic organizer and had reduced the stress on us to include only important decisions. She kept us informed about the people who had replied that they would attend; she had the gift bags prepared and labeled; she continued to work with the staff at the Ritz-Carlton regarding the food, rooms, outdoor setting, the musicians, and the flower delivery.

Another Jewish tradition we observed takes place on the Shabbat before the wedding at the synagogue. The bridegroom is honored by being called to read from the Torah.
(called an Aliyah) in the synagogue. This ceremony is called an Ufruf. After the bridegroom completes the reading of the Torah portion, in keeping with one custom in the synagogue, the congregation members throw candy and nuts at the bridegroom to wish the couple a sweet and fertile life. It is important to time the reading correctly so the bridegroom and the Rabbi can duck behind the podium when the candy bombardment is launched! Another part of the joy is when the Rabbi signals the children of the congregation to retrieve the candy.

Another of our tasks had been to find the perfect ketubah for us. This particular task had been an interesting activity. There were thousands of ketubah designs and most of the artwork was exquisite. After many days of searching, we eventually found a beautiful, colorful one that also incorporated directions for north, south, east, and west. Since we both love to travel, we felt that this ketubah represented that love and the directionality included in all of the parts of the world that we had seen as well as our lives together.
Finally, October 17th arrived. We woke in the morning to pouring rain! For the first time in 30 years, and contrary to all of our databases, we were looking out of the windows at precipitation and there were lots of it. However, as we drove to the Ritz Carlton shortly after noon, the sky was struggling to clear. By the time we arrived at the hotel, the sky was bright blue but continued to have an abundance of clouds. Barbara suggested that we move the wedding inside since the weather looked so threatening. I resisted the idea and said “If G-d wants to make us wet, we will all be wet.” Perhaps G-d must have been listening, since a few hours before the ceremony, the sky cleared at the hotel but provided a magnificent display of clouds and shafts of golden sunlight in the distant horizon.

Ann and I checked into our hotel room so that we could prepare for the ceremony. One of our most important tasks had been to lose weight and both of us had accomplished it. I was able to wear my tuxedo, in which Ann assured me that I looked “terrific. With her help, I was quickly into my tuxedo and off to meet Adrian, the videographer, and coordinate with Barbara Wallace any last details.

Ann had rejected the commercially available choices of wedding dress which she declared were antebellum styles from “Gone with the Wind.” Instead, she had selected a pattern, found the best materials, and had her dress sewn by an accomplished dress maker. It was a smooth, straight line design which was quite fitting for her. I was really happy with her choice and it was a perfect fit for her.

Ann was equally quick at changing into her dress. None of those butterflies and nerves for her! Suddenly, she received a call from Barbara Wallace asking where the challah for the meal was. We had forgotten them in Coto. (Maybe she did have butterflies.) She quickly went downstairs and found our dear friends, John and Lanelle Probe. They had been to our home many times since John had worked with me since his days at NASA. Now he worked for us in our San Diego
office. They were happy to help, so off they went to get the challah. They were perfect for this task since they were good friends with our two German Shepherds! We would not have been able to send some strangers to our house unless they wanted to be eaten. Fortunately, they were able to drive to our house, retrieve the challah, and deliver it to the hotel in time for the dinner. (They missed the beginning of the wedding since we had to begin on time in order to complete the ceremony before the sun set. However, their children in San Diego were watching the event on-line and described everything to them on their cell phone while they were driving back to the Ritz Carlton.)

My beautiful Wife – Ann Ariel

While John and his wife were driving to retrieve the bread, Ann and I were greeting our other guests. What a treat it was for us to connect with each one of these dear and cherished friends. We met Tony and his brother, Kevin, from South Africa and then our two Japanese friends, Jin and Yuki Hisa. Jin and Yuki had worn traditional Japanese wedding attire which was quite unique. We had old friends from graduate school, friends from the synagogue, California friends, and even some lawyers...the good ones! Although we had invited only a small group, they were dearly loved and close to our hearts.

Now, the Rabbi informed everyone that it was time to begin with the signing of the Ketubah. As Rabbi Einstein explained to our guests, we had two steps to complete. The first step was for the State of California which required that we have a license to marry in this state. Ann and I had gone to the Courthouse in Orange on August 3, 2004, so obtain our marriage license. We had waited for about fifteen minutes before we were called into the Clerk’s office. While we sat in front of the Clerk, we noticed music in the background. It was ABBA. We were sure that this must be a uniquely special coincidence
for that particular music to be playing in the Courthouse as we prepared to receive our license. The Clerk agreed as we explained our history with this musical group.
We gave Rabbi Einstein the California marriage license. He instructed our witnesses, John Soja, my best man, and Barbara Lentz, Ann’s sister, where to sign. After Rabbi Einstein had completed signing his portion, he informed the guests that we would now proceed with the Jewish portions of the wedding ceremony.

Rabbi Einstein explained to the group of wedding guests about the meaning and purpose of the Ketubah and what we were doing. First, Ann and I had to sign the document. Then our two witnesses, Marc Newmann and Bernard Kessler, signed it. The Rabbi verified that each step was correct and then he signed the Ketubah.

After the signing of the Ketubah was the “badekan” ceremony. Our guests gathered to watch as the Rabbi described the purpose. Gideon was able to identify Ann as the woman he was planning to marry and then, with assistance from the Rabbi’s wife and her sister, the veil was brought forward over the bride. Now we were ready to proceed with the wedding.

As the guests found seats outside, under “our” tree and waited while enjoying our musicians playing the harp and flute.

Barbara Wallace and the Rabbi prepared the wedding party in the proper order. First, the Rabbi walked to the chuppah, turned and waited for us. John Soja, my best man, and I then walked up together to the chuppah. Fortunately, John was holding the ring since I had no confidence in my nervous and shaky fingers.
John Soja and I walking together to the chuppah

Waiting with the Rabbi under the chuppah for my bride
Finally, it was time for Ann to walk to the chuppah escorted by her brother, Marshall, and her sister, Barbara. To my eyes, she looked beautiful and I was glad that I had finally proposed to this amazing person.

When Ann arrived at the chuppah, her siblings stepped aside and she then walked around me seven times.
Not surprisingly, a bride can easily lose count so there is usually someone, in Ann’s case, the Rabbi’s wife, who counts the number of circles. This assistant is especially helpful since the bride is frequently concentrating on not tripping on her dress instead of counting the circles. Fortunately, there were no mishaps with tripping and after she had completed the seven circles, we stood together under the chuppah with the Rabbi.

The kiddushin began with the Rabbi reciting the prayers, blessing the wine which Ann and I both sipped.
Then came the exchange of “something of value”. In our case, we had wedding rings which we had made in South Africa by the jeweler, Michael Solomon, who made the engagement ring. Michael Solomon is quite the romantic and he made our rings from the same block of gold. They were yellow gold on the outside with white gold in the center. I placed her ring on Ann’s right index finger and repeated the Aramaic phrase that accompanies this task. Ann then placed my ring on my right index finger and repeated the Aramaic phrase which was similar to the one that I had said.

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Exchanging rings
The Rabbi then read the Ketubah in both Hebrew and English. Following this reading, Rabbi Einstein includes an opportunity for the bride and groom to tell each other about their love for one another. He had each of us write these thoughts and share them with him. He had told us that rather than have us read these thoughts, that he would do the reading. He explained that, in his experience, the two people were rarely able to read them without crying, so he read each of the statements on their behalf. Rabbi Einstein began reading our documents. He read to me what Ann had written:

My Gideon,

Adorable, loveable, funny, intelligent, fantastic, and charming. This is Gideon. This is the man I love. Why do I love you? I won’t count all the ways, but there are two important ones: you make me laugh and you make me think.

You are always thinking, which is admirable, but it’s the way that you consider things that makes you special. It’s not just the obvious method or the way everyone else approaches a problem; you consider many different alternatives and then conclude that logic always prevails. You’re intuitive, reasonable, and creative. Remember when you were flying on the KC 135, or the Vomit Comet as it’s frequently called? You concluded that the expensive device which NASA had purchased to determine when the plane speed equaled that of gravity was subject to extreme vibration problems. So you held a pencil until it floated and used that to begin the zero gravity experiments. Logic prevailed and the simplest technique worked. If you don’t know the mathematical solution to a problem, your intuition and experience will suggest a rationale. Invariably, there’s a mathematician or physicist who derives formulas that verify your idea as accurate. You always say that you are a talented integrator, but for that, you must be smart enough to know what you want integrated and who has the right talent.

You have always loved to study: biomechanics led you to computers which directed your thinking to software; physiology developed into the study of how the body moves; film cameras became digital cameras and that led to the complex integration of cameras, computers, printers, scanners, and finally digital photography. You have always been a student with depth. Now, you’re stretching your mind by adding history and the theater! After three years at Christ Church, Oxford University, you’re beginning to love history (‘I’m so excited about that!!). In addition, you’ve added London theater to your learning list!

Travel doesn’t necessarily require thinking, but we always study and learn where ever we go. Originally, we were working and added the fun, leisure parts to the business. In recent years, we have historical and geographical overlays to each place we go and expand our minds while we’re there.

There’s never a dull moment with you. I read that a person laughs at something that is unexpected. You are always doing and/or saying the unexpected! You make silly jokes, funny faces, tell stories about experiences, and say outrageous things. Your smile and the twinkle in your eyes are infectious. I never know what funny thing you’re going to do next.
or say so I’m surprised and amused every day. Just walking through the airport will be a trip of humor for you. You have that funny little walk that cracks me up every time. You have such a clever mind and a quick wit so that you can always make a joke any time, place or circumstance.

They say that a Sabra, a native Israeli, is hard on the outside and soft on the inside and this description fits you perfectly. You can be firm, confident, and determined. We started our biomechanical business when we were graduate students with only $5.00 and a great idea! With charm and charisma, you convinced many large, well-known companies to hire us to do their R&D testing. For example, in a study on sound, we had a world-renowned violinist playing his instrument in front of our office wearing only his concert shoes and underwear. During an experiment to ascertain if there was a product defect by the manufacturer, we had gymnastic teams doing stunts on force platforms to measure the landing forces. We even had an extensive project to test feminine hygiene products. Somehow you convinced even the most skeptical company executives that we could help them improve their products.

On the soft side, you are a very sensitive, emotional individual. You can cry at movies, events, places, and for people. You also have a special capacity to know the best thing to do in a difficult situation. I remember the time we were waiting in line at John Wayne Airport for a flight to the East Coast. In line ahead of us were a young Marine and his wife. When it was their turn to buy his ticket, the airline counter agent refused to accept the young soldier’s check. The Marine and his wife plead their case but the airlines assured them his check would not be accepted with his military ID. He was on his way home to see his mother before being deployed overseas. The plane was scheduled to depart before he could go to the bank for a cashier’s check. We listened to the discussion, until you turned to me and we knew exactly what to do. You told the airline agent that we would pay for the Marines ticket. The Marine, his wife, the airline agent, and the people in line behind us were astonished at your offer. The Marine was so thankful and appreciative and gave us the check for the ticket price. Then you purchased your own ticket and left for your trip. Subsequently, we called the bank, verified that the check was good, and then we tore it up.

Thirty-five years ago, I was surprised after being your graduate school friend for two years, when the proverbial light bulb came on over my head and I discovered that I loved my best friend and fellow student. Since then, I’ve loved you will all my heart, my mind, and my being. Each and every day I tell you that I love you more than yesterday. I don’t know how it’s possible to love you more each day, but I do. You make me a better person than I am without you, you give my world vast dimensions of joy, creativity, and happiness, and you let me love you. You are my love and my life.

Rabbi Einstein then read to Ann what I had written.
To my Darling and Life Partner: Ann

I wish words could be seen three-dimensionally. The third dimension is the unseen feeling that I wish I could express and do not have enough words in that dimension to say it.

From the first time I saw you working in the Motor Integration laboratory at the University of Massachusetts, I knew that there was something in your soul which was unexplainable. I was in awe when you were able to answer all the difficult questions by our Statistical Professor when the rest of the class looked at you with surprise. I remember approaching you, without ever knowing your name, and asked you how you knew the answers, and what did you do to know them. You answered me with an expression like “Go to the library and find out for yourself.” Wow, I thought! Who is that girl? The beautiful blonde with the great body, wearing a mini skirt, who blew me off like that?

I was so lucky to be officially introduced to you later at the University by our dear mutual friend, Jim Sallidas. I remember he told you: THIS is crazy Gideon. You responded with: Oh, this is the crazy Gideon that you have been telling me about for such a long time? I was so lucky to be crazy then and I continue to be crazy about you.

So, 35 years have passed and what a life we have had together. We studied together, we traveled together, we created together, we invented together, we laughed and cried together. So, in 35 years there is nothing that we haven’t done together. It would take books to describe all our experiences and we haven’t reached the end yet. We are just starting now.

Now 35 years later, I love you more than ever for all the reasons that made me fall in love with you in the first place and all the other fantastic qualities you had and still have. As I said before, I love you more than words can say because there are no words to describe all the wonderful things about you and the marvelous life we have together.

My darling, I am so lucky to have you and thank God that He blessed me with you to share my life.

I love you

Gideon

Although Ann and I were teary eyed, it was Rabbi Einstein who had difficulty reading our texts without crying. It was very touching to us that our thoughts and our devotion were so meaningful to him as well.

The wedding continued with the last steps. The “sheva b'rachot”, or seven blessings, consist of praise for God, a prayer for peace in Jerusalem, and good wishes for the couple. Then John Soja gave me our “glass” in a white bag for me to step on to break. I smashed my foot down as hard as I could since I was nervous that I might miss the bag or not break the glass. Happily, there was a resounding “pop”, and everyone shouted “mazel tov” or “good luck.”
Ann and I rushed down the aisle and into a nice quiet room just inside the building for the Yichud. Neither one of us was hungry, but it was nice to have a quiet moment. Ann immediately took off her shoes to massage her feet. When you are most frequently in sneakers, heels can be a rude awakening for the feet.
The Yichud “Oh, my feet”

After a few moments, we emerged together to greet all of our friends as husband and wife. We took lots of pictures with each of them amid the happiness surrounding this event.

One of many photographs. Marshall and Barbara Ann’s Sister and Brother with us
Barbara Wallace announced that dinner was ready and for all of us to proceed into the room and locate their name tag on the plate in front of their seat. For our wedding, we made a break from the traditional setting. We had arranged one large table, forming a continuous rectangular rather than the traditional dais with the wedding party in front of round tables of wedding guests. In our previous experiences, there are numerous round tables for the guests and a raised dais for the wedding party. Usually, one of those guest tables has lots of fun and enjoy a hilariously good time while the rest are bored or falling asleep. To break from that arrangement, not only did we have everyone sitting at the same table, we separated the couples from each other. Wives and husbands were not seated next to each other but were placed with interesting new people to meet and share stories. Our reasoning was that after fifteen years or more of married life, on their way home that evening, they could each tell about the new people and exciting events that they had shared.
Our guests walked into the dining room, found their seats, and were soon opening the gift bag to discover their book and mug. I had assembled many of my favorite Israeli performances in a computer file which I had set to play as background music. The table was decorated with flowers arranged in small vases in front of most of the guest settings in addition to small votive candles. We had decided to have lots of flowers spread around the table rather than a few enormous arrangements. The idea was to have flowers everywhere and, at the end of the meal, guests could take the flowers home if they wished. Shortly after we all sat down, the Rabbi began the prayers which precede the meal. First came the prayer over the challah, which had finally arrived thanks to John and Lanelle. After his concluding prayers, the Rabbi had a few kind words about Ann and I before he was able to sit and enjoy his meal. I am sure he was tired and hungry after such a long day and must have been looking forward to finally beginning his Sabbatical.

Ann stood to say a few words. She held up her notes and promised the group that she would not talk too much. She thanked everyone for coming, announced that the South Africans had traveled the farthest, 10,355 miles and that our Japanese friends had flown 5,474 miles. In addition, she explained that there are friends and there is family, and the best combination is when your family consists of all your friends. She said that we were so happy that our family of friends could share this important day with us. Also, she thanked Rabbi Einstein for delaying his Sabbatical because, otherwise, we would have had to delay our wedding.

Groom and Bride Places

The missing challah recovered by John and Lannelle
Ann had contacted Michael Solomon, our jeweler, months before the wedding to make a few gifts. She had him make and engrave silver bracelets for her sister, Barbara, Neiani Johnson, who had helped her with so many things, and Robin Einstein, who had been invaluable with many of the Jewish details.

For me, she had designed a key chain which had yellow gold on the sides and white gold in the center. Vertically arranged in the middle, were my initials “G,” “B,” and “A” in raised gold letters. On the reverse side, our wedding logo of the heart and Jewish star was engraved. Underneath the logo, engraved in Hebrew, was “I love you” and the Hebrew date of our wedding.

I stood to thank everyone for coming. I mentioned that we could have invited much more people, but since we had waited thirty-five years, many of them were no longer with us. But we so appreciative of those that came to share our joy on this special day. I explained about the musical choices and that I had arranged a large screen in the corner of the room which had photographs taken throughout our lives. Another feature I noted was that when you marry in your sixties, many of the pictures are in black and white.

Everyone seemed to enjoy the meal and wine. There was buzzing throughout the room as people met and shared ideas while chatting with new acquaintances. After dinner and dessert, our guests smiling thanked us for the lovely event and left to drive home.

Barbara Wallace, Ann, and I gathered to decide things such as what to do with the vases of flowers, the candles, and the gifts. We had her put everything in boxes and gave her the keys to our car so that the hotel staff, under her guidance, could take care of these remaining items.

At this point, the bride and groom normally go to their room. However, I told Ann that we were going out drinking with our friends, Bob Wainwright and the South Africans! She said “Oh goodie!” so the five of us when to our hotel room so we could wear street clothes instead of wedding attire.

We drove to a local bar for a celebratory drink. We agreed to meet in Coto de Caza the following day around noon since we needed to work with them before they had to return home. Since South Africa is quite a long trip, it seemed only fair that we accommodate them. Ann and I decided that we could enjoy our Honeymoon at a later day. The boys took us back to the Ritz Carlton and they drove off to enjoy the rest of the night.
Ann and I went to our beautiful hotel room which had a balcony and a view of the ocean. We stepped outside to see the view for a moment. I have absolutely no recollection of anything after standing on the balcony with my darling wife. Ann told me the next day about everything that transpired subsequently. We went inside and I sat down on the edge of the bed. I said: “Ann….I….am…..so….tired” and after this announcement, I sagged back on the pillow sound asleep. She had to take off my clothes, put on my T-shirt pajama, and get me under the covers. I remember none of these activities. She also told me that for the first time in the thirty-five years she had known me, I did not brush my teeth before going to bed.

This is the story of our wedding and I am happier today than I was then. I am unable to explain why the feeling is different since we had lived together for so long. But somehow being married to the woman I loved made me very happy. I had to include this event in my book because there would be no book at all without Ann. To have a partner that you share every part of your life with, the good and the bad, your strengths and weaknesses, and to have love be so strong throughout----that is a blessing and miracle that outshines all else.
It was the 5th discus throw at the 1960 Olympic trials in Israel which changed the path of my life to one of unbelievable love, inventions, and experiences. Without that throw, I would not be writing this book and simply have become an excellent physical education teacher at Wingate. What gave me the courage and the confidence and the drive to make that throw? The answer, in retrospect, were the eight
years at Hadassim. Those years produced enduring friendships that were a lifeblood to me; academic challenges and interests that survive to this day; and tenacity to confront and resolve every situation that came my way. The discus and shot put throw that made my life are shown below. I broke the Israeli records in each event and this qualified me to compete for Israel in the Olympic Games in Rome, 1960. Seven years of training in Hadassim made me the athlete and tenacious individual that I am.

Discus and shot put Olympic trials for 1960 Olympics

After 55 years, I looked back to those formative years of my childhood and remembered all of the people I knew at Hadassim. The teachers had been our parents and the students were our brothers and sisters. We had been a family and not recognized it as such. Our class, the Class of 1958, had glued each individual into a unique family. Although I had traveled to Israel many times to meet with Hadassim friends during the intervening years, we had never had a gathering of our entire class.

I have described many of my childhood experiences at Hadassim in a previous chapter. Surprising, even after fifty years, many of us were still in touch with each other. Others had slipped away as though engulfed by fog, not dramatic departures, but lost and out of touch. I remember those days, the teachers, friends, and experiences, often during those moments when thoughts meander randomly without guidance or concentration. I had flashes of thoughts about someone or something which had occurred at Hadassim. There were frequently little tickles of thoughts and remembered experiences. Some of the historical photos are at the URL on the left:

http://arielnet.com/ref/go/1263

Suddenly, I experienced one of the phenomena that occur when you least expect it. It was a day like every other day, with no rational mental guidance, when my
random thoughts jelled into an idea. I realized that what I really wanted was to organize a reunion of all of the Class of 1958. Not just a small picnic at a local park but a giant Hollywood Oscar presentation-sized gala for everyone in my class.

