“It’s the motor, not the machine.” As a competitive cyclist in the late 1980s through the mid-1990s, I came to speak this phrase regularly. It became a familiar mantra that my compatriots and I would systematically repeat. Put simply, this saying means that one’s body—the motor—is vastly more important than any technoscientific device, pharmaceutical treatment, or psychological conditioning in the final outcome of a cycling race. In hindsight, I repeated this phrase to others and myself out of my own hubris, ignorance, and, most importantly, denial. This overly self-confident utterance by an aspiring twentysomething athlete should not come as a shock because a large part of elite competitive sport is about sustaining an unwavering, and often illogical, belief in oneself. It is a belief in the superiority and infallibility of one’s body that undergirds this way of thinking. The body is potentially the only aspect of an athletic competition that an athlete can control completely. When the “game” gets tough, the body and the mental and physical training absorbed by it will, one hopes, carry one through to triumph. This ideal centers on the belief that when all else fails, the “motor” will transcend all and deliver an athlete to victory. Thus, it should not come as a surprise that the phrase “it’s the motor, not the machine” mollified insecurities, inspired confidence, and supplied motivation to carry on, even when chances for success grew ever slimmer. The growing popularity of this phrase among cyclists, and
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others similar to it in other sports, stems from anxieties about uncontrollable unknowns.¹

One of the major aims of this book is to investigate how sporting communities respond to the uncontrollable unknowns that emerge from the inseparable interweaving of science and technology, or, more accurately, technoscience. In my case, as much as I attempted to push the technoscientific out of my consciousness, I was fully aware that technoscientific objects, practices, and procedures played a role in the final outcomes of races. By the 1990s, cycling, like most other sports, experienced a technoscientific explosion ranging from lightweight composite materials like carbon fiber to stretchy wind-cheating fabrics like elastane. Also during this period, sport began to embrace the scientific rigor that physicians, psychologists, and scientists brought to training, nutrition, and competitive preparation. These technoscientific pathways—just like in the broader society—progressed at a quickening and uncomfortable pace. Athletes like myself began to wonder whether these technoscientific evolutions would become revolutions, with the technoscientific overshadowing the corporeal to a point where athletic competitions would no longer be between athletes on the field, but between scientists and technologists in the lab.

As rhetoric around the “lab” in sport developed over the past few decades, the “lab” that dominated public and media dialogues was not the engineering lab where mechanical engineers and material scientists developed new sporting equipment, but the lab where biochemists and pharmaceutical engineers manipulated human cells to extract maximum performance. It is in this regard that the use, potency, and legality of performance-enhancing drugs have come to dominate discussions and debates about technoscience and sport. Unfortunately, for many, technoscience in sport has become synonymous with performance-enhancing drugs.

Until the last few decades of the twentieth century, the idea that athletes would use any object or substance—regardless of its legality or its impact on future health—to improve their chances of winning was a foreign concept for a large portion of sport’s viewing publics. These publics believed, at least in an American context, that elite athletes who willingly chose to use a questionable enhancing device or substance were rare. Only unethical or rogue athletes would stoop so low as to demean themselves and their sports, or irreparably damage their bodies, by “cheating.” But as
recent admissions and exposés in every major and minor market sport around the world have shown, the use of substances that athletes, trainers, or random acquaintances believed would improve performances and the ability to win are as old as sport itself. Even casual viewers of sport now understand that the late twentieth- and early twenty-first-century eras have become defined by lean mass–building substances such as human growth hormone (HGH) and blood-boosting drugs such as erythropoietin (EPO). The ubiquity of performance-enhancing substances has led to the dominant perception that the most prominent technoscientific changes within sport have been pharmaceutical.

Though the medical revolutions shaping the broader world unquestionably have reconfigured sport, the past fifty years of sporting history have seen many other less publicly volatile technoscientific developments profoundly influence the games people play. We, as a society, have given great attention to the drugs that influence sport, but the material artifacts that reconfigure the games we love to watch and play generally have not been a cause for alarm or investigation. This prominent focus on performance-enhancing substances obfuscates other technoscientific forms that impact sporting competitions. In order to gain a broader understanding of the ways in which science and technology—for better or worse—transform sport, this book aims to invert the weight of the relationship between performance-enhancing drugs and all other technoscience. By broadening the focus of science, technology, and sport beyond drugs and conceptually recalibrating this relationship, other increasingly important technoscientific artifactual interactions will come into higher relief. Extending discussions of sport beyond the well-trodden ground of performance-enhancing drugs will allow publics, athletes, governing institutions, engineers, scientists, and designers to gather a more contextualized understanding of the multiple ways in which technoscientific products have shaped and will shape the landscape of sport.

