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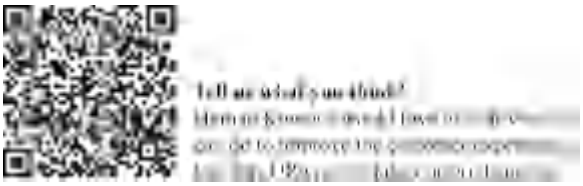

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FOREWORD

Reflections on Sport Science

September 2019

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Past and Present

Although many may make this mistake, science is not a debate where the side putting on the best show wins. Science is in reality a search for truth and clarity. Atlas did shrug, and objectivity, a value in science that informs the practice of science and discovery of scientific truths, should be highly valued.

From early in my life my interest was focused on biology and especially centered on trying to understand everything about strength-power training and athletic performance that I could. As I made my way through school and into college I could not help but be impressed with the extraordinary contributions that science and engineering had made in a variety of areas that impact people's lives. As popular as sport has been over the years and as big a business as it has become, I have wondered and still do wonder why more importance has not been placed on "sport and science."

It is easily argued that sport is one of the most important aspects of our life. For example: Turn on the 6 p.m. "News, Weather, and Sports"; whole magazines are dedicated to a sport or sports, newspapers and news websites have a sport section; many thousands of people watch sport on TV or attend competitions every week. Indeed, considering the great strides in technology, medicine/health, and generally making life more comfortable enabled by objectivity (science), a designed integration of sport and science should be a rational and logical goal.

During the last few years, roughly 1970 to the present, while there have been some great strides in sport science and strength and conditioning, there are many aspects that have not really changed. S&C coaches are still undereducated, undervalued, and with a few exceptions underpaid. Although some schools and professional teams are hiring "sport scientists and high-performance directors," they are greatly undervalued, often ignored. Unfortunately, many of them are very poorly trained to actually be sport scientists. Hopefully, this book and the move by the NSCA and other like-minded organizations toward certification will help drive the integration of sport and science, and a true push to educate sport scientists.

For the Future

While many readers may think this section is too philosophical or even esoteric, please consider:

1. How does the universe work? or maybe
2. How could the universe work?

The second question is perhaps more difficult as it requires considerable thoughtfulness, creativity, and even imagination. It requires a hypothetical/theoretical approach, but if you can begin to answer this question, the first becomes much easier.

One may wonder in pondering the second question: where humans are (and sport science is) going. Imagine the creation of the Star Trek Transporter and the ability of this device to reassemble humans (and other animals) into more than they were. This idea is without a doubt the dawn of the "New Eugenics"—the acceleration of human evolution—and it's not just the transporter; it's genetic manipulation, human interface/integration with artificial intelligence (AI). Whether you realize it or not, the new eugenics is upon us, with all of its possible benefits and hazards. Accompanied by all of the ethical and moral dilemmas that made the *Twilight Zone* and *Outer Limits* really good science futurism at times.

Imagine for a moment, a world that some of you will likely begin to experience in the not-too-distant future. A world that could have three distinct groups of humans. One "chooses" to allow the natural evolutionary process to take place; they die younger and still experience disease, but believe they take the moral high ground. A second group takes advantage of genetic manipulation

(CRISPR-Cas9, orthogonal ribosomes, and beyond); they live longer, have less disease, run faster, jump higher, lift more, and are more intelligent. In a third, human intellect/cognitive function can be transferred to AI, your intellect and cognitive function could live perhaps until the universe dies, you could be as strong and fast as an artificial body would allow, and intelligence could be boosted exponentially both by genetic and AI manipulation. What would this mean for sport and sport science?

A third question arises: "Where did we (you) come from?" And perhaps more importantly, "What did you come from?" (Think about the second question.) Think about who you are now and what you want to be. Think about facing the larger questions of the future.

While we normally address these types of thoughts and questions on a macrocosmic and futuristic scale, begin to think about them on a microcosmic and futuristic scale. All of you are interested and involved in sport science and coaching to a greater or lesser degree—how would these thoughts and questions affect your microcosmic world? Producing a better human being? Eugenics? Are you not trying to do some of this already?—training, dietary practices, for example? (Epigenetic alterations?) So where do you draw the line—or should you? Will the new eugenics produce super athletes? Is this the new ergogenic aid?—it's not that far off. Some of you will deal with these ideas more than as just thought questions. Indeed it is possible that sport will become passé as almost everyone could become an elite athlete (and more)—unless Stephen Hawking was right?