I broached the idea with Ann and she thought it was terrific. We had spent the previous year organizing our wedding, so we felt confident that we could do something as wonderful for my classmates. We decided to organize the reunion, hire the appropriate staff to assist us, and pay all of the expenses. We would need someone with skills similar to our previous “wedding coordinator.” Someone who knew how to organize a gala event in Israel and could work under our guidance. We wanted the event to be held in a fantastic hotel. We wanted everyone in the class to attend and they would be allowed to have one person accompany them, such as a spouse or friend. We wanted the event for our class only, not an enormous, out-of-control picnic where people brought their entire family!

The evening would begin with meetings and greetings of all of our class members and their companions. Everyone who receive a name tag and a program at this time. The meeting period would be followed by an elaborate and delicious dinner. Then we would have an evening of organized entertainment followed by the distribution of a special memorial book which would have to be written and published in advance.

During the previous fifty years, I realized how little we actually knew about each other prior to our arrival at Hadassim. Whether we should have learned about what each of us had experienced before our arrival is up for debate. The holocaust survivors certainly had not wanted to talk about how they had seen their parents killed. Nor had they want to discuss the details of their dangerous survival in often unbearable conditions. The
children with family problems, such as myself, did not want to discuss the problems we had at home, our feelings of abandonment, or difficulties with parents. Those who were there because their parents were in the government or were privileged in some way could not understand why they were sent away from their families to live at Hadassim. Because of these difficulties which each of us had experienced, all of us had maintained silence about our past life before arriving at Hadassim. It was as though we were born and our lives began on the day we arrived at Hadassim where we flourished under the loving care and directions of Rachel and Yirmeyahu Shapira.

There had been a strategy behind mixing these three groups of children together. The Canadian woman’s group of WIZO planned with Rachel and Yirmeyahu Shapira, the deans of Hadassim, to provide an environment to help each of these disparate groups of children. The three backgrounds that needed to be integrated were: the rich kids who must grapple with the realities of others’ struggles; the troubled kids who needed to grow in a positive environment and learn that success would result only with effort; and the holocaust survivors who could encounter a new, healthy, open world of a free and thriving Israeli identity. In the
end, these children of the Holocaust became Israelis, while the troubled kids transcended their backgrounds and ascended to the top strata of their professions, and the privileged learned to live uncorrupted by their bounty.

The actuality of our existence during those years was about today and the future, but nothing of the past. We were young people not focused on looking backwards. We were in the present and we were building our futures.

Now, after all of these years, I wanted a memorial book which would tell the story of each child before they had arrived in Hadassim and what they had done in the intervening years. I wanted to distribute this book to everyone attending the reunion.

Ann and I continued to think and plan the reunion while we were at our home in California. We realized that soon, we would need to travel to Israel to find the “coordinator,” arrange for the hotel, and solidify other associated details. I also needed to find someone who could interview our classmates and write their stories in a book.

I remembered one of my classmates, Uri Milstein. In the 10th-grade literature class, we were tasked with weekly compositions on a subject chosen by the teacher. Each Sunday, the class teacher, would randomly select two of the pupils to read their composition in front of the whole class. I would usually calculate the probability of the teacher calling me, so for a few weeks I would take the chance of not writing the composition and use the time to practice throwing the discus! Luckily I was never caught unprepared so when I was chosen; I had the composition ready.

However, Uri, it was a different experience. One week we had been assigned to write a composition about the War of Israel Independence in 1948. (That was one of my weeks not writing! But I was happy to listen to what the others had written.) Uri was selected that Sunday to read his composition. It was a fabulous presentation, with details, dates, and amazing stories from the War which we had learned throughout the course. Uri’s composition was so good that the teacher asked him to give him the notebook so we could publish it so that everyone at Hadassim could have a copy. Uri said that he did not want to turn over his composition. However, the teacher insisted and threatened to give him a zero score if he refused. When the teacher approached Uri and extended his hand to receive the notebook, Uri handed it over. The teacher, Michel Kashtan, thanked him and opened the notebook. The notebook consisted of blank, empty pages. Needless to say, Uri was in trouble and had to write his entire speech as an essay or receive an F grade in the class. I remember how riveting the story had been as Uri wove the dates, people, and events into an exciting narrative. After it had been revealed that he had created this “composition” extemporaneously rather than reading it, I was even more amazed.

That incident had fascinated me for years. I thought if I want to write a book with all of the stories of the students in our class, no one would be better for this task than Uri Milstein. Since I had not been in touch with Uri for the past 50 years, I had no idea where he was or what he was doing. My friend, Hillel, on the other hand, had kept in touch with many of our classmates over the years. I was sure that Hillel would know how to contact Uri or would find someone who could. When I telephoned Hillel, he told me that Uri was a very famous writer and, in fact, had written more than 20 books which were very popular in Israel. This was music to my ears since I really wanted to find someone to write the stories of our classmates and, with a history of published books, I knew that I must find Uri. Within a few days, Hillel was able to give me Uri’s phone number.
I called Uri from my home in California. “Hello Uri, how are you?”

“Who is this?” he answered in typical Israeli gruffness.

“This is Gideon Ariel, your classmate from Hadassim.”

Uri remembered me immediately and was very excited with this renewed contact. We had a long conversation about the past and present, and then I suddenly said, “Uri, I must have a book about the kids at Hadassim. No one knows anything about anyone’s past nor do we know what happened to them after we all left Hadassim. When we were students together in those days, we only knew the present and looked towards the future. Now is the time to amplify what we know about each of our friends and classmates. My plan is to write a special memorial book about each individual and hand the book to each of the “kids” at the reunion that I am planning for May of 2006.”

At first, Uri thought it was an impossible task to accomplish in such a short time, but he agreed to try. We settled on the price I would pay him to write and publish this book. I told him that I wanted a hard copy, first class book printed on the best paper and with lots of photographs. He told me this quality of book would be expensive. I told him that this was not a problem and to let me know where to send the checks.
After a week of research, Uri told me that it would take eight months to complete the job, he would have to interview each one of our classmates, as well as some who were above us and below us. Because Hadassim was small in size, we were all affected by students ahead of our class and behind it, so Uri suggested that we include some of those individuals who had significantly impacted our class including many of the teachers. I agreed, and the job began. We called the book, “Oasis of Dreams.” A link to our book, Oasis of dreams, in English and Hebrew, can be found at the following link:

Children of the Holocaust:

http://arielnet.com/ref/go/1265

Children of Distress:

http://arielnet.com/ref/go/1266

The Princes:

http://arielnet.com/ref/go/1267

Step one had now been implemented with Uri working on the memorial book. At this point, Ann and I needed to go to Israel to organize and activate the other parts of the reunion. My plan for the reunion was for the celebration in the month of May 2006. The month of May was nice because the weather was not too hot, people will not have left the country for vacations, and it was between the Jewish holidays of Passover and Shavuot.

Very shortly after Ann and I arrived in Tel Aviv, we met with some of my friends who wanted to help with the reunion. Before our arrival, I had let them know my intention of hiring a “coordinator” to
organize and conduct the tasks. I asked my friends to try to find some candidates for this job. To organize the reunion which I envisioned, I would require a professional who would, of necessity, be an Israeli and would have to be a genius at handling this monumental task.

We met several potential “coordinators,” but the woman suggested by Safra was the one who was most impressive. Her name was Dalia Guttman; she had organized many union events as well as honorary affairs for government officials. One event which she had organized was a gala affair honoring the retirement of General Ariel Sharon. One of my friends, Ilana Geva, had attended this event, her recollection was that it was marvelous. Clearly, Dalia was skilled at her profession.

Ann and I decided that of all of the people we had interviewed, Dalia was far superior to the other ones. She expressed a willingness to execute the task as we wanted it done and not be diverted by other input. I had emphasized that we were making the decisions regarding the activities of the reunion. She should listen to any of the class members who had suggestions, let us know what the ideas were, and then the three of us would make the final decisions. The reunion had been my idea and, like the Frank Sinatra song was going to be done my way.

I learned that Dalia Guttman had worked in television for many years before she became involved in producing events such as my reunion. For more than 25 years, she had worked in production, editing, and executive positions at the Israel Broadcasting Authority including “The Voice of Israel” and “Channel One.” Among her achievements, she headed the Mabat culture desk, produced a weekly cultural magazine, and in her most recent position at Channel One, served the director of programming.

As an independent producer, Dalia Guttman had produced films on the disengagement in Gaza and the defense industry for the Ministry of Defense, as well as features for Channel Two’s Friday night news program. In 2007, the year after she had organized our reunion, she produced “The Children of Teheran,” the first documentary ever made of this poignant episode in modern Jewish history.

During our meeting to sign her contract, I said, “Dalia, I have two requests for you when organizing this reunion. First, this reunion is going to be the best meeting you have ever organized. The second request is that you will never be able to organize a better one in the future.” She laughed with me at this level-of-excellence requirement, we began the work towards a perfect reunion.

Another idea I had was to make a movie about Hadassim: Then and Now. When I brought up the idea with Dalia, she became very excited about the project. She had been a film producer before she began her career of producing events. She said that she knew exactly who to approach to do the movie, Yehuda Kaveh.

Yehuda Kaveh is a documentary film director. In his career in Israeli television, Yehuda Kaveh has directed over 40 documentary films on a wide range of topics relating to Israel’s political history, the Israel-Arab conflict, Jewish history, as well as the nation’s artists, poets, and songwriters. As an independent director, Kaveh directed the “The Children of Teheran” with Dalia Guttman and David Tour. Kaveh was currently teaching at the Hebrew University of Jerusalem and Haifa University.

Dalia suggested that the movie would be able to incorporate the early years of Hadassim and Israel from film archives for what we were calling the “Then” segment. For the current or “Now” portion, two boys and two girls from the class would be interviewed. In this portion of the film, the four former “children” would return to Hadassim and describe their life there. The completed film would join these two segments of our life in Hadassim. A link to this film is here:
Following the discussion about the movie, we addressed who the participants should be and how we were going to find all of them. My goal for the reunion was to include anyone who had been in our class including the ones who were not enrolled for the entire eight-year period.

Fortunately, some of my classmates including Hillel, Alex, Safra, Uri, Rachamim, Eli Shabo, and Joseph volunteered to find the names and addresses of these far-flung Hadassim graduates. Their diligent efforts were fruitful as they located many students throughout Israel and beyond. They found one classmate living in a suburb of Paris, France while another one had emigrated to Canada. They even found one girl who had gone to India, changed her name, and was living in Hawaii. Another classmate, Lazar, had moved to New Jersey in the United States. However, since no one had been able to find him, everyone assumed that he was dead. It was quite a relief when he was located alive and well after all of those years!

We did our best to find every one of our class. I wanted everyone who had been a member of our class to be invited. Each class member could attend with one other person. The person could be a husband, wife, friend, or anyone they chose. But this reunion was focused on the class members, not their extended families so we had to very specifically explain in the invitation who could attend. We also made it clear that people needed to respond by a specific date so that

http://arielnet.com/ref/go/1268
Dalia could inform the hotel about the number of people for whom they would have to prepare food and dinner settings.

In addition to the students, I wanted to invite as many teachers and staff members whom we could locate. My thinking was that Hadassim was not just a school but had been a family of young people, teachers, staff members. I wanted all of these people, the whole family, to come together to celebrate. Now our net had been cast wider, but Dalia was certain that we could find many of these people through the various connections that Israelis have with each other. The invitation which we sent to everyone that we could find is shown on the left:

One of the first decisions that Dalia wanted us to make was the Master of Ceremonies. She explained that an event like the one we envisioned had to include a strong, forceful “leader” as Master of Ceremonies. Otherwise, the event would become a “free for all” with competing interests struggling to take over. Dalia’s suggestion as the perfect person as our Master of Ceremonies was Chaim Kenan. Chaim had been one of the students at Hadassim in a grade or so behind ours. Dalia had worked with Chaim’s previously and, in her experience, he was the perfect choice for the role. The job of the Master of Ceremonies required knowing how to control the flow of events, when to ease up and when to crack down, and how to execute these tasks so that everyone was happy. Without this ability to judge the situation and adapt accordingly, we could have a real mess of a meeting. I readily agreed. Not only did we need a Master of Ceremonies but I would not have to play the role of the “bad guy” when someone wanted to talk longer than his or her allotted time or change the program in some other way. Dalia said she would work on securing Chaim for this job.

We were making good progress, from my point of view, to make this reunion a reality. The next step was to select and secure the hotel to host the event. My first choice was the Accadia Hotel in Herzliya located on the sea. This serene enclave is perched on a cliff directly overlooking the relaxing Mediterranean and is located on the seafront of the upscale town of Herzliya. Herzliya was named after Theodor Herzl who was an Austro-Hungarian journalist, playwright, political activist, and writer. He was one of the fathers of modern political Zionism. Herzl formed the World Zionist Organization and promoted Jewish migration to Palestine in an effort to form a Jewish state (Israel) in the late 18th Century.

Herzliya had developed into the home of many of the high-tech enterprises that have made Israel famous. A few steps down from the Accadia Hotel’s terrace, a path takes you to a tranquil and seemingly endless shoreline. Herzliya’s sandy beaches are the perfect place to catch some sun or bathe in the warm waters of the Mediterranean Sea. The Accadia Hotel is in close proximity to the Herzliya Marina which is the city’s main entertainment hub. In 1995, the marina was declared an international port and was the biggest and most modern marina.
in the Mediterranean basin with an international seaport of 700 moorings. It hosts national and international sailing events and has many water sports activities. Around the marina, you will find inviting restaurants and bars as well as boutique shops. There is also the Arena Mall which specializes in fashion and accessories. The Accadia Hotel is a self-contained resort that allows indulgence in a host of leisure-time activities without leaving the property.

For our purposes, the Accadia hotel would be a perfect venue. It was close to but not in the bustling and difficult to drive and park city of Tel Aviv. It had a beautiful location, could accommodate any visitors who wanted to stay at the hotel, it had all of the facilities available for a group our size, and it had delicious food.

Dalia, Ann, and I met with the head of the conference and meeting staff. We explained about our reunion needs. He showed us the options available for a group our size. We selected the patio for the initial greetings, the indoor room for the buffet dinner, and a large meeting room with a raised stage for the after dinner show and entertainment. We arranged to have time from 4:00 pm until 1:00 am. Everyone assumed that this would be long enough. I guess they forgot that there would be 200 Israelis that had not seen each other for more than 50 years!

The last item to decide was about food choices. The conference manager explained several alternative menus and the associated prices. After patiently listening, I asked about the food served in their restaurant. The man explained that it was better and, obviously, cost more. I told him that I wanted the same, or even better, food than they served in their best restaurant. The manager’s answer was that the price would be much higher than normal. My response was that this reunion was special and “higher than normal” so I wanted the best food regardless of the cost.

We had accomplished most of the important preliminary details for the reunion. Uri and I had met several times and made some decisions about the final appearance of the book. We arranged to stay in touch regularly so we would be able to finish it in time to distribute it at the reunion.

Dalia and I had a list of things to accomplish. In order for us to keep in touch and be able to handle situations quickly, we arrange to communicate via Skype. It was quicker and simpler to ask questions, discuss situations, show pictures or diagrams on a computer screen. Dalia could show me the two choices she recommended for the invitation, for example, and I could tell her about another person that might be able to help her. It was a fantastically useful tool and saved me from having to fly to Israel many more times than I had previously anticipated.

One of my self-imposed jobs was to collect as many photographs as possible. These could be incorporated into the book Uri was writing or in other ways which Dalia might need. Not only my photographs were compiled, but any contributions from other class members were included in the assembly of photographs.

Some of the photographs I collected are in the following URLs:

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After we had returned to California, I called my old teacher, Dani Dassa, to let him know the dates of the reunion. I told him that everyone that I talked to in Israel had made me promise that Dani would be there! He assured me that he and his wife, Judy, would come to the reunion and would even stay at the Accadia Hotel.
The months passed more quickly than I could have imagined. I had to travel to Israel several times to participate in our movie, “Hadassim: Then and Now.” The four “children” were Hillel and me for the boys and Nurit and Iris for the girls. As we walked around Hadassim and discussed our days there, remembered events and people, we were either doubled over in hysterical laughter or crying.

May arrived and Ann and I flew to Israel. We checked into our hotel and immediately contacted Dalia. She had a list of items that she needed to discuss with us and to finalize the details of the reunion day. We met for dinner and I agreed with everything she suggested. After all, she had accomplished this entire meeting in just 7 months. I knew how difficult this venture had been since working with Israelis is like trying to herd cats.

Our teacher and friend, Dani Dassa, had arrived in Israel the day after Ann and I had. He and his wife, Judy, were staying at the Accadia Hotel, we arranged to meet them for breakfast at a beautiful restaurant, Terrassa, which prepared delicious Israeli food. Dani and Judy are shown below as we waited for our coffee:

![Dani Dassa and Wife Judy at Terrassa Herzliya](Image)

I was experiencing a range of emotions from Deja vu to excitement about the upcoming reunion as I sat across the table from Dani in Israel. The last time we had been together, sitting beside the Mediterranean Sea, was 1956.

Finally, May 20th dawned. I could not believe that the reunion was actually going to happen in just a few hours. All of the planning was completed. The anticipation of seeing friends and teachers and the celebration of the most important time in the lives of so many people was only a few hours away. I was a bundle of nerves. I do not even remember putting on my tuxedo or Ann fixing my tie. Everything was a giant blur until we arrived at the hotel ahead of all our guests and friends.

From this point, the reunion became a fantastic experience that blended the youth of our childhood and the wisdom of adulthood. The Class of 1958 began to arrive, a few at first and then a flood. The first step as to sign in at the
registration desk and received their name tags and a program for the evening’s events. The actual class members had a blue lanyard with their name tags.
The joy and excitement of the “kids” were incredible to see. Smiles, screams of joy, shocked recognition, the entire gamut of emotions were evoked with each new individual as they arrived. Regardless of whether the student was currently living in Israel or had arrived from some far flung corner of the World, riotous enthusiasm prevailed. The patio welcoming room became packed with people and the hubbub escalated with each new encounter. The time set aside by Dalia for people to arrive, receive their name tags and program, was one hour and a half hours. The plan was for everyone to then go inside for dinner.

The time came for the group to go into the dining room for the meal. However, after three attempts by the hotel staff to alert the group to come to dinner, Dalia went to Ann in a panic! She needed help in getting the people inside while the food was still delicious and to keep the program schedule intact. If we fell too far behind on the timetable, we would not be able to complete the entire program. This was the first time in Dalia’ and the hotel’s experience that
Israelis had not rushed for the food as soon as it arrived. Not only had they not made a dash for the dinner, they had not even responded to the repeated requests for them to come to eat.

Dalia, Ann, and I circulated among the guests and urged them to go into the dining room for dinner. After we had some of them moving in the right direction, it was easier to guide the rest of the group. Of course, the conversations continued non-stop throughout the meal. There were many positive comments about how tasty and delicious the food was, and the numerous trips to the buffet tables proved the point. After the dinner, the group was directed to the room for the organized show we had prepared.

The show began with an introduction by the Master of Ceremonies, Chaim Kenan. He had been a student at Hadassim although he was in a class behind ours. He began by having everyone turn off his or her cell phones which were not something that would have even been contemplated in the 1950s. Then he told everyone that there was a tissue at each place because everyone was going to need at least one before the evening was over.

Chaim Kenan explained that he had turned down the job as Master of Ceremony at least three times. Why should I do it he had asked Dalia? They were older and seemed so much bigger than I was; I was not part of their groups, sports, or classes. What did any of this mean to me? Then I began to think about Hadassim as a school and as a special place for children. I realized that all of the Class of 1958 had grown to be leaders in every realm of life: in business, military, government, education, professional, medicine, and so on. They had achieved these levels because the school and environment at Hadassim had given them the tools and the confidence to try and persist until they succeeded. Chaim said he realized that he, too, had followed in this tradition and wanted to be a part of the celebration of this Class and this school.

Following Chaim’s introduction, the program began with the short movie about Hadassim with Hillel, Iris, Nurit,
Miriam Sidransky, and me. We were laughing and crying together in the film and now, during the reunion, as well. Some of the segments of Hadassim in the early years were actually filmed by the famous and prolific producer, Steven Spielberg, which Dalia and Yehuda Kaveh had found in the Israeli film archives. An early movie by Steven Spielberg had been located in the archives and can be seen by following the following link:

http://arielnet.com/ref/go/1289

I had been especially amazing to discover a link between Mr. Spielberg, Hadassim, and all of our Class. The movie that Dalia and Yehuda Kaveh produced about our class can be seen by following the link shown below:

http://arielnet.com/ref/go/1290

When the film ended, Chaim called to the stage Shevah Weiss. Although Shevah was two classes ahead of ours, he had made a strong impact on me, individually. When Dani Dassa had worked with Shevah in throwing the discus, I had been so captivated by the event that I asked if I could retrieve the discus each time it was thrown. Shevah had also been my inspiration in lifting weights since he was a relatively small fellow but quite strong. He could carry two of three older kids on his back with no
problem. No one was aware of his past, at that time. Now, at the reunion, Shevah described how he arrived at Hadassim.

Shevah was born in Poland in 1935. He had been rescued by some partisans during the German occupation of Poland. After surviving the Holocaust, he described being taken with some other children to Italy where they were housed in a palatial mansion formerly owned by Hermann Goring. Among the hundreds of orphans housed in this mansion, Shevah was one of eight orphans who won a lottery for a passport to Palestine, which was controlled by the British under the Mandate at that time. He and the other seven children were transported from Italy to Palestine by ship and from there to Hadassim. The eight children decided among themselves to never tell what had happened to them in Europe before they arrive in Israel. Each of them would have a future but not the past. In 1962, when Israel tried the notorious Nazi SS officer and one of the major organizers of the Holocaust, Adolf Eichmann, Shevah learned, for the first time, what had taken place in Europe. Until then, he had been living in Hadassim oblivious of his and Europe’s past.

Shevah reminded the audience of the group who routinely went running with Dani Dassa. Where were they running? No one knew, but when Dani and Gideon started running the 8 km across the sand dunes, the other kids ran as well merely for the sake of running with Dani.

Chaim Kenan asked Shevah what was the most important thing about Hadassim? His answer was “everything.” He had learned to respect and not to hate; recognize mistakes and learn from them; it was permissible to make errors in leadership but correct them without hatred. His successes as a teacher, as a government leader, as speaker of the Knesset, resulted from the life among the teachers, leaders, and students at Hadassim. His last comment was that every child at Hadassim, Holocaust survivors, those from broken homes, and the elite, were each and every one disaster cases. But Hadassim had made them whole and healthy.

After the interview with Shevah, the program continued with a musical performance. The musicians were Gil Aldema, on piano, and Shalom Gerstein, playing the accordion. Gil Aldema was a famous Israeli composer and conductor but prior to these successes, he had taught music at Hadassim. For many years, he had collaborated with Dani Dassa, who choreographed the steps, to create many new Jewish dances. The musicians played several of their songs and the audience joined in to sing the lyrics.

After the singing, one of the class members, Safra, presented a slide show of what Hadassim had looked like when we were students. In addition, she included many photographs of our class at that time. It was fun for everyone to see themselves playing sports, climbing rocks on a school outing, and other events. In addition, Gila presented an amazing booklet that described each person in our class. Gila’s booklet can be found at the following link:
Chaim then called Dani Dassa to the stage. Apparently, Dani had not expected this and was quite flustered when he first arrived on stage. He told Chaim that he does not like to talk with this lips but with is feet in dance. However, he answered Chaim’s questions and then brought his wife, Judy, on stage to demonstrate one of the Israeli dances that he had created. He then gestured to the rear of the room where four of our classmates, Hillel and his wife, Thalma, and Avi, with his wife, performed one of Dani’s dances. Dance had been an important aspect at Hadassim and Dani had been a significant factor.

The next teacher Chaim introduced was Avinoam Kaplan, our biology teacher. Avinoam had been and continued throughout his life, to be obsessed with nature. He was an environmentalist before the name and idea had become popular. For example, the municipal authorities planned a road along a scenic area of the coast between Haifa in the north and Tel Aviv in the South. Avinoam and a group of his student went through a long section of the still untouched wilderness and carefully dug and transported hundreds of the native flowers. They rescued as many plants as they were able before the road was built.

Following, Avinoam, a group organized by Hillel’s wife, Thalma, sang an original song. The lyrics had been written by Chaim Kenan and the music composed by Gil Aldema. It was a beautiful and unique song and was appreciated by everyone.

The next speaker was Ann, my wife. I had been shocked when she asked if she could make a few comments at this reunion since she absolutely refused to engage in public speaking. Of course, I said yes and was pleased to see her go up on stage. Her speech was in English, but most of the audience could understand English. Her talk was actually pretty funny since she reminded them about some of the stories that she had heard over the years. Most of the stories were escapades that had involved me, but the entire audience remembered these, most notorious and outrageous, events. She also noted that the stories and misdeeds were about boys. Her conclusion was that the girls were perfect or had been too smart to get caught. Her talk was quite funny for my classmates since no one else on stage that evening would dare to have revealed some of our many misdeeds. I was very proud of her that day as I am every day.
Before Chaim called me to the stage, he thanked the people of WIZO which is the Canadian Woman’s Organization which had created and funded Hadassim. Without them, many of us would have suffered terribly rather than becoming the outstanding members of society that we were.

At that point, Chaim called me to the stage. My heart and mind were whirling with emotions. I tried to explain that Hadassim and all of the people, classmates, teachers, experiences, studies, had made me the success that I am. Life had been a roller coaster ride for each of us, before and after, Hadassim. But the lessons and friendships we had experienced in that childhood paradise and could never be repeated or repaid. I had spent my entire adult life remembering the place and the people; I had wanted all of us to be together one more time and that had been the inspiration for the reunion. I thanked the people for coming to this special event and that after we finished the last song, that each of them would receive the book Uri and I had written about us.

As I was finishing my speech, another famous Israeli, Gila Almagor, appeared at the back of the room with her cousin, Asher. Asher was one of our classmates, Gila was his younger cousin and has enjoyed a long and illustrious career in film and theater.

I was pleased when, at this point, my classmates presented me with a “thank you” plaque. The message was their appreciation for the idea and the fantastic implementation of the reunion. Ann and I had tried our best to arrange
for the best location, the most delicious food, and a memorial book for them to read and treasure. I felt that the plaque and the applause were heartfelt thanks for this effort.

I announced that the program was concluded. However, at the back of the room were the memorial books which Uri and I had written, there was a copy for each of them. Following much applause, the audience got up and went to retrieve their books.

A video of some of the reception and the program of the reunion can be viewed at the following link:

This amazing group of Israeli classmates of mine continued to surprise everyone. It was well after the time that the hotel had given us and most of the people were still socializing and signing each other’s memorial books. Finally, the hotel staff insisted that we leave so they could clean everything and let their own staff go home for a little sleep!

Two days later, Ann and I settled into our seats on the airplane for the long flight back to California. We agreed that the reunion had been a spectacularly successful event. As I sat thinking and discussing with Ann, I realized that all of my class were proud to be Hadassim “kids,” and each of us had accomplished much in our lives. That educational system of creative dialogue and love to its students produced whole and healthy citizens who contributed greatly to their country and to their families.

Our book Oasis of dreams: (In English and Hebrew)

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http://arielnet.com/ref/go/1293

For me, the reunion completed a 360-degree circle of my own life. I started the circle at Hadassim which created my foundation, I finished with the reunion at Hadassim since it was the reason I had accomplished so much in my life. I know my classmates felt the same way.

Sixty years have passed since the first eight holocaust survivors began their new journeys in the unparalleled marvel of Hadassim. The Hadassim project was a success primarily because of the complex, sometimes chaotic evolution of a radical idea: creative dialogue. The concept was given to Hadassim founders, Rachel and Yirmeyahu Shapira, by Schwabe, Buber and Yehoshua Margolin. Creative dialogue meant that learning and living must not be done by rote, but by active, participatory, questioning, and integration of others’ ideas with our own. We all learned from each other. Rachel and Yirmeyahu’s ability to fashion and crystallize that concept in institutional form was the sustaining pillar of Hadassim.

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They succeeded where others might have failed, because they took their philosophical masters both seriously and critically, giving authentic material form to their legacy.

The WIZO idea of appointing two directors for Hadassim, and those leaders’ abilities to maintain a creative dialogue between them, was a necessary condition for the success of the Hadassim experiment. Rachel and Yirmeyahu had chosen teachers for Hadassim who were inexperienced. They believed experienced teachers would bring their educational baggage with them and either distort or disrupt their unique, Schwabian conception. Hadassim was a place of learning not only for students but for the teachers as well.

The reunion had been my “thank you” to the friends and teachers and country who taught me to risk, invent, and continue to grow. These principles have not only directed my life but have been the source of my happiness.

As we flew high above the Earth, back to our sunny home and fascinating work, I experienced a sense of fulfillment and joy. I felt ready for the next challenge in my life.
Chapter 2: The Kidney Chapter

One of the things that Ann and I love to do is travel. We have traveled all over the World during the last 30 years and tried to include learning and information about the destination country on every trip. We are not the type of people to sail around in large cruise ships and eat 24 hours a day. We are physically more active and in constant search for new information, we love to learn.

Ann found that Stanford University Travel Service offered an excursion to Patagonia which looked interesting and was a location that would be new for us. We had taken several previous trips with the Stanford Travel organization and found them to be perfect for our style of travel. They selected interesting places, provided excellent teachers and guides, utilized wonderful hotels in exquisite locations, and handled all of the normally aggravating travel necessities, such as suitcase handling and transportation. So in February 2014, we flew from Los Angeles to Buenos Aires, Argentina where the trip would begin.

Normally, our travel plans are to arrive at our initial destination a few days early so we can recover from jetlag which affected Ann. While we were in Buenos Aires, we had an opportunity to meet and share time with our old and dear friend, Dr. Bill Laich. Bill and his girlfriend were graciously able to spend time taking us around the city and helping us sample the delicious variety of foods available. When the time came to being our tour to Patagonia, we said farewell for now with promises to meet again soon.

Patagonia is a sparsely populated region located at the southern end of South America, which is shared by both Argentina and Chile. The region comprises the southern section of the Andes mountains as well as the deserts, steppes, and grasslands east of this southern portion of the Andes. Patagonia has two coasts; a western one towards the Pacific Ocean and an eastern one towards the Atlantic Ocean.

The trip began in Buenos Aires and we flew from there to Ushuaia, Argentina. In Ushuaia, we boarded our cruise ship, the “Stella Australis”, which took us through the Beagle Channel to Punta Arenas. The Beagle Channel is named after the ship that carried Charles Darwin on his voyage of discovery from 1831 to 1836. We were able to see amazing scenery, including Cape Horn which is the southernmost tip of South America. We sailed through the Magdalena Channel into the amazing De Agostini Sound. It is located in the heart of the Darwin Mountain Range and we were able to go ashore and have a close-up view of the Auila Glacier as seen in the following photographs.
We landed on an island, uninhabited by humans, but home to a colony of adorable Magellanic penguins. We were able to walk on the path as long as we respected the cross traffic of penguins going to and from the water to their nests. It was extremely cold, at least, for the humans. However, the penguins paid little attention to the frozen people watching them as they went about their daily business. They were really cute and it was fun to watch them in their natural environment.

We continued our journey by boat and bus until arriving at our destination in the Torres del Paine National Park. In front of our hotel was a large lake and in the distance were beautiful mountains, the Paine Massif, that seem to change color as the sun pasted across the sky. The spectacular beauty of the location was enhanced by the reflection of the mountains and the sky in the lake. This beautiful tableau...
evolved as the sun’s position change yielding new images with the passage of time and light. It was easy to see why Patagonia is considered an amazing and beautiful place.

Our program spanned three days in the national park which included numerous hikes, horseback riding, and long walks. Ann and I normally selected relatively tame activities which consisted of walks along the lakes or moderate hiking opportunities. On one of the excursions, which turned out to be longer than we had anticipated, I experienced more difficulty than usual while walking up the hill. My heart was pounding, I was out of breath, and I felt that this was really too difficult for me.

Later in the evening, I was describing my experiences to one of our new friends, Dr. Myron Shapiro.

Dr. Shapiro and I had become “trip buddies” since I had difficulty going uphill and he had a problem going downhill. We frequently would sit together while Ann and Myron’s wife, Susan, continued the hike. The women would pick us up on the return trip. Dr. Shapiro asked if I had a cardiologist who is managing the Atrial Fibrillation which I had experienced for thirty years. I told him that I did not and he suggested that I visited his cardiologist when we returned to California. Since Myron practiced in Los Angeles, California, he was acquainted with many of the best physicians in various specialties. I agreed that this was a good idea and would contact him after we returned home.

We continued the trip through Patagonia enjoying the beauty with less vigorous excursions. One excursion was a boat trip around the lake in front of our hotel and another was a walk along the side of a lake as seen on the above on the right.

After we had returned home to California, I contacted the cardiologist recommended by Myron. Myron’s doctor, Dr. Satinder Bhatia, practiced in a large medical building in Beverly Hills, California with many wealthy and famous people among his clientele.
I had an all-day appointment during which Dr. Bhatia administered a series of cardiovascular stress tests on me. The test results demonstrated that I had excellent cardiovascular performance except for my on-going Atrial Fib which had been a factor for more than thirty years. Dr. Bhatia discussed the results with me and indicated that I was in good health for a man my age with no cardiac deficiencies. Ann and I returned to Coto feeling relieved at these results.

A few days passed and, as usual, I went to the gym to exercise. While I was running on the treadmill, the phone rang and, since it was Ann, I answered: “Yes, my darling, what is going on?” She responded that Dr. Bhatia had just called and insisted that I had to begin dialysis immediately since my creatinine value was 5.6.

Both Ann and I were shocked, surprised, confused, and relatively ignorant about what this creatinine value was and what it meant to my health. I did not experience any difficulties running on the treadmill or with any of my other exercises. If Dr. Myron Shapiro had not suggested going to a cardiologist, I would not have thought to visit any doctor. However, my blood work at Dr. Bhatia office showed a high level of Creatinine which indicates kidney failure.

I immediately began to research creatinine and its relationship to kidney function. Creatinine is a chemical waste product in the blood that passes through the kidneys to be filtered and eliminated in urine. The chemical waste is a by-product of normal muscle function. The more muscle mass a person has, the more creatinine they produce. Levels of creatinine in the blood reflect both the amount of muscle a person has and their amount of kidney function.

Most men with normal kidney function have approximately 0.6 to 1.2 milligrams/deciliters (mg/dL) of creatinine. Most women with normal kidney function have between 0.5 to 1.1 mg/dL of creatinine. Women usually have lower creatinine levels than men because women, on average, have less muscle than men. Other factors that may affect the level of creatinine in the blood include body size, activity level, and medications.

When there is kidney damage or kidney disease, and the kidneys are not able to filter waste efficiently, there will likely be a rise in creatinine levels in the blood. Dialysis is needed whenever kidney function is too low to maintain health. Some people who have no symptoms of illness at all discover that they have advance kidney disease when high creatinine levels are detected in routine blood tests. When signs of too little kidney function do arise, they may include loss of appetite, vomiting, itching, weakness and flu-like symptoms. Swelling in the legs and shortness of breath may occur if water builds up in the body.

Serum creatinine can be tested in both the blood and in the urine. These tests can help evaluate kidney function. Knowing your serum creatinine allows your doctor to calculate your creatinine level along with your age, gender, and race, to determine your glomerular filtration rate (GFR). GFR is a measure of kidney function. If you know a serum creatinine level, you can determine the stage of Chronic Kidney Disease or CKD.

In addition to an elevated creatinine level, my GFR was nearly 12. Imagine what a shock it was for me to be told that I had a terrible disease. I rarely had an alcoholic drink other than an occasional glass of wine or beer; I had never smoke; I had been exercising since I was about 11 years old; and my
diet was focused on eating healthy, organic, low-fat foods. I had lived my live focusing on healthy activities so I was completely dumbfounded how this could have happened to me.

When I was on the exchange program from Israel in 1963, I was sent to Colorado State University (CSU) in Fort Collins, CO to work with the track coach there. While I was at CSU, I asked the coach if I could enroll in the anatomy-physiology course being taught in the medical school at that time. He agreed and arranged with the instructor to allow me to attend. I remember that we covered only two organs during the first quarter: the heart and the kidney. At that time, the class was quite extensive in the details of those organs. Now, in 2014, I began an intensive study on the operation of the kidney from a personal and imperatively necessary point of view.

The kidneys are two bean-shaped organs that extract waste from the blood, balance body fluids, form urine, and aid in other important functions of the body. They reside against the back muscles in the upper abdominal cavity. They sit opposite each other on either side of the spine. The right kidney sits a little bit lower than the left to accommodate the liver.

When it comes to components of the urinary system, the kidneys are multi-functional powerhouses of activity. Some of the core actions of the kidneys include:

**Waste excretion:** There are many things the body doesn’t want inside of it. The kidneys filter out toxins, excess salts, and urea, which is a nitrogen-based waste created by cell metabolism. Urea is synthesized in the liver and transported through the blood to the kidneys for removal.

**Water level balancing:** As the kidneys are key in the chemical breakdown of urine, they react to changes in the body’s water level throughout the day. As water intake decreases, the kidneys adjust accordingly and leave water in the body instead of helping excrete it.

**Blood pressure regulation:** The kidneys need constant pressure to filter the blood. When it drops too low, the kidneys increase the pressure. One way is by producing a blood vessel-constricting protein, angiotensin, that also signals the body to retain sodium and water. Both the constriction and retention help restore normal blood pressure.

**Red blood cell regulation:** When the kidneys do not get enough oxygen, they send out a distress call in the form of erythropoietin, which is a hormone that stimulates the bone marrow to produce more oxygen-carrying red blood cells.

**Acid regulation:** As cells metabolize, they produce acids. Foods can either increase the acid in the body or neutralize it. If the body is to function properly, it needs to keep a healthy balance of these chemicals. The kidneys do that, too.

Most people are born with two kidneys, but many people live with just one. Because of this ability to live with only one kidney, kidney transplant surgeries with live donors are common medical procedures.
today. Because of all of the vital functions, the kidneys perform and the toxins they encounter, however, the kidneys are susceptible to various problems.

The kidneys are remarkable complex in their structure and functions. The actual filtering occurs in tiny units inside the kidneys are called nephrons. Every kidney has about a million nephrons. Within the nephron, tiny blood vessels called capillaries intertwine with tiny urine-carrying tubes called tubules. A complicated chemical exchange takes place, as waste materials and water leave your blood and enter your urinary system.

Initially, the tubules receive a combination of waste materials and chemicals that the body can still use. The kidneys measure out chemicals like sodium, phosphorus, and potassium and release them back to the blood to return to the body. In this way, the kidneys regulate the body's level of these substances. The right balance is necessary for life, but excess levels can be harmful.
In addition to removing wastes, the kidneys release three important hormones:

**Erythropoietin (EPO):** which stimulates the bones to make red blood cells.

**Renin:** which regulates blood pressure.

**The active form of vitamin D:** which helps maintain calcium for bones and for normal chemical balance in the body.
As soon as I had the unfortunate news from Dr. Bhatia, I contacted my primary care physician, Dr. Fernandez, for an appointment. During my visit with Dr. Fernandez, he felt that this aspect of my health care would be best addressed by a nephrologist and recommended Dr. Nathaniel Ho. I quickly made an appointment to see him.

Dr. Ho had vast experience in treating kidney disease and is board certified in Nephrology and Internal medicine. He specializes in all aspects of nephrology with special interest in treating resistant hypertension and kidney stones. Ann and I arrived for our appointment with all of the results from Dr. Bhatia’s stress test and lab results.

We reviewed the findings and compared them to my previous creatinine results for the previous ten years which Ann had gathered from our files. This year, 2014, my level was 5.5 and the previous February, it had been 3.2. Dr. Ho’s opinion was, that at my age and with no known reason for my kidney failure, that I would need to begin dialysis in the very near future.

Ann asked which would be better: a kidney transplant or dialysis. As a kidney donor to his brother with end-stage kidney failure, Dr. Ho had personal experience with the transplantation process. His immediate response was that a kidney transplant was far superior to dialysis, however, I would have to be realistic about realizing this goal because of my age. He suggested that we proceed along two paths simultaneously. He recommended that we go to the University of California San Diego (UCSD) for the transplantation route since the waiting time for a cadaver kidney is shorter than in the Los Angeles area. At the same time, we should quickly prepare for dialysis when the creatinine levels warranted it.

The first issue that Ann and I examined was what exactly were the steps in obtaining a kidney transplant. We learned that kidney transplantation is the treatment of choice for people with kidney failure. This allows patients to stop dialysis, decrease their fluid and diet restrictions, and enjoy a much better quality of life. At this point in time, we were pursuing the transplant route, but there might come the time when I would have to begin dialysis.

The first thing that the potential kidney recipient must do is find a hospital that provides this particular surgery and then they must successfully complete a series of tests. To qualify for placement on the kidney transplant waiting list, a potential recipient must be relatively healthy and not have cancer or infection.

If the medical evaluation shows that you are a good candidate for a transplant but you do not have a family member or friend who can donate a kidney, then you will be put on the transplant program’s waiting list to receive a kidney from a deceased donor. Everyone on a regional list also is on a national list kept by the United Network for Organ Sharing (UNOS). This means that when your nephrologist places you on his/her transplant center’s list, you also are placed on the national list kept by UNOS. When a kidney becomes available in any area, information is sent to UNOS and a list is generated of individuals who potentially would be recipients for that kidney. If the kidney is a perfect match for someone on the national list, it will be offered to that person no matter where they are located.