Another aspect is that hopefully these thoughts bring home the inevitability of a "brave new world" and perhaps a truly better one: A good student of history will note that most, perhaps all, alterations in our timeline and cultural evolution have often been pushed and even driven by a handful of people. These pushers often shared psychological characteristics. Most had great intellects, most had high standards and expected others to adhere to those (and were often surprised and frustrated when people could not live up to them), almost none were politically correct, and all had great passion and emotion, including frustration and anger, that drove their intellect. They also had flaws and quirks. For example: Isaac was able to stand on the shoulders of giants and look down on those he thought could not. He had extreme bouts of depression and outbursts of a violent temper; these same "flaws" likely drove him to *Principia* (look it up). Temujin (look him up) literally left pieces of himself over most of Asia while

building an empire; Ludwig transitioned the classical to romantic and was described as irascible, often had fits of depression, was deaf for a good part of his life, but wrote *Eroica*.

I think a very important aspect is to remember, the Vulcan approach to important scientific, cultural, and historical alterations, and evolution of ideas does not always work for humans. Often great intellect, artistic gifts, and the ability to drive change are in turn driven by emotion and passion. That brings us to a final thought (this time). Do you have the passion and the intensity of intellect to drive sport science forward? Indeed, what can you be?

(End)

September 2019

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First, I am honored and humbled to have been asked to give my reflections on the evolution of sport science. I know there are many others with longer evolutionary tales and experiences with this term and concept, from Al Vermeil, to Bob Ward, to Gene Coleman, to Terry and Jan Todd, to a host of other colleagues in my generation. My colleague, Dr. Michael Stone, is giving you another view of this field's evolution. We each share with the men and women of our generation the events that shaped us. For me, I have been blessed by so many people who have framed my career and shaped my views about this field. So upfront, I apologize for the many names I cannot share in this foreword, especially my many graduate students who in reality define my career.

To provide any comprehensive insights to enlighten you on the evolution of sport science is an impossible task. Hopefully, this book will start to give some of the insights into the many dimensions of this evolving field. To that end, I acknowledge the limitations of my perspective and experiences but will try to capture some of these ideas. In my view, there were so many evolutionary trails that started on their own paths and merged to enhance one another in the continuing challenge to better understand the demands of a sport and help

prepare athletes to perform better.

“Sport science”: The words themselves in combination have been a paradox for years. In many ways, this continues. Winning is now, and science is slow. Can it provide the so-called quick fix or silver bullet so many coaches are looking for in today’s highly competitive and financially rewarding field of sports to produce winners? For me, it means to take care of athletes and give them the guidance and tools that allow them to safely compete and realize their potential. As a former strength and football coach at the junior high, high school, and collegiate levels, I could see the benefits of a properly developed and implemented training program for both young men and women before it was even popular in the 1970s.

While beyond the scope of this short foreword note to you, the field of physical education of yesteryear, sadly not today in most curriculums, provided one basis for what we now call sport science. Such curriculums with the required sciences of anatomy, physiology, chemistry, biomechanics, motor learning, exercise physiology, sports psychology, sports history, and coaching have set the table for the study of sport by students. Many of these students went on to become sport coaches and strength and conditioning coaches. Sadly, the rigor of physical education programs for science is missing from most curriculums. For me, such a rigorous major in physical education and health education gave me the scientific understanding of sport and basics to build upon. It was in essence the basic building blocks of sport science at the undergraduate level. Without such sciences the ability to think through the functions of the human body and how exercise might impact it is missing. Learning to work with people and teams of research professionals in a laboratory day-to-day was an important element for me to work my way through college in addition to being an athlete. Laboratory work with now-outdated technologies, which included breaking down maximum oxygen consumption tests, analyzing bags of air with a Haldane gas analysis apparatus, and analyzing heart rates from EKG strips, taught me early in my career the importance of numbers and data. This is so vital in any sport science program today.