Those who are on the list are waiting for a non-living donor kidney to become available from a transplant center. According to the National Kidney Foundation, it is difficult to predict how long a person will be on the waiting list, but, on average, waits of two years or more are not uncommon. However, the wait can be longer for older patients.

Actually, there are two sources for kidney transplants. One is from a living donor, and the other is from a non-living donor (also known as a cadaver donor). Patients who have had kidneys donated from living donors usually enjoy higher success rates than those who receive organs from non-living donors, since there is less chance of rejection.
How long an individual has to wait depends on many things but is primarily determined by the degree of matching between you and the donor. Some people wait several years for a good match, while others are matched within a few months. The average waiting time for a kidney is three to five years, depending on blood type. However, older individuals frequently fall outside of these time boundaries.

Suitability is initially based primarily on two factors:

1. **Blood type**: The recipient’s blood type (A, B, AB, or O) must be compatible with the donor’s blood type.

2. **HLA factors**: HLA stands for “human leukocyte antigen”, a genetic marker located on the surface of your white blood cells. You inherit a set of three antigens from your mother and three from your father. A higher number of matching antigens increases the chance that your kidney will last for a long time.

If you’re selected on the basis of the first two factors, a third is evaluated:

3. **Antibodies**: Your immune system may produce antibodies that act specifically against something in the donor’s tissues. To see whether this is the case, a small sample of your blood will be mixed with a small sample of the donor’s blood in a tube. If no reaction occurs, you should be able to accept the kidney. Your transplant team might use the term negative cross-match to describe this lack of reaction.

While I was reacquainting myself with the kidneys and their function, I also discovered information about transplantation. Learning about how normal kidneys function was quite amazing but, with no idea that I might need a transplant, I suddenly found myself learning about the procedure. Perhaps my studies were prescient but, as time would tell, also necessary. At the time, kidney donation was not on my mental horizon. None the less, I continued to study everything that I could find.

When a person receives a kidney transplant, the donor kidney will be placed in the lower abdomen. The kidney's blood vessels will then be connected to the recipient's iliac artery and vein. The surgeons will then connect the ureter to the bladder. The old kidneys remain intact and not removed. One reason that the old kidneys are left is that reside in a well-protected area of the body and there are also structures around it, for example, the adrenal glands, that can be damaged during surgery. Transplanted kidneys are placed in the iliac fossa (in the pelvic area) and attached to a different set of blood vessels. Because of these two things, unless the original kidney actively poses a danger to the patient (for instance, if it has a tumor in it), it creates an unnecessary additional risk to the patient to remove them. A diagram of a person with a transplanted kidney is shown on the left:

After the appointment with Dr. Ho and his recommendation that a transplant would be better than dialysis, Ann contacted the UCSD kidney transplantation center and scheduled our first meeting in June which consisted of an introductory class for all interested recipients. We attended the class and were given a long
list of tests and procedures that would have to be completed at UCSD prior to any transplant. Following
the lecture was a question and answer session, so Ann asked whether there was an age limit. The emphatic
answer was “no.”

The UCSD transplant tests included X-rays, blood and tissue typing, urine tests, CT scans, ultrasounds
scan, electrocardiogram and echocardiogram, as well as a nutritional evaluation, psychosocial, and psychological
testing. In addition, there were tests to be performed outside of the hospital such as colonoscopy, urological
testing, dental clearance, and so on. It was a long list, but we were undaunted since the alternative was less
attractive.

Once again, Ann’s focus on details and task completion was apparent. We began a series
of doctor appointments, lab tests, and diagnostic procedures as well numerous trips to UCSD for their in
house tests. Finally, everything had been done and we anxiously awaited the committee meeting decision
whether or not to place me on the transplantation list. It was November by now and we had been dealing
with my problem of renal failure and struggling to solve it. Our nurse coordinator, Dave, was very
optimistic since my overall health was quite good, I was continuing to exercise and eat well, and all of
my test results looked good. The UCSD cardiologist and surgeon had been very positive with regard to
my potential success with a transplant.

Unfortunately, during this lengthy testing period at UCSD, my kidney function had continued to
deteriorate. Dr. Ho said that I had reached a level which necessitated dialysis. He told me that there are
two types of dialysis: Peritoneal and Hemodialysis. In both cases, the purpose is to remove the waste
products which are accumulated by being alive and which are normally filtered by the kidneys. When
the kidneys are unable to do the job or can only remove some of the waste, dialysis provides an external
mean to assist or replace the cleansing process.

Peritoneal dialysis is one way to remove these waste products from the blood when your kidneys
can no longer do the job adequately. A cleansing fluid flows through a tube (catheter) into part of your
abdomen and filters waste products from your blood. After a prescribed period of time, the fluid with
filtered waste products flows out of your abdomen and is discarded. A schematic diagram of the
procedure is shown below:

Peritoneal dialysis provides a treatment that can be
performed at home, at work or while traveling, and, therefore,
can offer greater freedom or mobility than hemodialysis. The
process can be done manually by changing the bags or with a
machine. One company, Baxter, make a machine that
automatically circulate the fluids through your body while you
are sleeping. There “cycler machine” provides a form of
continuous therapy where the solution fills the abdominal
cavity, resides there for a proscribed period of time, and is
dautomatically drained. These repeated cycles are performed by
the machine while the patient sleeps. Patients have fluid in their
peritoneal cavity at all times during the therapy while the patient is attached to the cycler, except for the
end of the drain period before refilling begins, and some fluid is left in the peritoneal cavity after
disconnecting.

The machine is programmed to control how much fluid goes in and out and how often this
happens. Initially, the patient prepares him or herself and the machine with lines and these are connected
to about 10-15 liters of fluid, usually in 5 or 6 liter bags. The end of the line from the machine is connected
to the catheter at bed-time and remains connected all night which averages 8 hours. The fluid that comes
out is collected in a large drain bag which is disposed of when the patient is disconnected from the
The machine is programmed to control the fluid movement. It uses a series of clamps and pumps to control when the fluid should be drained out and when to put in a new fluid. The machine is programmed for each individual since everyone needs different amounts of dialysis. A picture of the machine without the fluids or fluid lines is shown on the next page.

The idea of peritoneal dialysis seemed like a good choice for me. First, I could use it at night while I was sleeping and, if we wanted or needed to travel out of town, we could take the equipment with us, so I decided to use this method. Both systems required surgical intervention and peritoneal requires the insertion of a catheter into the abdomen. There is a short waiting period for the surgical site to heal and then dialysis can be started.

I began the peritoneal dialysis in September of 2014. It began and remained a hellacious experience! Ann and I spent at least an hour before bedtime, heating the fluid, cleaning the area, the machine, and me with disinfectants. Then there was a complicated procedure of connecting the tubes and beginning the cycler machine. This portion of the process was the easy part. Hell began when the draining and refilling segments came. I was never able to drain correctly and the machine would set off loud alarms alerting me to correct the situation. I would stand or sit and even tried lying on the floor with my feet up on the bed to drain the fluid. Eventually, I would be able to remove enough fluid to proceed to the next cycle. Unfortunately, this interruption occurred on nearly every cycle all night long. I sometimes was able to sleep for an hour during the time that the fluid resided in my abdomen. But I never slept through the night and could only sleep in the morning after we disconnected the machine. I was always exhausted since I was unable to sleep. The fatigue increased as time passed and every day felt like another day of dragging through life.

The days and months had slowly passed since we had first gone to UCSD to have a transplant. I continued to fulfill the requirements which UCSD told me that I would have to complete successfully prior to any transplant. I had a colonoscopy as well as the “green light” laser surgery for prostate reduction. These were normally simple procedures but were made more difficult since I had to undergo the procedures as well as performing my peritoneal dialysis at night. However, they had to be done and we were quite hopeful that UCSD would place me on the list soon.

In early November, my nurse coordinator at UCSD called and he let us know that on the following Thursday, my case was to be presented to the committee to make the determination. He was cautiously optimistic because I was in such good health but my age could be a factor. Dave assured us that we would know within in 10 minutes of the decision. Needless to say, we were both quite anxious and afraid to be optimistic, but we were hopeful since my health was good overall.

Rejected! That was the committee’s decision. Imagine the crushing devastation when Dave called to tell us the bad news. He had been in the committee meeting and reported that my rejection was based solely on my age. Dave was equally upset and recommended another hospital in the area where he felt we would find success. He promised to send them my records and would provide us with contact information there.
Ann and I were devastated by this news. Why had they wasted six months of my life? They knew my age in June, why had they not told us then? We have never received an answer to this question.

I continued my daily regimen of waking, breakfast, exercise, and dinner. It sounds less bad than it actually was for me. I was unable to sleep well at night since the cycler machine was noisy and set off the alarms about every two hours. So in the morning, I would disconnect from the machine and try to sleep at least for a few hours.

Eating as also difficult, since some of the liquid is left in the abdomen even when disconnected. This created the sensation that you are full so meal times were less than enjoyable. After only a few bites of food, the sensation is that there is no more room in the stomach. Dialysis patients have very strict nutritional guidelines. You must consume 80 to 100 grams of protein every day, limit potassium and phosphorous, and beware of salt and sugar content of food. This meant that every meal was filled with protein sources in order to attain the daily requirement. In addition, liquids had to be restricted. The dialysis diet is the opposite of the normal diet when protein is lower and water is higher.

In addition, the liquid in the abdomen not only gave the constant sensation of fullness, but it interfered with other activities. It was impossible to do abdominal exercises. Meal times became a chore rather than a joy. Dinner had to be consumed early in the evening so that there was time for the system to process the food and, hopefully, eliminate some of it. Otherwise, the dialysis was restricted since the abdomen was full of waste and had less room for the liquid. I was truly miserable.

During this time of feeling miserable, we continued to hope for a kidney transplant. We contacted the second hospital in San Diego which was the one that our nurse coordinator at UCSD had recommended. We waited a month for the mandatory class and when we arrived, were told that it had been canceled. They apologized for not telling us but it was too late to save us the two-hour drive. They scheduled a meeting with their nephrologist and following that appointment, we did not hear from them for three months. It was terribly frustrating to feel so physically miserable with dialysis. It was surely a low point for both of us. But we are not quitters so we continued to face each day as it came.

Despite the difficulties associated with PD, I continued to exercise every day at the gym as well as going to the beach in Newport Beach to walk barefooted in the sand. Walking in sand is a wonderful exercise for the feet and legs in addition to demanding more energy than walking on a sidewalk. I had loved walking barefooted in the sand since my boyhood days in Tel Aviv. Now, at the age of 75, it remained an enjoyable exercise and both Ann and I love the ocean.

One day in early December, we went to the beach to enjoy the ocean and walk in the sand. The beach where we normally walked was near a large “stream” which flowed directly into the Pacific Ocean. This was one of the normally small streams that run into the ocean which increased or decreased in volume depending on the amount of rain which runs off from the land. That day was overcast following several days of rain. A huge storm had dumped so much rain so that the stream was flowing vigorously. Unfortunately for me, since I was the one who walked with bare feet, the water was full of the things that had not been processed by any water treatment facility. All matter of things is washed off during rain storms and flow into these streams and, eventually, into the ocean. Agricultural fertilizers and sprays, garage oils and solvents, things people dump in drains are just a few of the terrible poisons that were flowing into the ocean where we were walking. I was walking barefooted in the sand oblivious that the water splashing over my feet and up to my knees was filled with filth and pollutants.

The next day I felt pain in my feet and calf muscles that developed to the point where I could hardly stand or walk. I did not want to go to the doctor since I assumed that this problem would pass. I was partially correct about the pain in my feet and legs subsiding, but the pain then moved up higher in my body. I also had some nasal congestion so I thought perhaps it was the flu.

I went to the doctor who shrugged his shoulders and said it seemed to be some kind of virus. They swabbed my throat and did a blood test all of which were negative for bacterial. The result was to send
me home and wait for the “virus” to pass. This “virus” lasted for two months with varying symptoms. I felt terrible and probably looked as bad as I felt. At home I could hardly walk. My three daughters visited me for a week after New Year began in January and I could hardly keep my eyes open or move around. At least they were old enough to drive to the bagel shop and enjoy Disneyland without me!

The pain progressed through my body with a variety of symptoms which seem to vary as they moved from one body part to another. Ann had to wash me, tried to coax me to eat, and had to help me to go from the main room in the house to the bedroom to lie down. I was sure that I was going to die soon.

A few weeks later, I felt pressure over my heart. Ann and decided that we should go to the hospital to determine what was wrong and, perhaps, find something to cure me. When we arrived at the hospital, they checked my heart rate and blood pressure which turned out to be elevated. They could not identify a cause and attributed my symptoms, again, to a viral infection. The staff cardiologist in the hospital performed an EKG and decided that I had Congestive Heart failure. He told me to come to his office as soon as possible because he suspected that I would need open heart surgery.

The next day, I left the hospital and went to see my primary care physician. He reviewed the hospital records and suggested that I make an appointment with a cardiologist that he knew and trusted. Cardiology was not his expertise but he was suspicious that the reason my heart was malfunctioning was probably due to pericarditis rather than something worse. He was sure that the cardiologist whom he was recommending would be able to make a better determination.

Once again, I returned to my search for knowledge to understand my current cardiac situation. I again was thankful that I had sent time in the medical school at Colorado State University as well as my subsequent studies. I began research on the heart and specifically on pericarditis.

The pericardium is a tough, layered sac that wraps around the heart. When the heart beats, it slides easily within the sac. Normally, only 2 to 3 tablespoons of clear-yellow pericardial fluid are present between two layers, which lubricates the heart's movements within the sac. In pericardial effusions, significantly larger amounts of pericardial fluid accumulate. Small pericardial effusions may contain 100 milliliters of fluid while very large pericardial effusions may involve more than two liters of fluid.

Most pericardial effusions are caused by inflammation of the pericardium, a condition called pericarditis. A common symptom of pericarditis is chest pain, caused by the sac’s layers becoming inflamed and possibly rubbing against the heart. It may feel like pain from the heart. Pericarditis can be attributed to other factors, including viral, bacterial, fungal, and other infections. Since I had been experiencing what had been thought to be a virus, perhaps that was the explanation for this apparent heart related symptom. It seemed that my primary care physician had identified the condition of my heart and I was optimistic that the cardiologist would be able to correct the problem.

When a pericardial effusion is caused by pericarditis, the main symptom is chest pain. The chest pain may be made worse by deep breathing and lessened by leaning forward. When pericarditis is causing a pericardial effusion, other
symptoms may include: fever, fatigue, muscle aches, and shortness of breath. These are exactly the
symptoms that I had.

What had motivated the cardiologist of this hospital to suggest open heart surgery, was a mystery.
Maybe it is the good medical insurance that I have. I believe that it is important to be as knowledgeable
and informed as possible rather than letting someone who had known you for only five minutes is making
decisions. They may turn out to be correct in their diagnosis, but it is always good to be as informed and
educated as you must be your own advocate.

We visited the cardiologist that my primary care physician had recommended. He performed
several tests and came to the conclusion that I did not need open heart surgery. He suggested that we
wait for my heart to recover from the pericarditis as well as waiting for the virus to run its course. Ann
and I were relieved to learn that my heart condition was not as severe as the hospital personnel had
believed. However, we still had the on-going problem of the kidney, dialysis, and trying to find a
transplant.

Unfortunately, I still had to deal with the daily effort of dialysis. When I had been in the hospital
overnight, they had performed PD there. Not only is it impossible to sleep in a hospital, but now I missed
sleep with the PD. After I had returned home, it continued to be very difficult to sleep at night and
draining of fluids was a problem. Since dialysis was a requirement for life, I had to persevere.

Shortly after my hospital stay, the liquid that is removed at night during the peritoneal dialysis
was cloudy when we examined it in the morning. Ann collected a sample and we went immediately to
see my PD nurse. She sent the sample to the lab and, to be on the safe side, gave me in a dose of antibiotics
in the fluid which she infused into my abdomen with the normal dialysis liquid. This was on Friday.
Monday morning came with a scary lab result. The lab had discovered a fungal infection.

I quickly learned that fungal peritonitis (FP) is a rare but potentially fatal complication of chronic
peritoneal dialysis (PD), associated with high morbidity and mortality ranging between 20% and 30%.
If not leading to death, the inflammatory process usually causes irreversible damage to the peritoneal
membrane with subsequent dropout from PD therapy. Fungal peritonitis is a serious complication and
should be strongly suspected after recent antibiotic treatment for bacterial peritonitis. Fungal peritonitis
accounts for 3% – 6% of all peritonitis episodes. The most common cause of the disease is Candida,
although there are others.

It was a frightening diagnosis but, rather than spend valuable time to determine which specific
fungus I had, the doctor decided to use one of the most common and, normally effective, drug. The main
factors associated with the development of FP include previous antibiotic therapy, particularly for
bacterial peritonitis, when two important operative mechanisms coincide: fungal overgrowth in the
gastrointestinal tract and declining peritoneal defense because of peritonitis.

The management of FP poses a difficult challenge. Prompt initiation of therapy is critical, but no
typical clinical picture has emerged, and the infecting organism can be difficult to isolate. The approach
to the disease has changed considerably in recent years and the 2005 guidelines from the International
Society for Peritoneal Dialysis list FP as a strong indication for immediate catheter removal with
temporary hemodialysis. Dr. Ho proscribed the antifungal drug, fluconazole, and I was instructed to have
the catheter removed as soon as possible.

This required one surgery to remove the abdominal catheter and the second one to insert a
different type of catheter in my neck. Apparently, the potential source of the fungal infection was frequent
use of antibiotics during the various bouts of the two-month disease which may or may not have been a
virus as well as the use of antibiotics several times when the dialysis fluid had been “cloudy”. It is not
abnormal to have a case of excess use of antibiotics wiping out the bad bacteria and leaving the system
open to attack from “opportunistic” alternatives. In other words, wiping out the “bad” guys also
annihilate the “good” ones as well. This leaves the system vulnerable to other types of infections such as
the fungus which I got. No one knew where the fungus had come from but many fingers were pointed at my time in the hospital.

After removing the abdominal catheter, a different system was introduced in order to continue with my dialysis. This alternative technique to cleanse the blood is “hemodialysis”. Normally, hemodialysis employs a fistula, which I will explain later. Initially, since there was insufficient time for the surgery and healing time for the fistula, I had to use a catheter directly into a vein in my neck which sends blood directly into the heart. This neck catheter was surgically implanted during the same operation that removed the abdominal one. A diagram of the neck catheter is presented on the next page:

During the time I had the neck catheter, I learned about hemodialysis in depth. The dialysis machine filters wastes, salts, and removes extra fluid from the blood because the kidneys are no longer healthy enough to do this work adequately. The machine mixes and monitors the “dialysate”. The dialysate is the fluid that helps remove the unwanted waste products from the blood. It also helps balance the electrolytes and minerals at their proper levels in the body. The machine monitors the flow of the blood while it is outside of your body.

In hemodialysis, blood is removed from the body and filtered through a man-made membrane called a dialyzer, or artificial kidney, and then the filtered blood is returned to the body. The average person has about 10 to 12 pints of blood. However, during dialysis, only one pint (about two cups) is outside of the body at a time. In order to perform hemodialysis, there needs to be an access created to get the blood from the body to the dialyzer and back to the body. There are three access types for hemodialysis: arteriovenous (AV) fistula, AV graft, and central venous catheter. In my case, I began with the central venous (neck) catheter and then after surgery and healing, I was able to use an AV fistula located in my upper left arm.

When a patient goes to hemodialysis, a nurse or technician will check vital signs and weigh the patient. The weight gain will tell how much excess fluid the patient has to have removed during the treatment. The patient is then “put on the machine”. Patients with a central venous catheter will have the two tubes from their access connected to the blood tubes that lead to the dialyzer and back to the
body. Patient with a vascular access (AV fistula or AV graft) will have two needles in their access. One needle takes blood out of the body, the other needle puts it back. Once the patient is “put on the machine”, the dialysis machine is programmed and then treatment begins. A picture of a typical dialysis machine and patient is shown on the left.

Blood never actually goes through the dialysis machine. The dialysis machine is like a big computer and a pump. It keeps track of blood flow, blood pressure, how much fluid is removed and other vital information. It mixes the dialysate, or dialysis solution, which is the fluid bath that goes into the dialyzer. This fluid helps pull toxins from the blood, and then the bath goes down the drain. The dialysis machine has a blood pump that keeps the blood flowing by creating a pumping action on the blood tubes that carry the blood from the body to the dialyzer and back to the body. The dialysis machine also has many safety detection features and warning sounds alert the staff if anything is amiss.

The dialyzer is the key to hemodialysis. The dialyzer is called the artificial kidney because it filters the blood which is a job the kidneys used to do. The dialyzer is a hollow plastic tube about a foot long and three inches in diameter that contains many tiny filters. There are two sections in the dialyzer: dialysate section and the section for the blood. The two sections are divided by a semipermeable membrane so that they do not mix. A semipermeable membrane has microscopic holes that allow only some substances to cross the membrane. Because it is semipermeable, the membrane allows water and waste to pass through, but does not allow blood cells to pass.

Dialysate, also called dialysis fluid, dialysis solution or bath, is a solution of pure water, electrolytes and salts, such as bicarbonate and sodium. The purpose of dialysate is to pull toxins from the blood into the dialysate. The way this works is through a process called diffusion. In the blood of the hemodialysis patient, there is a high concentration of waste, while the dialysate has a low concentration of waste. Due to the difference in concentration, the waste will move through the semipermeable membrane to create an equal amount on both sides. The dialysis solution is then flushed down the drain along with the waste. The electrolytes in the dialysis solution are also used to balance the electrolytes in the patient’s blood. The extra fluid is removed through a process called filtration. The fluid is pushed off by higher pressure on the blood side than on the dialysate side.

Blood needs to flow through the dialyzer for several hours to adequately clean the blood and rid the body of excess fluid. Traditional, in-center hemodialysis is generally done three times a week for about four hours each session.

Despite the various and unpleasant symptoms, I was experiencing, dialysis had to continue using the neck catheter. As soon as I completed the drug regimen to destroy the fungus in my body, it was time to perform the surgery to create a “fistula” for my hemodialysis. A fistula is a surgically-created vein used to remove and return blood during hemodialysis. An “arteriovenous (AV) fistula connects an artery to a vein. Arteries carry blood from the heart to the body while veins carry
blood from the body back to the heart. An AV fistula causes extra pressure and extra blood to flow into the vein, causing it to grow large and strong. The larger vein provides easier and more reliable access to blood vessels. After the surgery heals and the vein is strong enough for the dialysis, it is used and the neck catheter is removed. A diagram of a fistula in the lower arm is shown below; my fistula was in my arm but above the elbow.

Dialysis patients are all too familiar with the routine of their treatments: Go to the clinic, determine the pre-treatment body weight, have temperature and blood pressure taken, get stuck with needles (unless the patient has a catheter access), have tubes connected from their access to the dialyzer, and then sit in the chair until it is time to go home. When I first learned about hemodialysis, it did not sound like such a bad system. However, once I began the process of thrice weekly trips to the clinic, I became acquainted with the discomfort, fatigue, and feeling as though I had been kicked and trampled by a herd of horses. I changed my mind! It had not taken long for me to realize that neither peritoneal nor hemodialysis provided quality of life. I could not believe that I, a two time Olympian who had strived for perfect health for 75 years, had to endure this a procedure. This was not life, I thought, and death could hardly be worse.

However, one must continue dialysis to remain in the fight. In addition to having to endure these dialysis sessions, kidney patients must learn a whole new way of eating and drinking. Foods must be low in potassium and phosphorus since the machine cannot remove these molecules. This sounded easy until I discovered that many foods that I love are no longer permitted. Bananas, orange juice, nuts and seeds, pomegranates, and so much other delicious, ordinarily healthy foods, are not allowed. The kidney diet includes, in my opinion, many “approved” foods which are poor in nutrition such as popcorn, corn flakes, rice milk, white bread, white rice, crackers, and candies!

Ann was outraged at the diet given to her for me to follow. To our way of thinking, the diet was low in nutrients and extremely high in foods that do not promote healthy bodies. In addition, dialysis patients are the reverse of normal people in that they must consume 80 to 100 mgs of protein every day as well as restricting liquids. I had no idea that 2 or 3 eggs for breakfast, lunch with turkey, and a dinner with steak or chicken, was barely getting to the required protein level. Ann began to introduce protein drinks whenever she could just to get the levels up. She had to force feed me in an effort to get enough protein and allowable vegetables and fruits. Another problem, which was more subtle but persistent, was that tastes change. Food which tasted delicious to me in the past, now was tasteless. I had no appetite and I know it was a struggle to get sufficient nutrition from me. I felt terrible, was apathetic, and had no desire to eat.

In the dialysis center you are not a human, you are a number. Everything functions according to protocols. Once a month, blood is collected and analyzed. The results indicate whether various minerals, hemoglobin and albumin levels, and several other factors are up or down. Regardless of what your blood results indicate that you need, you get the same shots of iron, or Epogen, or Vitamin D as everyone else in the Center receives. There is no differentiation for individual needs or adjustments to the unique condition of each patient.

I realized that I had to have dialysis in order to say alive. However, it was depressing and discouraging to wake every morning feeling awful. I felt terrible every day, not just on the treatment days. I began to see the dialysis center as a “torture chamber” and a “cemetery with lights.”

I reached a milestone of sorts, when it was nearly a year since I had first been diagnosed with a kidney problem. I had been diagnosed in late February or early March of 2015, and we were a year down the road with little to show for all of our efforts. I had been rejected by UCSD for my age, not my health. The second hospital had not bothered to contact us after the initial meeting with their nephrologist. But Ann was unwilling to give up.
We had successfully fulfilled all the tests listed on the UCSD form which seemed to be standard for all of the hospitals. Now that I had been turned down by my one hospital and completely ignored by another, we realized that we had to keep looking for a hospital. What we needed was a hospital that would actually agree to give me a kidney transplant. We decided to try one more in southern California and selected Scripps Hospital in La Jolla, California since they were relatively close and had a transplant program.

We made the appointment and drove to La Jolla, CA which is about 60 miles from our home. We spent the entire day with various staff appointments, blood test, chest X-rays, and finally we were seen by the transplant nephrologist. He seemed to be impressed with my overall health levels and the results from all of the other tests results which I had undergone. We told him of our previous experience at UCSD. His response was that if we had come to Scripps last June, they would have transplanted me rather than beginning dialysis.

He said that I would have to increase my cardiac output to 50% since it had fallen below that during my bout with the virus. I assured him that I was feeling better and would continue to exercise. I promised him, as a two-time Olympic athlete, that he could count on my recovering and would be ready for a transplant as soon as they were. I also let him know that I had a living donor, my eldest daughter, Tova.

Ann and I felt encouraged by the responses we had received at Scripps Hospital. It was also relatively convenient for us since we could easily jump into the car at a moment’s notice to drive there. While we waited for them to contact us for additional tests and to process my donor, we had to continue the horror of dialysis.

My dialysis continued on a schedule of 3 times per week. Each time I was connected to a machine for 4 hours. The procedure has been described previously but a picture of me connected to the dialysis machine is shown on the left:

When we had first visited Scripps, I was still recovering from my bout with the virus and the fungus. I was subjected to all of the normal transplant tests including blood tests, X-rays, and doctor exams. The last exam of the day was with the nephrologist who told me that my health was acceptable but they would not agree to a transplant until my cardiac output was 55 percent. I told the doctor that I had been in two Olympic Games and I knew how to train! I promised him that within a few months, I would increase my cardiac output to the level he required.

Since I had recovered from the virus and fungus infections, I had been able to return to regular physical exercise and training. I could not work out at all on the days I had dialysis, but on the other four days, I went to the gym regularly. I rode the horizontal stationary bike and was able to increase the time from 5 minutes to 20 minutes within about two months. I began walking on the treadmill, at first every slowly, and worked my way up to 15 minutes per session. I also spent time with flexibility and abdominal work, as well as training with barbells and resistive exercise machines. I was determined to improve my health because it helped to feel better, it counteracted the depression of dialysis, and it was the only path to a transplant.

By August, my heart health had improved so that the ejection had reached a level of 55 percent. I was scheduled at Scripps Hospital to see the surgeon and the cardiologist for evaluation. I had excellent
exam results with each doctor. The surgeon was quite excited to have the opportunity to perform a transplant on a two-time Olympian. He said I would be his first one.

We had one more trip in September of 2015 to Scripps for my last evaluation. After I saw the nephrologist for the second time that year, he was quite impressed by my overall health improvement. The transplant committee met in early October and they placed me on their transplant list. We were overjoyed. At last, we felt like there was hope.

However, in the same conversation with the nurse coordinator from Scripps when she informed me that I was being placed on the list, she said that they had rejected my living donor. At that time, my oldest daughter, Tova, was the one being evaluated to be my donor. When she was disqualified by the donor section of Scripps, it was disappointing for all of us. By rejecting my living donor, this meant we had to find another living donor or wait for a cadaver. Since I was now 76 years old, any cadaver that would be offered to me would be the one that had been rejected by everyone else. No hospital was going to give a newer, younger, good kidney to someone my age. I would be offered the “factory rejects”. It was a relief to be finally “listed” but the prospects of actually getting a kidney seemed bleak.

Our emotions were in turmoil. Ann told me that she was convinced that we would not be getting a transplant at Scripps so we were going to have to find one somewhere else. She was absolutely determined and repeatedly said “I’m not giving up! You are going to get a kidney!” Ann’s daily mantra became “You are going to get a Kidney!” and she repeated this many times every day.

Since I had grown up in Israel, I began to contact my friends there. My friend, Avi Meiri had a family member who had traveled to Latvia where he lived for three months until a donor became available. Avi arranged for me to discuss the situation with the transplant doctor in Israel. He said that I would have to travel to Israel and have the same series of examinations, blood tests, X-rays, and everything that I had already done in the United States. I could not merely send my previous results.

Another friend, Yosi Tanner, found an organization in Israel but, again, I would have to travel to Israel to meet with various doctors. In addition, I would have to find a compatible donor. Trying to find an avenue through my contacts in Israel demonstrated that it was becoming increasingly more complicated at every turn.

Micha Spira was another Israeli friend who tried to find a route for a kidney transplant there. His results were similar to my other friends who found that anyone over the age of 70 was precluded from a transplant in Israel. Micha promised to keep looking for another option.

It seemed, that our best option at this point was with our dear friend, Dr. Bill Laich, in Spain. Bill had moved to Spain from Argentina, where we had seen him before we began our trip to Patagonia. Bill had been involved in setting up a new hospital in Madrid, but since it was a private hospital, they were not given permission by the country to perform kidney transplants. All Spanish transplants had to be performed in State hospitals. Arranging for a kidney transplant in Spain would require allotting of preparation and we would have to find a living donor to travel with me for the transplant. Bill was confident that everything would be successful, but as with my attempts in Israel, more complicated.

Ann and I were aware that none of these options was easy or practical. In addition, we would have to pay for everything including my and our donor’s surgical costs, travel expenses, overseas residence for a period of time. We would have to arrange for adequate medical follow-up when we returned to the US. But one thing was for sure, regardless of where the surgery occurred, I had to find a kidney and that meant a living donor.

At the Dialysis center, I had become friendly with another patient, Rich Hodges. Rich is a wonderful person and we shared interesting stories when his chair was beside me. We were “dialysis buddies”. During these chats, I told him about my frustration in trying to find a kidney. He suggested that I meet friends of his, Helen and her husband, Bill. Bill was an older fellow who had undergone the same struggles that I had but he had been lucky enough to have received a kidney. Rich thought that
these two people could evaluate what we had done so far and perhaps suggest what else we should try. I contacted Hellen and we arranged a meeting at their home.

During our meeting, Helen nodded her head as we described the long, circuitous, and, to date, an unsuccessful route that we had taken. She and Bill had traveled the same path. Since they had ultimately achieved a successful outcome, she had some advice for us to try. A very important element was to be prepared and provide details whenever we met a physician. Bill brought a large notebook with all of his lab work, every prescription medicine, professional consultations, and so on. It was an impressive collection of documents but both of them were sure that this information, well organized, was indirect evidence that they would be equally meticulous with his health care after a transplant.

Helen showed us on her computer system the large collection of items she had accumulated regarding kidney transplantation. She had organized letters, blogs, photos, and websites that other patients had created in their efforts to find donors. Helen assured us that getting the word out would enhance our opportunity of finding a donor. She suggested that we distribute a blog on the internet and tell our friends that we are seeking a kidney donor. Helen offered to stay in touch by e-mail and to provide any additional assistance that she could. We thanked them for all of their help and ideas and promised to stay in touch.

Shortly after our visit with Hellen and Bill, she sent me an e-mail about a Dr. Mark Wedel. She had sent an e-mail to Dr. Wedel asking whether he would be willing to chat with us. Of course, she could not guarantee any miracles but she said that Dr. Wedel had helped a number of people tread the waters of transplant. She also told us about his book entitled “So You’re Thinking About Kidney Transplantation”. She said it was a great help guide for those seeking a transplant. At this time, we were happy to have some encouragement since it had been a rocky road to this point.

Not long after this e-mail, I received a phone call from Dr. Wedel. He offered to meet us at our home and insisted that he would drive up to see us from his home near San Diego. Of course, we were quite eager to meet him.

On that Sunday afternoon, Dr. Wedel appeared in our house. He came with his own giant bottle of water and appeared to be in excellent health which was remarkable since we soon learned that he had received a kidney transplant five years earlier. Dr. Wedel described his saga to obtain a transplant. It was fascinating and complex. As he described the flow of events in his own quest for a kidney, there were peaks and valleys which he said are common for most people. He examined our documents and evaluations and felt that we were on the verge of being placed on the list and receiving a transplant at Scripps. It turned out that the surgeon who had examined me was a golfing buddy of Dr. Wedel so he said he would put in a good word next time they met on the links. He built up our hopes in the process since he understood the
difficulties that we were experiencing. After a three-hour visit, he gave us his book and autographed it. We were very appreciative of the time and effort he had taken to visit us and for the copy of his book.

Dr. Wedel had spent three hours with complete strangers. We had never met him before that afternoon, yet he had gone out of his way, driven more than four hours, and given his entire Sunday to us. Ann and I were amazing that such a wonderful person existed.

During our conversation with Dr. Wedel, he mentioned an organization in Brooklyn, New York called Renewal. This organization is composed of Orthodox Jews that have had great success in finding donors. He suggested that we contact them and perhaps they could help us. It turned out that this was one of the most momentous days in our lives but on that particular afternoon, we did not know it. All we knew that day, was tomorrow will be another agonizing experience at the dialysis center.

Ann was ever the optimist. She sat beside me and told me something that totally effected my outlook and gave me the motivation to continue. She said: “Gideon, this is your 3rd Olympics! The first two required long and hard work but you persisted and did as well as you could do. But this is the Olympics for your life. You must work towards this Gold Medal. You will have to strive and train for this with more effort than for the first two because this one is much more difficult. This Olympics is for more than a gold medal; this one is for your life. Remember: WE WILL NOT AND CANNOT GIVE UP”. That was an awe inspiring thought for me at this low point in my life. Once I could imagine that I was training and working for my 3rd Olympics, I felt renewed hope.

We decided to contact Renewal in Brooklyn immediately. We found their website on the internet and read that Renewal is a nonprofit organization dedicated to assisting people suffering from various forms of kidney disease. They are a multi-faceted proactive team that is dedicated to saving lives through kidney donation.

Their website seemed to be especially geared for us. They described that in a serious medical diagnosis, the patient and family could quickly be overwhelmed by the pronouncement that one is suffering from irreversible kidney failure. With the increased frequency of transplants from non-related donors, they decided to start an organization dedicated to assisting people suffering from various forms of kidney disease. That was how Renewal was born.

Although their aim is to help in any way possible, the ultimate goal is obtaining a kidney for those that would like to undergo a transplant. Their waiting list includes people from all walks of life, of all ages, and from all parts of the world, including the USA, Canada, Israel as well as England and Brazil. Renewal has been successful in helping many of these patients, but the need is still great since each year, 8 percent of the patients on the national list die waiting for a kidney.

I sent an e-mail message to Renewal on Sunday night after Dr. Wedel left us. The next morning there was an answer for me to contact Mrs. Rivki Grossman and she would be able to help me. We called immediately after reading the message and left a voice message. Shortly thereafter, Mrs. Grossman called. She explained that Renewal works with only 5 hospitals: three in New York, one in Miami, Florida, and one in Cleveland, Ohio. We felt that the most convenient plan for us to work with Renewal would be to travel to New York. She said we would have to complete the application form and provide three letters recommending me to Renewal. One letter was to be from our Rabbi, one from a community leader, and a third from someone who know me and my character. She gave us the names of the three hospitals and said when we contacted them, to make sure we specified that we were working with Renewal.

I immediately filed in the application and sent it. Ann contacted our Rabbi Einstein who said he would send the letter immediately. Next I contacted my dear friends, Bob Wainwright, and Mac Wilkins, who said they would write letters as soon as they hung up the phones.

Ann contacted each of the three hospitals and was able to schedule an appointment for me at each of them. It was early November, but we were fortunate in making appointments before Thanksgiving. It
seemed impractical to have three hospitals so we called Mrs. Grossman to ask which hospital they would recommend as the most appropriate one for us. We could hear the discussion in the background as we waited on the phone and then the answer was “Mount Sinai” since they have extensive experience in dealing with out of town patients. We cancelled the other two hospital appointments and began to prepare for our trip to New York.

Ann was even busier than usual. Not only did she have to take care of all of my dialysis responsibilities and other daily needs, which were quite time-consuming, but now she had to prepare all of the details for our trip to New York. She arranged our flights, hotel, and made sure that we had our house covered in our absence.

Our California dialysis center arranged for my dialysis sessions in New York. This is not something that the casual tourist can do. A dialysis patient cannot walk into a center and ask for treatment. The system is more complex and complicated than that since the new center has to have all of the patient’s records prior to the first visit. Fortunately, we had enough time to have all of this processed before we left. I was extremely stressed about this aspect and had been reluctant to travel to New York. Dialysis saps all of your strength and hope for the future, but Ann reminded me that we had to try this since we were not getting anywhere in California. It was the 3rd Olympic reminder.

As with everything we do, Ann and I had checked into the kidney transplantation program at Mount Sinai. We learned that the Mount Sinai’s Kidney/Pancreas Transplant Program was one of the nation’s leading academic kidney transplant programs. They began in 1967, had performed more than 3,000 adult and pediatric kidney transplants. We read on their website a description of their philosophy which championed a concept that was especially important to us. The statement was:

One of the first kidney transplant programs in the Northeast, we have made significant strides in providing more options for patients previously denied access to transplantation due to medical factors.

Comprehensive, Multidisciplinary Care
Located in New York City, the Kidney/Pancreas Transplant Program is part of Mount Sinai’s Recanati/Miller Transplant Institute (RMTI), a comprehensive adult and pediatric abdominal organ transplantation center. Our multidisciplinary team includes experts in nephrology, surgery, anesthesiology, critical care, transplant immunology, and urology. This interdisciplinary approach allows us to provide the best in patient care by taking advantage of the most innovative developments in surgical techniques and transplant medicine. Patients who come to our program have access to the services of The Mount Sinai Hospital, an internationally acclaimed medical institution.

Increasing the Number of Donors
Mount Sinai has one of the largest living donor programs in the United States. Half of the yearly transplants performed involve living donors. As part of our commitment to enhancing quality of life for patients before and after transplant, surgeons at our hospital performed the first laparoscopic donor surgery in New York State in 1996. This procedure dramatically reduces recovery time for individuals donating a kidney to a loved one. So far, more than 1,000 laparoscopic donor surgeries have been performed in our transplant institute.

Our newly endowed Zweig Family Center for Living Donation focuses on providing the best in medical, surgical, and psychological care to living organ donors. The Zweig
Family Center for Living Donation is further developing Altruistic and Donor Exchange programs which will enable all potential recipients to have optimal opportunities to access live donor transplantation.

Mount Sinai is one of the first programs in the country to offer “donor exchanges.” This innovative program enables kidney transplant recipients who have willing but incompatible living donors to exchange kidneys with compatible donors. We participate in local and national paired exchange programs and donor chain initiatives.

**Increasing Clinical Eligibility**

Mount Sinai has made great progress in increasing the eligibility of patients previously denied transplantation due to clinical factors. For example, Mount Sinai has an active Paired Kidney Exchange program allowing patients with incompatible donors to receive compatible organs through a process commonly known as a “kidney swap”. We developed and implemented a successful desensitization program to reduce the effects of antibodies that may hinder the ability of many to receive a successful transplant. We can now treat many patients who, due to their high immunologic risk, were previously ineligible for transplantation.

**Research Initiatives**

Mount Sinai researchers are working hard to improve organ preservation, reduce rejection, minimize postsurgical complications and the side effects of immunosuppression, and prevent the recurrence of disease.

The more that we read, the better we felt about traveling to New York. Although I felt physically terrible most of the time, Ann assured me that this would be good for us and she was confident that we were making progress. “We are going to get a kidney” was her continuing litany.

We flew to New York on November, 21, 2015. Ann had arranged for us to stay in a nice hotel, The Pierre, on East 61st Street and 5th Avenue which was a cab ride away from the hospital, the dialysis center, and Renewal. I arrived exhausted from stress and renal failure. If you have never had kidney disease, there is no way to describe the fatigue and depression that accompanies it. Ann was like the world’s best coach always encouraging and trying to divert my attention from the negative to the positive.