The Olympic Games in conjunction with the world politics of the Cold War also fueled the drive to further develop training theories and examine athletes who were successful and promoted the embryonic concept of a sport science team of experts. Seeing my friend and college football teammate, Dr. Steven Fleck, become one of the first sport physiologists at the U.S. Olympic Training

Center (OTC) in 1979, I saw the early impact on how the Olympic Games stimulated the concept of sport science. I also had the good fortune to benefit from grant funding to study sport. This again showed how important funding was to drive sport science forward and help athletes with more sophisticated views of their sport. Having had the opportunity to work with the OTC's Coaches College, I saw again firsthand how science education was such an important part of the equation and vital in any sport science program. Working with Dr. Vladimir Zatsiorsky at Penn State University for many years teaching a class in theory of strength training and writing a book together, we kidded about making "East meet West." I realized from the many stories how sophisticated yet simplistic the programs and principles were to achieve optimal training for sport performance. It opened my eyes as to how former Soviet and Eastern Bloc countries viewed sport and how teams of scientists used Western literature, advanced physics, and mathematics to develop technologies (e.g., electrical stimulation, EMG, and biomechanical analytics) to design periodization theories. Thus, support and funding for such efforts were in part driven by the Olympic Games. Sport science was a beneficiary and continues to evolve.

Medicine was the word more closely aligned with the word *sport*, but from sports medicine other fields had scientific interests not directly concerned with the medical aspects. Thus, the American College of Sports Medicine's new journal in 1969 was called *Medicine and Science in Sports*. Sports medicine had spread out into the associated fields of athletic training and physical therapy with specializations for team physicians and orthopedic surgeons all interested in the prevention and care of athletes. The prevention aspect of athletic training merged, as history would prove, nicely with the goals of the strength and conditioning professional. As a professor and director of research in the Center for Sports Medicine at Penn State, under the direction of Dr. Howard Knuttgen, I saw what an evolution might look like in sport science when we created what would really be the first sport science program at Penn State starting in the late 1980s. We found that some coaches and teams wanted to know more than just the injury and rehabilitation aspects of their sport. Working with many outstanding physicians and athletic trainers in this area I saw what a genesis of a program might look like in sport science that would be realized some 20 years later at Penn State. However, for me the realization of a fully integrated program in sport science came at the University of Connecticut, where for over a decade we had "Camelot." Coach Jerry Martin was the head coordinator of strength and

conditioning, Dr. Carl Maresh was the chair of Kinesiology, Bob Howard was the head athletic trainer, and Dr. Jeff Anderson was the team physician. This allowed for the full integration of athletic and academic programs. However, I was reminded of another lesson in evolution—if a careful eye is not kept on the environment, in this case, leadership, the evolved organism can crash and burn and become extinct. Bringing lessons from that experience here at The Ohio State University I have seen a burgeoning program develop in sport science over the past 5 years, and Coach Mickey Marotti, our assistant athletic director, supporting this effort for further such integration and use of science in sports.

In my view it was the field of strength and conditioning with its long history of physical development and performance arising from the resistance training sports of weightlifting, powerlifting, and bodybuilding, as well as track and field, that pushed the need for greater understanding of athlete development and the different sports forward using the sciences to do so. For me, this field provided the evolutionary "big bang" for sport science bringing together all of the different elements needed. The paths merged and planet "sport science" was created. The development was seen in the founding of the National Strength and Conditioning Association (NSCA) in 1978 by Boyd Epley. This fueled the interest of strength and conditioning professionals who wanted to know more about the science of sports and physical development. My many interactions with Boyd and his longtime assistant, Mike Arthur, allowed me to see from the start how a program and organization could impact athletes and professionals. This was the genesis of sport science. The NSCA was thus energized to emphasize education with Ken Kontor appreciating its importance, certification with Dr. Tom Baechle, and research with its two major journals being *Strength and Conditioning Journal* (formerly the *NSCA Journal*) in 1978 and then in 1987 a research journal dedicated to the concept of the applied aspects of conditioning, *Journal of Strength and Conditioning Research* (*JSCR*). I had the opportunity to work with both journals, especially the *JSCR*, where I served as editor-in-chief for 30 years. This allowed me to see how the growth and need of applied research related to sport science worldwide.