The next day, Sunday, our dear friends, Bob Wainwright and Jeremy Wise, make the long trip from their homes in New Jersey and Massachusetts to see us. It was very uplifting and helpful for my mood to see these dear people and recognize the effort which had gone into their trips. We had a wonderful afternoon and evening with them and over a delicious Italian dinner, we laughed about some of our crazy escapades from the past.

The next morning, Ann and I went to Renewal at their Brooklyn office. Ann and I were apprehensive since our entire trip, and kidney future, was linked to this organization. The interview went very well. They were impressed by my accomplishments and the letters which they had requested from the Rabbi and others had extolled my virtues as well. We were relieved when they said they would accept me as a potential recipient.

During the meeting, they explained the process. They would assign me a new “name”, R1013, which was how I would be recognized at Renewal. I could mention myself by name when I wrote my blog or sent e-mails asking for help. But if anyone wanted to help or knew someone else who might be willing to donate a kidney, they must refer to me as “R1013” not as “Gideon Ariel”. All communications and any correspondence with potential donors were to be sent to Renewal not to me. I was instructed
that people should not respond to Gideon Ariel, but rather send everything to Renewal and reference in the communication should be with regard to “R1013”.

Ann and I promised to do everything that Renewal asked. The staff joined our meeting and made many suggestions about how to find donors. Since I was well known around the World, in Biomechanical and Track and Field areas, they thought I might have the most success in sending out targeted e-mails and posting a blog. They recommended that I prepare the text and they would review it for comments. I promised to work on the blog as soon as possible and would send it to them via e-mail. We left Renewal with buoyed spirits.

Ann and I returned to The Pierre Hotel in Manhattan. I was exhausted; more than usual since I had jet lag, was emotionally drained from our trip to Renewal since I had been so worried that they would reject me, and I needed dialysis. We had scheduled a dialysis session at the Mount Sinai medical center for 6 pm, so I was able to have a short rest before we left for that.

At that moment, I felt overwhelmed. I recognized the exhaustion that indicated that dialysis was necessary but, at the same time, I was encouraged by the response of the people at Renewal. They had not made any promises, but they had a positive outlook which was not an attitude that I had experienced in California. I could not bring myself to hope but Ann reminded me that this was another “training session for my 3rd Olympics”. She unrelentingly reminded me that we were going to be successful. “You are going to get a kidney”.

The next morning, Wednesday, November 25, 2015, dawned crisp and chilly for us, the Californians. But we were oblivious as we rode in a cab to Mount Sinai Hospital. As the elevator doors opened on the 11th floor, we were greeted with “Kidney Transplant Center” signs. I silently hoped this would be as momentous an event for me as when my ancient ancestors, the Israelites, arrived at Mount Sinai in the Judean Desert.

After registering at the desk, there was a flurry of tests: blood, urine, blood pressure, pulse, temperature, and others. Then Jonathan, my nurse coordinator, came in to describe the steps involved in processing me like a kidney transplant candidate. Ann gave him an enormous notebook with the last five years of my medical history. Data sheets were encased in plastic “windows”, front and back, and categorized by topic. The first page was the letter from Scripps Hospital placing me on the transplant list. Subsequent sections presented all of the evaluations and notes from the various physicians; all of the laboratory results; the “green light” laser prostate surgery; the colonoscopy; the dental exam and clearance; immunizations, including, tdap, flu; and other results. Jonathan said he would have the pages scanned and returned to us. Ann immediately responded that the book had been prepared specifically for them to keep; we had our own copy. This notebook consists of at least a 100 or more pages. On the front of the book, I had put a photo from the 1960 Olympic Games in Rome where I carried the Israeli flag. The photo is shown below:

Jonathan then described the schedule for the rest of the day. We would meet the nutritionist, financial advisor, and nephrologist. He said we would have to come another day to see the surgeon. Ann asked if this meant we would have to fly back from California to see the surgeon. Jonathan responded in typical, help-the-patient-first, fashion. “Oh my gosh, I forgot how far you have come. I’ll try to find a surgeon that is still here. Since it is the day before Thanksgiving, many of our staff members will have left. Don’t worry; I’ll take care of this.”

The meetings went as Jonathan had described. Surprisingly, we stayed in one room and the people came to us. Our previous experiences had involved our running from room to room. When the nephrologist examined me, he described the tests that would need to be performed and we responded that we had done all of them. They were all catalogued in the notebook that we had brought and given to Jonathan. Immediately, the notebook was located and the nephrologist could see what had been done and the results. His response was quite positive which was a relief for both Ann and I.
Lastly, Jonathan brought us a surgeon, Dr. Antonios Arvelakis, to make his examination. He had a charming personality and an accent. I immediately asked if he was Greek and he responded in the affirmative. I then described how I had competed in the famous, ancient marble stadium in Athens as a member of the Israeli national team. Also, I asked if he knew the Greek champions, Antonios Kounadis, the discus thrower, and Georgios Tsakanikas, the shot putter. I described how I had competed against these men and that they were far better athletes that I was. Dr. Arvelakis was excited and described that, as a young child, these athletes were among his heroes and that he knew them well. We continued to chat about people we both knew, such as Giorgos Dalaras, the singer-musician, and Melina Mercouri, the singer turned politician. The deliciousness of Greek food was roundly and enthusiastically proclaimed. It was an amazingly enjoyable conversation with the doctor and we were very pleased that he found me remarkably healthy in spite of the renal failure.

After the exam by Dr. Antonios Arvelakis, Ann and I looked at each other with a sense of relief. Maybe there was hope, after all. Jonathan came back to tell us that our day was complete but we had one missing test – a chest X-ray. He gave us the form and directions where to go downstairs to the hospital to complete my evaluation. He explained that it takes two weeks to process the blood tests and then the committee would meet to evaluate my case. We should expect to hear from them shortly after their meetings.

We thanked Jonathan for his help and left to go do the X-ray. As we were leaving the 11th Floor Kidney Transplant section, we met several of the Rabbis from Renewal. They kindly asked if everything had gone well and was there anything they could do to help us. We were amazed that only the day before, we had been strangers, and now they were at the hospital ready and willing to provide any assistance than we might need. We described our day so far and expressed our hopes that all would go well for placing me on the transplant list. Then, we thanked them for their help and made our way down to the Radiation Department.

After this long, but heartening day, I still had to go for dialysis. When I had completed the treatment at ten o’clock in the evening I think I felt the greatest exhaustion that I had ever experienced. We took a cab back to the hotel and I dragged myself back to the room. For the first time in my life, I agreed to let Ann order our dinner from room service! I have never wanted to eat in my hotel room, but I only had the energy to lie in the bed. It turned out that the food was truly delicious and I was surprised how much better I felt after finally getting some food in my stomach.

The next morning, Thanksgiving Day, we flew back to California. The following day, Friday, I was back in my chair on dialysis for the next round of being trampled by the herd of horses. At least I knew that we had tried and would have to wait patiently for a response from Mount Sinai Hospital.

I began work on the blog that Renewal had asked me to prepare. I sent the draft to Rabbi Josh who quickly responded with some suggested changes. I did as he asked and when he gave his final approval, I sent it out. Until this point in time, I had kept my condition a secret. I was embarrassed that, as a strong, vital, former Olympic athlete, I was such a physical disaster. The people at Renewal and the doctors at Mount Sinai had helped me understand that kidney failure is just a disease. Anyone can be sick at any time. This was a disease that can be helped with a transplant. It is not a cure, but it is possible to save a life and live a long and productive time with this help. However, if no one knows you need help, it is hard to find success. They explained that telling people the situation and asking for help is not a bad thing nor should it be seen as shameful or embarrassing. You are only asking for help, they all told me.

My own e-mail contacts were extensive since I had been a biomechanist, had presented at conferences, sold products, and had friends around the World. My e-mail list had nearly 10,000 contacts of my customers and friends. At this point I could only wait for a response.
One email that I received, shortly after I sent the blog was from one of my customers, Dr. James Hackney. In 2012, Dr. Hackney had downloaded our APAS system for use in his research at his university. At some point after that, Dr. Hackney sent me some interesting questions, as shown below:

Dear Dr. Ariel,

I hope that this message finds you doing well. I am in the process of revising a manuscript describing a study with which I used the APAS as the instrumentation for data collection, and I am embarrassed to admit that there are some issues regarding filtering which I am not sure that I can answer, despite reading some sources including MODIFIED SEGMENT LENGTH NORMALIZATION by Stivers K A. Wise J., Ariel G., Vorobiev A. G., and Probe J. D. (which I accessed through the Ariel Dynamics website).

One of my questions is very direct. In the filtering program, when one advances the display to the acceleration data curves and then applies a digital filter (with a low pass frequency cut-off of 10 Hz in my case), is one actually filtering the acceleration data, or filtering the displacement data and observing the changes resulting in the acceleration curves which result from the filtering of the displacement data?

The second question I have is actually from one of the reviewers. “What are the characteristics of digital filter, and what is equivalent cut-off frequency and decay rate in the displacement domain of the filter which was applied in the acceleration domain?” Could you please direct me to literature which answers the previous question regarding filtering in APAS?

Thank you so much for your generosity with your time and effort!

James Hackney PT, PhD
Department of Physical Therapy

We had exchanged similar e-mails during the intervening years. After I had sent the blog about my need for a living kidney donor, I received the most amazing e-mail from James:

Dear Gideon,

I actually would consider doing donating a kidney to you. Twelve or thirteen years ago, when I was a PhD student at University of Minnesota, and was considering doing it for a friend’s husband, and had my blood antigen matched. I don’t know if these records are still available, or would be helpful if they are. What is the first step I should take to see if I am a possible donor for you?

Best,
James Hackney PT, PhD
Department of Physical Therapy

Needless to say, I was shocked and joyful at the same time. My answer was immediate:

Dear Dr. Hackney:
Wow!!!! Thank you so much. I am speechless at your wonderful offer.
Please contact the organization who will help and guide you through the entire process. They are wonderful and kind people and will keep everything confidential. You can learn about Renewal and see them on their Web at:
www.renewal.org
Make sure you watch the video at:
http://www.life-renewal.org/
If you call or write to Renewal, please use my code: R1013. This identification code will enable the wonderful people at Renewal to know that someone is contacting them about Gideon Ariel. Thank you so much for your assistance in saving my life.

I made sure that James contacted Renewal and, although we had been in communication with each other for quite a number of years, I did not want to break Renewal’s strict rules. They had explained the rationale for maintaining distance and silence between of donors and recipients. Renewal had been actively involved in more than 100 kidney transplants in just two of the New York hospitals. Although their success rate was phenomenal, some donors changed their minds 24 hours prior to surgery. Therefore, rather than put undue pressure on the donors or cause anxiety in the recipients, Renewal kept them isolated from each other. They told me of instances when potential donors had changed their minds the day before the operation was scheduled. It was an infrequent occurrence but they felt better at keeping information private until the transplantation proceeded. This strategy eliminated the stress from donors and recipients.

Another individual with whom I was in contact on a regular basis was Lucia Tristao, whom I discussed in a previous chapter. When Ann and I had initially travelled to New York in November, we had shared lunch with Lucia, Bob Wainwright, and Jeremy Wise. During that luncheon, Lucia learned of my problem and said she was blood type “O” and was willing to be a donor. After thanking her profusely, I had given her the phone number for Renewal and explained how they worked. Lucia promised to call them. She had called me periodically to tell me about which tests she had taken and the kindness of the people at Renewal. When Renewal personnel told her not to talk to me, she explained that we had been friends for more than 30 years and it was hard not to speak to each other. However, the folks at Renewal were very emphatic about this point, so she kept most of her information to herself from that point.

Within two weeks, I received a call from Mount Sinai telling me that I had passed all of their blood tests and they had reviewed all of my previous test results and physician comments. At their committee meeting, they had readily agreed to place me on their transplant list. In addition, they were in the process of evaluating my donors. I was overjoyed to have been placed on their transplant list and surprised to learn that things were happening so quickly since my previous experiences were that everything proceeded at extremely slow speeds.

Later that same day, I had a call from my friend, Lucia Tristao. She was calling to let me know that she had passed all of her tests so far. She only had two more days of testing and then she would know whether she was qualified to give me one of her kidneys. Again, I was shocked at the speed which the various New York groups were moving in the transplantation process.

December rolled into January. My recipient coordinator, Eileen, called to say that several donors had been identified and things looked promising. She directed me to get clearance for surgery from my cardiologist. Ann and I jumped on this task and sent the positive results to Eileen a week later.

Eileen called to say everything was ready for the transplant and she hoped it would be scheduled for the middle of February. Ann and I were overjoyed but afraid to be too excited. There were so many things which could go wrong.
As things transpired, Renewal and the Mount Sinai Hospital staff determined that James Hackney would be the best candidate since he was 52 years old, the other donors were older. The situation was that James was teaching at the university and would not be available until April 1\textsuperscript{st}. For Ann and I, this was the longest month and a half in either of our lives. Days seemed to be 72 hours long rather than the short 24, but we could only wait and hope for the best.

Finally, the surgical date was set for April 14\textsuperscript{th}. I was instructed by Eileen to come to NYC on April 3\textsuperscript{rd}, have dialysis on April 4\textsuperscript{th}, and arrive at Mount Sinai at 9 o’clock on April 5\textsuperscript{th} for blood tests and examination by my surgeon.

Ann now began the enormous job of preparing for our trip. Not only did she have to arrange air travel to New York, housing, and dialysis for the time between April 3 and April 14, but she had to prepare for the three months that we would be living there following the transplant. She gathered clothes, shoes, soaps, and all of the other items that she was sure that we would need. You would have thought we were traveling to Outer Mongolia and would never see a store to purchase our supplies. Eventually, she packed eight boxes and shipped them to our friend Bob Wainwright in New Jersey since he could drive them up to us once we were in our “permanent” apartment.

Finally, the long anticipated day arrived and we flew to New York. By this time, my energy level was quite low so every physical activity seemed to sap everything out of me. Walking from the jetport gate to the luggage arrival site felt to me like I was climbing to the top of Mt. Everest. However, Ann was always there, cheering me on, and reminding me that we were arriving at my 3rd Olympic city for the games to begin soon.

I had the dialysis on Monday at a wonderfully friendly center located only 2 city blocks from our apartment. Ann had found a residential hotel so she could prepare our food. We had learned months before, that dialysis patients can rarely find proper food at restaurants. Therefore, Ann shopped carefully and prepared our food. She is a health nut and insists on purchasing organic fruits, vegetables, and meats. Also, she strives to provide as “heart healthy” diets as possible so we have quite a lot of fish as well.

On the morning of Tuesday, April 5\textsuperscript{th}, we arrived early at Mount Sinai for our appointments. Eager, excited, but afraid to be too optimistic would best describe our emotions. After the blood tests, which seemed to be so many vials I felt there would be nothing left in me, we were taken to the examination room to meet my surgeon.

The appointment was set for 9:30 am. We waited and waited and checked our watches and kept waiting. Finally, at 10:30 am, the door opened and someone we had never seen before walked in and sat down. He said that he was Dr. Arvelakis’ boss and that our surgeon was still operating on a patient so he hoped we would not mind if he performed the examination. We were shocked that the head of the department was taking his time to examine me. The doctor was Dr. Ron Shapiro and we chatted about his background and the circumstances that brought him to Mount Sinai. He reviewed my records and, at one point, looked at me quite quizzically, and said “Are you really 76 years old? Because you look better and fitter than I would have expected.” As Dr. Shapiro continued with the physical exam and record updating, we discussed what had brought us to New York. We described how two hospitals had turned me down solely due to my age and that the third hospital had not contacted us in 6 months. He looked me directly in the eyes and said “Any hospital that fails to perform a transplant on a recipient who has a living donor, is committing murder.” Dr. Shapiro told us that Mount Sinai had transplanted a patient the previous year.
who was 82 years old at the time and had not only survived, but was playing golf every day weather permitted. He concluded his examination and proclaimed me fit and healthy enough for the transplant.

We also discussed with Dr. Shapiro our concerns about finding a transplant nephrologist near our home in California. We asked if he would be able to recommend a hospital, staff, and transplant nephrologist, in Southern California where we could receive care. We told him that there was no way that it would be as good as Mount Sinai, but we needed help closer to our home. He promised to take care of this need before we were ready to return to California which would be some time in the next three months.

When we returned to our apartment, we read about Dr. Shapiro who is the head of the Transplant Center at Mount Sinai is Dr. Ron Shapiro.

Ron Shapiro, MD, is the new surgical director of the Kidney and Pancreas Transplant Program at Mount Sinai’s Recanati/Miller Transplantation Institute. Dr. Shapiro, a leading surgeon with more than 30 years of experience in the field of transplantation, trained at the University of Pittsburgh under Dr. Thomas E. Starzl, a transplant pioneer. Before coming to Mount Sinai, Dr. Shapiro was a Professor of Surgery at the University of Pittsburgh and the Robert J. Corry Chair in Transplantation Surgery at the Thomas E. Starzl Transplantation Institute. After 26 years with the University of Pittsburgh, Dr. Shapiro is leaving his endowed chair in Pittsburgh to return to The Icahn School of Medicine at Mount Sinai, where he completed his internship and residency.

In his new position at the Recanati/Miller Transplantation Institute, Dr. Shapiro will oversee the abdominal organ transplantation programs and services specific to adult and pediatric kidney transplantation, as well as adult pancreas transplantation. RMTI is among the most comprehensive transplantation centers in the world, and includes one of the largest living donor programs in the United States.

Dr. Shapiro has co-authored four books: Atlas of Organ Transplantation, Renal Transplantation, Pancreatic Transplantation and Living Donor Organ Transplantation.

Ann and I were amazed that such a gifted and obviously important staff member had examined me. Dr. Shapiro had even told us about the two transplants that he had performed over the weekend. In addition to his stellar skills and reputation in his medical field, he was kind and charming. He calmed our fears and apprehensions with his cherry smile and pleasant demeanor. Our spirits were lifted every time we met another staff member at Mount Sinai. Everyone we met was kind and sympathetic. Every experience from drawing the blood, having vital statistics measured, and interacting with the doctors was another lesson in caring and optimism.

We were pleased to learn from Dr. Shapiro that my surgeon was to be Dr. Arvelakis whom we had met during our first visit the previous November. We researched him and discovered that he had amazing credentials. Antonios Arvelakis, MD is a practicing Surgeon in New York, NY, specializing in Transplant Surgery. He currently practices at
Mount Sinai School of Medicine and is affiliated with MidState Medical Center, The Mount Sinai Medical Center and Yale-New Haven Hospital. Dr. Arvelakis also practices at Yale Transplant Surgery Department in New Haven, CT. In addition to English, Dr. Arvelakis’s practice supports these languages: French, Spanish, Arabic, Korean, Polish, Vietnamese, Russian, Italian and German. We knew he was an amazing surgeon and had been fun to talk with during our previous meeting, but we had no idea that he knew so many languages as well. We were sure that I was in good hands with Dr. Arvelakis as my surgeon.

At this point, we were waiting on pins and needles until April 14th. Our friend, Bob Wainwright, drove up from his home in New Jersey every other day just to see me. My friend, Lucia, walked across Central Park nearly every day to see if she could help in any way. It was gratifying to know that I had such good friends in my life.

On Saturday, April 9th, we moved from our apartment to the Mount Sinai Transplant Living Center (TLC). This facility is just a few blocks from the hospital and is designed for patients and family members to live in an environment that is more like a home rather than an impersonal or strange hotel room. My donor, James, would arrive the next day and we wanted to be there to greet him and assist in any way that we could or that he might need. He arrived about 6 pm so we all three enjoyed one of Ann’s home-cooked meals.

Renewal had made all of the arrangements for James, met him at the airport, and driven him to the TLV. Our room was in a different section of the TLC from James’ but we met every morning for breakfast. Our routine was quickly established. James would wake very early in the morning, buy a cup of coffee from the corner shop, and walk up to Central Park to enjoy the scenery. He would be back for breakfast and tell us where he planned to walk that afternoon. Other than his one day at the hospital, I think James walked at least 6 miles around the various boroughs of New York every day. Ann prepared dinner for all of us every evening during which we enjoyed interesting conversations about biomechanics. James’s field is Physical Therapy so his biomechanical applications were different from those I had done in sports. We soon discovered that he was extremely knowledgeable in so many related areas so our evenings were lively and informative.

We eagerly waited for James’s wife, Polly to arrive on Monday. James decided to surprise her and meet her at the airport. I was relieved that he decided NOT to walk all the way to LaGuardia to meet her. We were instant friends when Polly arrived. She took off her coat, kicked off her shoes, and was happy to enjoy some of the vegetable beef soup that Ann had made for all of us. We became great friends during those days that we spent together before and after the surgery.

Another family at the TLC were the Crepis. The father, Paul, had received a kidney from his son, Andrew, on Tuesday before we arrived on Saturday. Paul and Andrew had been discharged on the same
day that Ann and I had arrived. It was extremely helpful for Ann to meet the patient and his donor since it was “on-the-job” training for her. Paul’s wife, Beverly, was a fountain of useful hints, details about medicines, and the many other aspects that transplant patients experience.

By Tuesday, Ann, Polly, and Bev had become like sorority sisters with so many newly shared experiences. They helped each other with all manner of things such as where to get double extra-large pajama bottoms. Neither Ann nor Polly had realized that post-transplant patients are full of gas and have unnaturally distended abdomens. Normal pants cannot close so they were off to the store to find these sizes. One night, I arranged for my friend, Lucia, to accompany Polly to a Broadway play and we promised to be good “baby sitters” for James. We were all happy and, perhaps a little apprehensive, but finally Thursday arrived.

Two men from Renewal came to the TLC at 5 o’clock in the morning to take us to the hospital. They guided us to the reception desk, waited with us until it was time to go to the preparation room. With so much experience, they knew exactly where to go and guided us at every turn. When the time came for James and I to take the elevator to the operating floor, the Renewal gentlemen took Ann and Polly to the appropriate waiting room. After they had been sure that the two wives were settled and secure, they explained that they needed to leave them in order to check on two patients at a different hospital.

While our wives were waiting for James and I, the procedures for a kidney transplant began. The activities are actually two separate operations: one for the donor and the second for the recipient. These operations are actual very complex and require a team of medical professionals and, of course, a kidney. The process of kidney transplantation is a precise sequence between donor and recipient. James’ surgery began first. He was anesthetized and his left kidney was surgically removed by his surgeon, Dr. Chin. After the kidney had been deemed healthy, it was prepared for transplantation. As soon as my doctors were advised that my “new” kidney was coming, my transplant surgeon, Dr. Arvelakis, made an incision on my lower, right abdomen just above the groin.

As soon as James’ kidney arrived, Dr. Arvelakis connected it to my vessels and reported that my “new” kidney began working immediately. He then placed it in the lower abdomen. My “new” kidney's blood vessels were connected to my iliac artery and vein. He then connected the ureter to the bladder.

After the surgery, I was taken to the recovery care unit where I was monitored by medical personnel until the anesthesia wears off and I woke up. During the recovery period I had been told about some things that I could expect: some pain; an ultrasound procedure to verify that the new kidney was functioning correctly; and a catheter to drain urine from the bladder would have been inserted but would be removed as soon as possible. One important reason for the catheter was so that the urine could be monitored for color and quantity.

About 9 hours after she had seen me get into the elevator with James to go to the operating room, Ann was called to the waiting room desk to meet Dr. Arvelakis. He described how well the surgery had gone and that my new kidney was functioning perfectly. He told her that I would soon be sent to the recovery room, have an ultrasound to make sure that the new kidney was functioning correctly, and that after about four hours I would be transferred to a normal patient hospital room. He then asked her if she had any questions. Ann later told me that she was so happy and relieved that, probably for the first time in her life, she was speechless. “Numb” was how she described herself. Finally, she was able to ask if I was alright and Dr. Arvelakis assured her that I was perfectly fine. He said she could go up to recovery in about half an hour and see for herself.

Of course, I was unaware of all of these activities. I remember riding the elevator up to the operating room floor. James and I parted with thumbs up and I was taken to a preparation room. The staff had me lie on a bed where they proceeded with all of the regular pre-surgical activities. My abdomen was shaved and “painted” orange. The nurse inserted an IV in my arm while the anesthesiologist told me what he was going to do and when. Dr. Arvelakis came to tell me that James’ surgery was proceeding
nicely and that my operation would begin soon. He also smiled and told me not to worry because everything would be fine. The last thing I remember was being wheeled into the operating room as I dozed off.

I do not remember anything else until I awoke in the recovery room. When I woke up, I felt no pain and asked the nurse had everything gone well and did I have a new kidney? She assured me that everything was perfect and that my new kidney was producing quite a lot of urine. Since the nurse was emptying and measuring the urine output, she showed me the full container. I had not seen that amount of urine from my body for years and was ecstatic to know that James’ kidney was working so well for me!

At that point, I saw Ann and I greeted her by asking “Who are you?” Every time that I had been anesthetized, I had asked her the same question so she was appreciative of the joke since she knew I was awake and aware. Ann stayed by my side for the next four hours before I was transferred out of the recovery room to my hospital bed.

I was unaware of my hilarious behavior which Ann has laughed about every time she has described the situation. I certainly do not remember pressing the “pain medication” button but apparently I pushed it frequently. This contributed to my not having pain but added an extra dimension to my jokes. Ann told me that I asked the nurse to have dinner with me as soon as I got out of the recovery room (Ann assured me that the nurse agreed with every one of my proposals!). I continually told my other nurse that his country produced great sportsmen and women but I named his country Russia, Ukranine, Georgia, and several others but he was not actually from any of them.

One of the Renewal gentlemen visited later in the evening. Ann said he listened attentively as I babbled about my father traveling from Poland to Israel in 1917; how my grandparents had lived in Jerusalem; what I had done as a child; how I had come to America. It seems that I talked at great length while he nodded and smiled in agreement. I have absolutely no recollection of this conversation, but Ann told me that it was something unusual, to say the least.

Finally, about 8 o’clock in the evening, they wheeled me up to my hospital room. I shared my room with another transplant patient. James’ room was next door to mine. Donors are given private rooms to reflect their honored status as life givers. Ann checked on Polly and James. James was sitting up and eating his dinner while Polly beamed at his side. All was well with both of them which was a great relief to us.

Ann helped me eat the jello and other bland things that arrived on the meal tray. I was astonished that I could eat and was even more surprised that I ate everything in front of me. That was a phenomenon that pre-dated dialysis. Ann stayed with me until 10 o’clock and reluctantly left so she could have some dinner and sleep.

When Ann arrived the next morning, I was having breakfast. She had brought my camera to take my picture and it is shown on the left. For the first time in years, my skin actually had
color as opposed to my previous pale white completion. My hemoglobin level had been 8 the night before, but my morning, it was higher so I had not needed a transfusion. My appetite was good so I ate nearly everything they sent on the tray. My blood levels were excellent. In the afternoon, I was able to get out of bed and walk around.

My first walk was to go next door to see James. He had been walking around earlier with his wife and was now resting. We were both happy to see each other and that everything had gone so well. I told him what a fantastic kidney he had given me and he said it was an “industrial strength” model.

Ann and I had discussed for several months what we could do to thank someone who saved your life. Money was not the answer because, as James had said, he had given me a kidney not sold me one. So what could we possibly do to say thank you for such a profound and lifesaving gift. Finally, we decided that education for his sons would be a way.

We sat in James’ hospital room and described our idea of saying thanks. We would pay for the college education for his sons at any school they wanted. The parents and boys would make the choices, they would guide them as parents do, and we would provide all of the resources that would be needed including travel and living expenses. Both James and Polly were overwhelmed but agreed at last.

We left their room and continued my walk. Since it did not seem prudent to overdue the first exercise day, we returned to my room. This schedule continued for three more days and then I was discharged.

The discharge was conducted by Dr. Rafael Khaim who sat with us as he patiently explained the procedures that we had to follow every day. We were thoroughly instructed which medicine to take, how much, and when. These routines were specific and there could be no deviations or exceptions. The medicine had to be administered on time, every time. Any deviation could result in the kidney being “discovered” by the immune system. Should that occur, the normal body immune response would seek out and destroy my “new” kidney since it would be perceived as a foreign invader which needed to be annihilated. Dr. Khaim was kind and gentle in his approach. Everything was now in our hands and the details could be extensive and overwhelming, but Dr. Khaim assured us that it would be straightforward and we would have no trouble following the directions. However, he told us to call him at any time, night or day, if we needed his help.

We promised to follow the rules precisely and Ann, ever the detail person, made copious notes. We left the hospital with an enormous bag of medication. We returned to the TLC and were greeted with cheers and congratulations by the staff and current residents. Although I felt good, I was quite tired, so I immediately went to our room to take a nap.
Alyson was the young woman administrator at the TLC. She had Lupus, which had damaged her own kidney, and she had received her transplant about nine years earlier. She was still at the Center when I arrived and joined the group in welcoming me “home”. Alyson had worked hard to help all of the donors, recipients and their families, to have a peaceful, calm, home-like atmosphere.

Alyson also gave us an excellent suggestion which was to have alarms set on our cell phones which would alert us at the two times each day that I had to take my medicines. What a fantastically helpful hint that was and one which we continue using. No matter where we are, what we are doing, when those alarms sound, there is no delay in taking the pills. We have been watching a movie, in the doctor’s office, and riding in a cab when the alarms have gone off. Ann always carried the medicine and some water to wash them down. We are meticulous about the schedule and hope it will serve us well.

Everyone settled into the recovery mode at the TLC. James was incredibly healthy and begun his walks around New York shortly after his discharge from the hospital. It seemed that Central Park was his favorite place since he made many trips up there to walk around, eat from the food trucks, and sit to watch the people. Polly went with him and, fortunately, they had lovely weather for their weekend strolls. Polly had to return to Missouri on Tuesday, but James would be staying until Friday since he had to be seen and released by his own transplant surgeon.

Ann was our “administrator”. She arranged for James to have his granola for his early morning jaunts. She took care of me and fixed dinner for all of us each evening. We were supposed to take care of James but he was well beyond the need for our care. We mostly enjoyed meals and conversations together each day.

At this point, the plan was for James to see his surgeon on Thursday and fly back to Missouri early Friday morning. I realized that Friday night was the evening that we celebrate the Jewish holiday of Passover with the meal known as the “Seder”. I wanted James to share this Seder with us but we could not change his trip schedule.

I decided that we would celebrate the Seder on the 21st, in the evening since it would be the 22nd in Israel. This was really a challenge. Usually, Seder plans are weeks in the making: cleaning the house, shopping for and preparing things in advance, setting the table, and cooking. We had two days of which we had to cram two weeks of work. I contacted the people at Renewal for their help. Ann was able to buy all of the food necessary but we were missing a few item. We had to have the Haggadah which is read by everyone during the Seder. “Seder” means “order” and the Haggadah presents the entire evening sequence of events of prayers, readings, and instructions “in order”. We had to have this for things to go smoothly. We had also invited Lucia to join us and, as it turned out, she had a white tablecloth which we could use for the holiday meal.

The Seder table

The Matzot with James in the background
The wonderful people at Renewal were able to bring copies of the Haggadah, a pre-made Seder plate, yamakahs for the men, and the gefilte fish. Now, we had all of the basic requirements for our Seder.

We had fun spending our Passover Seder with two dear friends. The next morning, we arose at 5 o’clock to say our thanks and safe trip to James. We obviously would stay in contact since we now shared our DNA with each other.

Later on Friday, Bob Wainwright drove up with his big SVU to help us move to our new apartment at the Bristol Plaza. Our apartment was quite spacious with a large living room, dining area, fully equipped kitchen, huge bedroom, 1 and ½ bathrooms, and extensive storage spaces. Another handy advantage was daily maid service to change all of the linens and clean the kitchen.

When we arrived, I realized that I was tired which reminded me that it was just over a week since I had undergone major surgery. However, with the help of the hotel staff, Ann and Bob were able to move everything into our apartment.

Now, Ann and I could live more normally than we had in some time. We settled into a steady routine. There was a full laundry facility just outside our door so Ann could keep everything clean since cleanliness was an important factor in maintaining the health of kidney transplant patients. She could shop daily at several local stores and acquire fresh organic fruits, vegetables, as well as meats and fish. The doctors had impressed upon us that we needed to avoid crowds, that I should not shake hands or kiss people, and focus on germ-free living. Therefore, Ann prepared all of our food for each meal.

Initially, I was still prohibited from eating some of the same foods that had been part of the dialysis diet. However, within a few weeks, my kidney was able to process everything. Imagine my joy the day Ann gave me orange juice which she had just squeezed and a banana. I had not been able to enjoy these for nearly two years.

Our routine included going to the hospital twice every week for blood tests and seeing the physicians. Blood was drawn as soon as we arrived at the hospital since the doctors needed to know the blood levels before I took the next dosage of drugs. Afterwards, I could take my medicine when our telephone alarms sounded. Frequently, these alarms would go off in the middle of a physician’s exam. But they were unperturbed and, in addition, pleased that we were so responsibly compliant with the taking the medicine exactly on time. Each week I was able to meet members of the fantastic medical staff. My first visit after surgery was with Dr. Arvelakis.

When Dr. Arvelakis entered the room, he seemed to bring the sunshine with him. He exudes such happiness with his happy demeanor that you find yourself smiling. I was wearing one of my normal animal T-shirts since that is what Ann selected for me to wear, and the first thing Dr. Arvelakis mentioned
was the lion on my chest. This launched the
conversation into animals and pets and how
much all of us loved animals. Dr. Arvelakis
told us about his boxer and how obsessed he is
with her so Ann asked, since he had a cell
phone, did he have any pictures. Oh my
goodness, his entire phone is full of pictures of
his adorable dog, from puppyhood up until the
day before.

After we had finished with our animal
discussion, Dr. Arvelakis examined me and
answered all of our questions. The incision site
looked good and he pronounced me in good
health. He reiterated the instructions not to do
abdominal exercises, but walking, walking on
the treadmill, and carefully controlled resistive
weight lifting was approved.

On the cab ride back to our apartment, we were again discussing the excellence in quality and
caring staff members at Mount Sinai Hospital. It seemed to be the focus of our conversations each and
every time we interacted with someone there.

This was our New York routine for the next month and a half. Mondays and Thursdays we went
to the hospital for blood tests and to see a doctor. Each week, I was examined by a different physician,
either Dr. Arvelakis or my transplant nephrologist, Dr. Delaney.

Dr. Delaney had first visited me when I was still in the
hospital. Now she examined me every other week, alternating
with Dr. Arvelakis. Dr. Delaney had been educated in London
receiving both MD and Ph.D. degrees and had additional studies
and training at Montefiore Hospital in New York. Not only was
she smart and personable, but she had a charming Irish accent.
She was very thorough in her examinations but Ann and I
sometimes forgot to listen to the details since we would be caught
up in her lilting accent.

Every day, we exercised and I was surprised to see and feel
the improvement in my strength levels so soon after we had begun
this daily routine. I had a nice long nap every afternoon. We
watched movies on our system every night after dinner. Our
friends, Bob Wainwright, Lucia Tristao, and Jeremy Wise, would
frequently visit which helped the recovery process.

The gentlemen from Renewal also visited quite often now
that the transplantation had occurred. Prior to that, they had
maintained distance since there should be no contact between
recipient and donor prior to the transplant. Now they called and regularly visited to inquire about my
health and to see if they could do anything to help us. As time passed, we realized what an amazing,
generous, and caring group of people they all are. Their focus is to find kidneys for people who need
them and make sure that the transplants happen.

The more we learned about the thinking and actions of Renewal, the more we came to appreciate
the devotion and dedication that these people have for individuals in need. They were always positive
and happy in their demeanors and did everything to help with the mundane details of life, such as making sure the donor and his or her family were supported in every way. For example, relieving the anxiety of getting to the hospital on time for surgery, guiding us step-by-step through the initial in-take procedures, and staying with us until the last moment provided a sense of comfort and reduced the fears and trepidations that can accompany pre-surgical events. After the surgeries, they provided many additional tasks to help the donor and his wife through all of the steps of recovery. They visited him in the hospital every day, picked up James and his wife when he was discharged from the hospital and drove them to the TLC. They made sure that they had food and offered to assist in any way that would hasten and enhance his recovery.

Now that the transplant had taken place and James had returned to Missouri, they continued to give attention to me and our needs. Since there were no more impediments to discussing financial matters, I asked David Schischa whether we could reimburse them for all of the expenses they had made in supporting James and his wife. His answer, surprisingly, was “no”. All of their finances are covered with donations since they are a tax-exempt philanthropic organization. David explained that all costs of the actual procedure are covered by the recipient’s insurance. Transportation for the testing, if needed, is taken care of by Renewal as is food, lodging for a family member wishing to be with the donor during the hospital stay. Renewal’s goal is to assist each and every patient and donor with any help and support they may need. He further explained that all of the testing, housing, and transportation for each donor costs Renewal approximately $20,000.00. They raise monies to pay for this kidney donor through donations to Renewal.

My question was what their largest donation was? David described how a family had pooled their money and give $300,000.00. Ann and I had already discussed the subject, so I told David that we wanted to give $100,000.00 which would help five other people to live a new life like I was. Needless to say, this donation was accepted by Renewal as you can see in the photograph below:

The people from Renewal became regular visitors to our apartment. In early May, they asked if I could give a presentation at one of their fund-raising events, which I quickly and willingly agreed to do. Ann and I arrived at the site and saw approximately 75 people chatting. A.J. Gindi was conducting this particular fund-raising event. He had told us previously, that he had donated his kidney several years before and that life-saving event became his inspiration to try to help other people receive transplants. A.J. introduced me to the group and I explained my situation from kidney failure to transplantation. I told them that as a recipient, I had given $100,000.00 to help Renewal give life to other patients in need and that every individual in the room had to give money to help others. My plea must have been persuasive since they raised $250,000.00 that evening.

I was happy to receive the following letter from A.J. Gindi on behalf of Renewal:
Dear Friend of Renewal,  
Kidney Transplant NOW  
Please pray for:  

Donor: Avigayil Mechsa bat Batya Itta  
Recipient: Mordechai David ben Aliza Freida  

Today’s donor, Avigayil, decided to donate her kidney immediately when her husband the recipient found out he would need a kidney transplant. Because of her selflessness Mordechai will B’H not need to undergo dialysis as most kidney transplant recipients need to until they find a donor. He surely will be indebted to his wife for the rest of his life.

Today’s Transplant is dedicated to the speedy Recovery of Gideon Ariel. Gideon Received his new lease on life last month with his Kidney Transplant. Gideon is Renewal’s first former Olympian to receive a kidney. He played in the 1960 & 1964 Olympics on the Israeli team.

B’”H, kidney transplants have a great success rate. However, there needs to be Siyata Dishmaya that they be successful. Please take a moment to say tehillim for the success of the transplant.

Thank you,  
A.J. Gindi  
Community Advocate  
Renewal

The day before we left to return to California, some of the Renewal members came to say good bye and good health. While we were chatting, Mechachen Friedman told me that I had at least five additional donors in addition to the ones we knew. We knew about Lucia and Ann’s brother, Marshall, but there were others as well. Although we did not know these people, we were grateful that they had been willing to help save my life. Before they left at the end of the visit, we took the photograph shown in the previous page.
In the time after my transplant, my normal weekly routine continued. The sequence for kidney transplant patients is blood tests and physician exams twice a week for the first month. The second month, these tests are reduced to once a week. The third month, testing is done every other week. On testing days, Ann and I would try to go outside in the beautiful sunny May days each time we went to Mount Sinai. We tried to go outside when the weather was sunny and warm, but several times, we enjoyed museums instead. Although my stamina was improving, it was still limited so these excursions tended to be short.

Outside in Central Park

One day in May, Drs. Delaney and Arvelakis informed me that I could go home to California. My health, the kidney, all the blood work indicated that I was ready to return to my own home to continue the recovery process. I knew that Ann was worried that it was too soon for me to leave Mount Sinai, but I wanted to go home. It was such a strong urge, that Ann relented and began the process of moving.

Since I knew that we were leaving the excellent care of Mount Sinai, I sent an e-mail to Dr. Ron Shapiro to ask about where he suggested we go for care once we returned to California. Since I had only met Dr. Shapiro one time, and that was nearly two months ago, I was not sure whether he would even remember me. I was surprised to receive an answer to my e-mail within 2 hours as follows:

Shapiro, Ron (Transplant)
To: Gideon, Rafael

Dear Dr. Ariel,

This is already organized. Cedars has agreed to follow you—I got this sorted out either just prior or just after your transplant. Rafael will explain it all before you leave New York.

Ann and I could not believe it. It had happened again; the most unbelievable attention from caring people and this was the head of the transplant department. He had so many things to do that were so important and life-saving, but he had taken personal time and effort to respond to me. We were and had remained in awe at the fantastic people at this hospital.

Our trip back to California was the same process, in reverse, as traveling to New York City. This time, I was so much healthier. Ann packed boxes for shipping, cleaned all of our things out of the apartment, arranged for air and ground transportation, and all the other things involved with moving home. My job was electronics and, at Ann’s instances, taking care of myself and not to overdo anything. I had to organize our computers, movie system, the new printer we had acquired, and the numerous
collection of wires and connectors. Ann had an entire box just for these things. She made sure that one of the jobs was taking a long nap in the afternoon.

My last examination at Mount Sinai for blood tests and the last doctor exam included a meeting with Dr. Rafael Khaim.

Dr. Khaim is the clinical operations manager for the kidney and pancreas transplants. He had been the one who discharged me from the hospital and now he needed to explain all of the details of life in California vis a vis my new kidney. He explained that my care had been arranged through personal contacts between Dr. Ron Shapiro and his colleague, Dr. Stanley Jordan, at Cedars Sinai Hospital in Los Angeles. These two doctors were old friends and had on-going research studies together. Dr. Khaim had contacted and arranged for my care to be transferred to Cedars Sinai and had transmitted all of the necessary records regarding my surgery and post-surgical care.