Concomitant to all of this was the fact that funding would be the engine for progress. Funding was critical to all of the advances for all sciences, including sport science. Government grants are typically tied to understanding and improving health treatments, health outcomes, and fighting and curing diseases. Thus, research in sport and athlete training and performance was left to other

sources of funding or merged into a health care line. Funding to study sport, while existing in some countries, was not a typical funding line in most countries around the world. I saw this when collaborating with my friend and colleague, Dr. Keijo Häkkinen, at the University of Jyväskylä in Finland. For many years in Finland, sports research was funded by various government entities but slowly shifted to health-related issues. Our passion for resistance training drove both of us to be very creative in our grants that included resistance training in health-related problems but also had relevance to sports. In combination with my former postdoc, Dr. Robert Newton, from Australia, I learned the importance of worldwide collaborations in this process for developing research globally. For many investigators it was just a passion, or as some have said, a hobby due to the fact that they were athletes in their youth. Examples of this abound. Thus, the sport science projects they undertook were related to their scientific training and area of research. They then needed to find internal funding to get studies done. Again, Olympic Committees and various corporations played considerable roles in funding sport science as it related to nutrition, materials, apparel, or equipment.

Ultimately, it was the exponential development of technologies from computers that required buildings to house this technology, which now can be accomplished using a cell phone or laptop. Corporations in the U.S. and around the world continued to make advances in communications, computers, microcircuits, software, biology, and bioengineering, all of which fueled various aspects of sport science. The United States' space program, celebrating its 50th anniversary of putting a man on the moon, funded and accelerated technological advances that spilled over to all sciences including sport science from materials to computers to software to biology. From my experiences as the associate director at Penn State's Center for Cell Research, which was funded by the National Aeronautics and Space Administration (NASA) for the commercial development of space, I was able to see the history of NASA. Having been involved with three shuttle missions that carried experiments, I saw up close the meaning of "work the problem." Admiring the human accomplishment of putting a man on the moon by the end of the 1960s, one realizes it took tens of thousands of professionals and corporations each working on different detailed and minute aspects of the larger goal to achieve. Just putting together the Saturn V rocket was an achievement of enormous technological complexity. This represents a model of my view of the challenges we face in the development of

the field of sport science. It takes a team to get the job done and use evidence-based practices in sport science.

The military research programs took an interest in soldiers' health when a U.S. Air Force physician, Dr. Ken Cooper, reported his aerobics findings back in the 1960s on cardiovascular risk markers. Then in the 1980s the realization that soldiers were a type of athlete arose from the world of strength and conditioning. "Soldier fitness" (and performance) became a coined term. Having been a captain in the U.S. Army stationed at the U.S. Army's Institute of Environmental Medicine, under the visionary direction of Dr. James Vogel and Dr. John Patton, I saw how focused research for task-related mission demands mimicked what athletes need from sport science. I used such experiences in studying men and women warfighters over 4 years when I entered into an academic career. Subsequent research that I was involved in for the Department of Defense continued this line of work for me. This included women's health and preparation for combat-related jobs to demands of special operations warfighters in the different branches of service. Each acted as a model for me as to how vital evidence-based practices are and again how it takes a team of scientists and professionals to figure it all out. It was more than just metrics, despite the book and movie *Moneyball* bringing math and modeling into the public consciousness. However, for numbers to be meaningful they would need both context and scientific validity for the prediction models to work.

I got into this field unknowingly as a young boy. I wanted to be a better football player and found out that one of my heroes, Jimmy Taylor, of Vince Lombardi's Green Bay Packers, lifted weights. From there, my story started like so many others had. I asked my father to take me to Sears to buy a set of weights. From that point, I became fascinated and even obsessed with questions as to how the body works. Two other Packer heroes of mine, Jerry Kramer and Bart Starr, found out from Coach Lombardi that there is no end, just the continued chase for perfection with the hope of catching excellence in the process. So it goes with my view of the evolution of sport science.

RECOMMENDED READINGS

Amonette, WE, English, KL, and Kraemer, W.J. *Evidence-Based Practice in Exercise Science: The Six-Step Approach*. Champaign, IL: Human Kinetics, 2016.

Shurley, JP, Todd, J, and Todd, T. *Strength Coaching in America: A History of the Innovation That Transformed Sports*. Austin, TX: University of Texas Press, 2019.