Dr. Khaim gave us a large notebook with all of the necessary data we might need at Cedars Sinai as well as contact information. He was able to answer all of Ann’s questions and calmer her with assurances that we could contact him if there were any problems. We were sad to leave Mount Sinai, but we were happy to be going home. We thanked Dr. Khaim profusely for the help and kindness he had shown us.

Finally, May 21st was our departure day from New York City. What a fantastic day it was to be traveling home with my “industrial strength” kidney and a new lease on life. I had spent only forty-nine days in New York City, but had evolved from a horrible existence in renal failure to a healthy promising future of good health. It was more than a dream come true. I truly had won a Gold Medal at my Third Olympics.

Now that I have a healthy, properly functioning kidney, I have asked myself what have I learned from this experience. There are three categories of thought: my own individual health experiences, the medical professionals I encountered, and advice for other people with kidney disease.

In retrospect, I realize the many mistakes and missteps I made between the first evidence of kidney failure and the transplant. I was informed at the beginning, that transplantation was better than dialysis. For this reason, Ann immediately contacted the suggested hospital, UCSD, and made an appointment for us to attend the initial, mandatory class. This class is required before they would begin the testing to determine whether or not I would be accepted as a transplant candidate. At the end of the two-hour class, Ann had raised her hand and asked whether age was a factor. The answer had been that they have no age restriction.

We proceeded under the assumption that, other than failing kidneys, I was in good health and would be approved for transplantation. To that end, I had the “green light” laser surgery to ensure that my new kidney would have no back pressure from an enlarged prostate. I had a colonoscopy to verify that there was no cancer. I had numerous other medical examinations during the nearly six months while we waited for my being placed on the “list”. It was, therefore, a crushing event when I was rejected in November due to my age. They knew my age in June and they could have told me at that time that I should consider looking for alternative transplant hospitals. This process of being accepted by a hospital, spending six months of testing and waiting, and then being rejected due to age was repeated three times before we traveled to New York and received a kidney.

What I understand now, and wish I had learned this at the beginning rather than at the end of the process, is the importance of finding the right hospital at the beginning. If the hospital does not provide timely information about you and your current status, if they are not forthcoming about your prospects
for transplantation, then keep looking until you find a hospital that will. It is your life. Do not let a hospital delay the process and steal time from your life. Ask at the beginning and keep the pressure on them. You are your only advocate.

In retrospect, I believe that I started dialysis too early. I certainly did not feel good when my creatinine reached 6. I started the procedure with peritoneal dialysis but soon learned that it did not provide the freedom of life that had been promised. I was unable to sleep, I always felt so full of liquid that it was difficult to eat, and then I acquired a potentially deadly fungal infection. Hemodialysis was equally horrifying. Not only was it time consuming, but I felt terrible all day and night. It kept me alive, but there were many days that life did not seem worth living.

I believe, however, if I had found a hospital like Mount Sinai, which approached the situation with a sense of urgency, I might have been able to skip the agony of dialysis or delay the onset. The message here is waiting as long as you can before you begin dialysis. If you have found the right hospital and the best staff, they will help you with this decision.

Another mistake was that I did not recognize nor accept kidney failure as just a disease. I was ashamed and embarrassed to ask for help. This was a dreadful mistake. I should have begun actively and with real urgency looking for a living donor. If you are in this situation, you must aggressively search for a donor. You might need more than one potential donor since frequently donors and recipients have incompatibilities of blood types, antigens, or other things. Keep looking. Make sure your hospital processes your potential donors quickly. Never forget that this is your life and you must maintain as much pressure as you can to save it. If you have found the right hospital and doctors, they will be as involved and concerned as you are; they want to give your life as much as you want to have it.

Another mistake we made was not realizing the need to aggressively search for living donors. In general, a kidney from a living donor is healthier and will last longer than one from a cadaver. There are wonderful, generous people who are willing to help you. Sometimes, you just have to ask. That was how I was able to find my wonderful donor, James. I asked for help. Do not stop asking; send blogs; put up posters in coffee shops or company notice boards; spread the word. Do not be shy about asking for help. Remember, it is your life you are saving.

Be sure that the potential donors are connected with your transplant hospital or support group. Since distance is to be maintained between donor and recipient, find a way to keep checking on the progress in identifying a donor match. This step will be quite difficult because of the separation between donors and recipients but it is the most important aspect. You must have a donor and I suspect that the expression “the squeaky wheel gets the oil” is probably appropriate in this area as well.

Between the discovery of kidney failure and transplantation are a giant, dark maze of mystery, lost time, and ignorance. Even when you acquire copies of your own medical history, it is virtually impossible to know what the doctors and the hospitals are actually thinking about your individual situation. The desperate recipient is kept in the dark about the chance of transplantation. Even if living donors are being processed on your behalf, you are not allowed to learn anything about their progress or failure. The recipient is kept in the dark at each and every step.

While we were in New York, we met another recipient who had spent the previous two years as I had……waiting in vain. He had a living donor but one month before his transplant at a hospital in Connecticut, his doctor detected a spot on one of his kidneys. He was told that the kidney would have to be removed and he would have to wait two years before he could be transplanted. However, since he was 68 years old, two years later would put him over their limit of 70 years for transplantation. He asked what this meant for him. The answer was that he was going to die. The end of the story for this man is much happier. He contacted a doctor at Mount Sinai. His kidney was removed, found not to be malignant, and he received a kidney from his living donor the following month at Mount Sinai Hospital.
Ann and I spent two miserable years stumbling around making one mistake after another. But my wife would not give up. Every patient with a kidney problem must have someone to help them in their struggle. You must have someone who will encourage you; search, dig, question, harass, and never quit. You feel terrible every day but you must have an ally who feels better and can continue to search on your behalf.

We compliantly waited for the system to work for us. The system failed us until we found Mount Sinai and Renewal. These two organizations believe in life and work to give each person, donor and recipient, the ability to live. Without them, I probably would not be here today.

Keep trying. Search relentlessly for donors. There are wonderful people out there who will selflessly, lovingly, give you a kidney. Keep looking for them. Find a hospital that is committed to saving your life not just extending it with tests and exams. Keep looking for that institution and those doctors that are committed to you; they are out there. Never go outside of the legal system. There are legal ways to find a kidney, but you have to keep looking for one.

Never, never, never give up.

So, this is the end of the amazing story that revived my life from the horrible existence of dialysis and renal failure. I am recovering my health and my life. I hope to be able to travel again with my loving wife, Ann. I would never have made it without her. She never gave up for one moment and always encouraged me. How lucky I was to find the amazing organization, Renewal, and the best hospital and doctors in the world, Mount Sinai in New York City. Most of all, I owe my life to Dr. James Hackney. James gave me, very nearly a complete stranger, one of his kidney. He gave me life just because I asked him for help and he believed that he must help people. I still cannot believe that such a saintly person actually exists in this world, but James does. Every morning when I wake up, in good health, I appreciate and thank this wonderful man for giving me life. I am so happy to be alive; I owe my life and happiness to James Hackney.
Chapter 22: Now and Forever

This is the end of the book but not the end of anything else. Ann and I continue to study, travel, and enjoy our life. We continue selling our APAS system around the world. I spend countless hours on the phone helping customers understand how to implement and operate their newly acquired software. Our CES has undergone a revision and been readily received by its new customers.

I could retire, I suppose, but sitting around watching television and failing to contribute or learn things does not appeal to me. I continue with my inventions since my life has always been about exploring opportunities. My technologies, unlike so many other technologies, have not become outdated. As long as there are muscles, bones, ligaments that need to be studied, whether for athletic purposes, health reasons, product testing, or other reasons, my technology can be applied.

It may seem odd that a man who grew up running in bare feet in a land of the ancient Middle East should end up in California able to provide shoes which he designed. I was a man who discovered a fascinating technique to study the body through biomechanical analyses and was able to build a career with it. Biomechanics allowed me to create endless products that helped people win awards and Olympic medals, become stronger, and some things that created the ability to simply enjoy lives more than they had previously. These successes came from creating real things that had once only been in my imagination.

What simulated this drive? I am sure much of it was to prove to my father that I was worthwhile. Most certainly it started that way but as time passed my imagination and goals became a pathway to help people. An inner knowledge, born out of my experiences at Hadassim, that if you try, work, struggle where necessary, you can be successful and achieve more than you had expected. Once I had an idea, I acted on it, from creating a variable resistance exercise machine or going to see the president of Data General without an appointment to persuade him to provide free computers to America’s Olympic athletes at the Colorado Springs Training Center. Never did I see myself as lying on my deathbed thinking, I wish I had done that.
I had my dreams as a child: The Olympics. A Cadillac in America. A Ph.D. These I accomplished because I first envisioned them and was willing to work to achieve them. I had to have had some kind of a dream when I took a plane and found myself in Wyoming which was a place that I had never known about nor had any idea where to find. I could not even locate Wyoming on a map before I arrived there.

I had a dream, after seeing what the East Germans were providing for their athletes, of starting an Olympic Training Centers in Colorado Springs. This dream led me to the Chairman of the Olympic Committee, Colonel Miller, and to Data General and other companies to make the Center a reality. I strove to make my dreams tangible and so they were.

I learned how to incorporate people into helping and how to select the proper people for the task at hand. Ann has been my love and in business and in life. Jeremy Wise, Irving Dardik, Vic Braden, William Morrisroe, Victor Palmieri, Michael Greenisen, John Probe, and so many others have contributed to my personal and professional life.

But my work was not an odious job that had to be suffered and tolerated to earn a salary. My work was my passion. It was the most fun and exciting part of every day. My work was enjoyment, a challenging experience which consumed me every day.

My work efforts were in the arenas that held meaning for me. I loved being at the Olympics, and I found work that returned me to the Olympics time after time. I loved athletics, and I found work that allowed me to live with athletes and coaches. This love of athletes and movements focused my interests in the study of the mechanics of the body and the games. My interest and study of biomechanics grew from this passion. My “business” emerged from this interest.

The moment I saw Coto de Caza, I fell in love with the place, and I imagined having a laboratory there. I worked to make that imagination become reality. Of course, there was some luck involved, but there was also an opportunity. My talents were real, and the people behind Coto de Caza recognized this, and another of my dreams came true.

This book tells my story, but it also tells a story of how to live a life that is full and rich and wild with imagination. How can someone live a life which is exciting, fascinating, and fulfilling? The answer is to work towards what you dream of wanting to do. You must want something with all your heart and mind and then work hard to make it happen. Never give up on yourself and never say “No” to your dream. Always remind yourself that I WILL do it, and I CAN do it. The famous Irish poet, Samuel Beckett, said:


This sentiment was one that I lived without knowing that Mr. Beckett had expressed this sentiment. I first learned this quote when I saw it tattooed on the arm of the tennis player, Stan Wawrinka. Mr. Wawrinka was quoted in The Guardian newspaper as saying:

“It’s how I see life and tennis. The meaning of the quote doesn’t change no matter how well you do. There is always a disappointment, heartache. You are losing almost every tournament. You need to just accept it and be positive because you are going to lose and fail.”

Mr. Wawrinka’s struggle to succeed in his chosen profession was as compelling as mine has been. I had been told that I was not good enough for the Olympics, that a computerized exercise machine was too expensive, that I could not do something that I envisioned because it had never been done. These obstacles were never seen as barriers to me but rather as my next challenge. I always tried again, tried harder, never gave up.
I believe that life must be full, and the joy is to live it to the fullest. With learning, with doing, with beauty, with risk, with love. In this book, each chapter has shown how life came to meet me and how I responded to each challenge.

Throughout my life, I have had people to guide and help me. I did not do everything by myself. The teachers at Hadassim, the people of Wyoming, my wife, Ann, were all major contributors to my growth, successes, and confidence. Few people, if any, can become successful without dreams and encouragement.

A few months ago, I almost died from renal failure. Ann encouraged me to seek a kidney transplant despite the difficulty of my age which was 75, at that time. As was presented in a previous chapter, receiving a kidney transplant at my age had initially seemed almost impossible to achieve. But to be able to compete in the Olympic had also seemed to be an impossibility. Yet because I worked hard and never stopped trying, I was able to compete twice, in 1960 and 1964. When my kidneys failed, Ann explained that I was training for the most important “Olympics” of my life which was to get a kidney. She told me, “we will get your “Olympic Gold Medal.” As you read the story previously in the book about the “Kidney Connection,” I did get my “Gold Medal.” I have a transplanted kidney from an amazing donor, so now I have the most valuable “Gold Medal” of life.

Another extremely important aspect of our life is study and education. Ann and I are not only involved with our business. Learning is an essential component for each of us. We have never stopped studying. We have several avenues that we pursue to acquire knowledge: travel, on-line studies, and DVD courses.

We have participated in many trips with Stanford Travel Service, Smithsonian, and National Geographic. With the excellent guidance and instructors from Stanford University, we explored Vietnam and Angkor Wat in Cambodia, participated in two music courses in Italy, and traveled to Patagonia to see the farthest points of the Americas. We sailed from Copenhagen, Denmark to St. Petersburg, Russia along the “historical waterways of the Baltic” with guidance from the Smithsonian. On this trip, we met Lech Walesa, Polish Politician, and leader of the labor union as well as the former Premier of the Soviet Union, Mikhail Gorbachev.

We traveled to Peru and climbed to the top of Machu Picchu with National Geographic and from there we explored a section of the Amazon River region. We always select trips which incorporate learning with lectures on the ship as well as guided excursions to sites ashore. We are only interested in trips which focus on education.

Most of the on-line courses were scientific or math-based classes. Many universities and colleges provide videos of each lecture for a particular course. For example, I recently “took” a course on “mechanics.” The most amazing part of the course for me was that the professor cared more about the students actually mastering the subject matter than he did about the grades they would receive. He explained that this course was the basic knowledge that the students would need for the remainder of their college courses. Therefore, it was imperative that they master each topic presented. This sentiment reflects my own opinion about school and education. You must learn it for yourself and not for the grade. If you do not make the material “yours” in your head and part of your understanding, you are only cheating yourself. A bad grade might disappoint parents or the teacher, but the person who suffers the most is the student.

Another source of study for Ann and I are DVDs. There is a company, The Teaching Company, located in Chantilly, VA who offer DVD and downloadable classes in an enormous variety of topics. From this vast resources of The Great Courses, we have taken more than 50 courses and loved every one of them. The topics have ranged from history, science, math, art, music, and amazing people, such as Leonardo da Vinci. Ann and I have the classes on our cell phones so wherever we are, gym, car, or waiting somewhere, we study. Once Ann told me that she was jogging while listening to a lecture on
supernovas. When the professor said to watch the supernova explode, she did and ran into a big bush. She explained that the bush was not injured by her crashing into it and, yes, the supernova explosion was truly awesome.

In addition to these on-going studies, my latest project is to improve my photography skills. I have several books and DVDs to use to reacquaint myself with some of the basics of photography, and I want to be more comfortable with each of my three Nikon cameras. Since each one of them is more sophisticated and robust in abilities, I want to learn each one of them thoroughly.

These are only a few the things that we study. This what Ann and I have pursued for many years. We do not pretend to be experts in European history of the middle ages nor to be masters of geology, but we want to keep our brains stimulated every day. It is said that your body must be used, or you lose the ability to use it. Brain research shows that this axiom is also true for our mental abilities. We try every day to “Use it so we won’t lose it.”

Travel has been a passion for both Ann and I. We have been all around the World and some places we have been to repeatedly. Ann can never get enough of the wildlife in South Africa, and I am fascinated by Italy. We have been to too many places to mention individually, but anyone who is interested can see for yourself by clicking on the links provided below:

URL (Uniform Resource Locator) are included for you to link on the Web.

http://www.arielnet.com/flickr/collection/63732780-72157638742612273
Collection. Italy

http://www.arielnet.com/flickr/collection/63732780-72157670681452055

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I have also attended many conferences and was a speaker at many of them. Again, rather than enumerate each of my presentations, I have provided links for anyone who is interested to see or follow these trips and/or lectures. The links are provided below:
Collection. Conferences

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1998 - ISEK (92)
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Dr. Marcus in San Diego (2)
Edinburgh with Gilad (10)

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I still present my technology at conferences. For example, my next presentation will be at the US Track and Field Coaches Association in Florida. I have been told that I will receive the George G. Dales Lifetime Contribution to Track and Field award which is the association’s highest honor.

Future projects we are working on include the Virtual APAS, where analysis of the Human Body from the Mechanical point of view will be easier to conduct and be automated. I hope to be able to use this new, exciting system at the 2020 Olympic Games in Tokyo which will be 56 years after I was there to carry the flag and compete in the Olympic Games.

Education, Travel, Innovation, Exercise. These are the many interests which have stimulated our past. We are hopeful that we will continue to study and travel in the future. We hope to keep our brains and bodies busy as long as we live.

The name of this chapter is “now and forever” and this is where Ann and I are in our lives. I can hardly wait for tomorrow because I have another dream.
Gideon Ariel’s List of Accomplishments

- Ariel was the **FIRST COMPANY** to create a biomechanical system for scientific, educational, and commercial applications. (1968)

- Invented and build the **FIRST AIR SHOE** (1971)

- Tested with Howard Head the **FIRST LARGE-FACED TENNIS RACKET**. (1974)

- Built one of the **FIRST PERSONAL COMPUTERS** to be utilized in analyzing sports performance. The project was funded by the Secretary of Finance, William Simon and the CIA director William Casey and Dr. Irvin Dardik. (1976)

- Introduced the **FIRST ELECTRONIC DIGITIZER** (sonic) for use with 16mm film tracings. (1970)

- The first to connect a force platform to a computer AND to write the software to control it. (1972)

- Invented and developed the **FIRST VARIABLE RESISTANCE EXERCISE Equipment.** (1972)

- Provided the first hardware-software controlled interface for other input signals, such as EMG integrated with the movement analysis system. (1972)

- Supplied to Kistler Force Plate producer the **FIRST DIRECT INTERFACE** to the computer and A/D converter on Data General Mini Computer. (1973)

- Suggested and established the **FIRST UNITED STATES OLYMPIC TRAINING CENTER** at Colorado Springs, CO. Gideon Ariel was appointed as the founding Chairman of Biomechanics. (1976)

- Established the first organized Olympic Training Analysis in the United States at the Olympic Training Center in Colorado Springs. The APAS system is used at the Olympic Training Center. (1976)

- The **FIRST to GRAB VIDEO IMAGES** and store them on the hard disk for subsequent processing. (1980)

- Provided the **FIRST COMPUTERIZED VIDEO DIGITIZING** using the computer’s display monitor as the tracing medium. (1980)

- The first to invent the **VARIABLE RESISTANCE EXERCISE EQUIPMENT.** (1969)

- The first to connect the motion analysis system with the Ariel Computerized Exercise System (CES). (1972)

- The **FIRST BIOMECHANICS COMPANY** to conduct **RESEARCH IN SPACE** with NASA.

- The first Biomechanical Company to have a Web Site available on the Internet. (1991)

- Introduced the first ON-LINE digitizing system on the Internet. (NetDigi) (1993)
• Introduced the first AIR SHOE (Way before Nike) (1970)

•Introduced the first DOWNLOADED, full Biomechanical System from the Web to your own computer. (1997)

• Introduced the first Biomechanical System to capture DIGITAL VIDEO from the CAMCORDER CAMERAS directly to the hard disk and allow high speed digitizing.

• The first Biomechanical Company to introduce interface to Digital Video (DV) technology in streaming video directly from digital cameras to hard disk with real time 3D analysis at 240 Hz. (1999)

• Established the "Net Society of Biomechanics" - NSB to allow biomechanists and others to share data on line and exchange data in real time. (1999)

• Introduced the FIRST AFFORDABLE HIGH SPEED CAMERA at 240 Hz to be used with direct capturing to hard disk and up to one hour of continuous recording. (2000)

• First Virtual Biomechanical desk top World Wide, (2000)

• Full Biomechanical Analysis on Wireless Cellular Phone, August 2000.

• Swing Watch Inc. The first Wireless Biomechanics Company. So this is how sports and fantasy can combine to create real life.

**Dreams can come true.**
Gideon Ariel, Ph.d. – Publications


69. Biomechanical analysis of ballistic vs. tracking movements in tennis skills. Proceedings of a National Symposium on The Racquet Sports, the University of Illinois at Urbana-Champaign, 105-123, 1979.


90. A study to determine the aerobic adaptation to work and fatigue training modes on the Ariel CES Multifunction Station. 1991.


Some of the consumer magazine stories about us:

If you wish to read any of the magazine story in its entirety Click on the following URL or scan with your QR reader, which is a free app on the net.

http://arielnet.com/ref/go/5000
Some of the televisions productions about us
You can watch any of these videos by clicking on the following URL or scan the QR:

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