The current relationship between athletes and equipment, bodies and technoscience, or the motor and the machine is messy at best. Every sport has its requisite gear, but historically sports sublimate this gear to individualized performances and the cultural assertion that the athlete, the body, or the motor has been and will always be vastly more important and valuable than the equipment, the technoscience, or the machine. But what happens—and what does it mean for the social and
cultural infrastructure of sport—when technoscience reveals itself to be more than the instruments of a game? These disjunctures expose a set of assumptions that privilege the human body to the point that sport regularly disavows the substantive impacts that technoscience has on the outcomes of games people play.

In the past few decades, it has become harder and harder to deny or even ignore the impact of technoscientific equipment on sport. Athletic events from bass fishing to the America’s Cup have shattered the illusion that technoscience is just merely equipment and highlights just how dependent sport is on myriad technoscientific artifacts and practices. Yet, for the most part, contemporary society still views sport as a decidedly human physical endeavor. Humans are social creatures, and the historical emphasis on the human motor over technoscientific machinery not only motivates athletes when the scary efficacy of the next technoscientific implement can be seen on multiple horizons but also supports the collective rejection of the present real power of technoscience in sport. Dominant narratives of athletic and sporting competitions are about human physical and intellectual struggle as well as a host of cultural assumptions, beliefs, and practices that work to privilege the human body over the technoscientific.

To sustain the elevated status of the athlete and the human body in these narratives, technoscience must appear as mere instruments of a game to obscure the intricate interplay among people, institutions, rules, regulations, and technoscience. Understanding the place of technoscience within sport goes beyond the tensions between body and machine. Sport is bound together by and through an evolving network of athletes, engineers, designers, publics, and technoscientific artifacts. This interconnected web of human and nonhuman elements comprises an overlapping set of sporting cultures that form around a specific sport or sporting activity. Within these sporting cultures, technoscience exists as an uncomfortable problem that will continue to produce palpable disruptions within these cultural communities if we cannot build a coherent way to evaluate, assess, and understand the roles of technoscience in multiple sporting domains.

Phrases like “it’s the motor, not the machine” exist because of the historical tensions between the human body and equipment within sporting competition. Yet this phrase performs different work depending on
one’s position. For athletes, phrases of this type represent a set of psychological and rhetorical motivational structures designed to inspire athletes that, if they continue to flog their bodies through gut-wrenching training sessions, they will someday become “champions.” This blind reliance on and belief in the body is part of what makes sport so seductive, because in multiple instances athletic bodies proved themselves to be otherworldly through miraculous and transcendent performances. Roger Bannister’s 1954 sub-four-minute mile at the Iffley Road track at Oxford University is one such moment.2 This event—and many others, such as Bob Beamon’s 8.90 m long jump at the 1968 Mexico City Olympic Games—represents the triumph of the mind and body over the natural world. Bannister’s and Beamon’s bodies defied wind, weather, gravity, and nature itself to do the seemingly impossible. For athletic competitions such as track and field, there have been historical moments when the human body invariably has been significantly more important than any manmade technoscientific contrivance. It is these sporting occurrences that sustain the power of the body narrative within sport.

Over the past fifty years, the body narrative has begun to show signs of stress fractures. More recently, the increasing power of technoscience has exposed, and in some cases ruptured, the coherence of the body narrative. Instead of understanding what these technoscientific changes mean, sport often closes ranks and attempts to quickly, and often haphazardly, patch these expanding crevasses. From elite-level soccer blocking any form of goal-line technology until the 2014 World Cup as a belated response to the barrage of YouTube-able instant replay videos exposing the limitations of the human eye in determining close goals, to automobile racing’s endless tweaking of regulatory formulas to blur engineering potency as a means to reclaim driver skill and ability, sports fans, competitors, governing bodies, and equipment manufacturers are now living in an era where tough decisions will have to be made in order to determine if sport, in the future, will be more about the motor, the machine, or some transient equilibrium between these two poles.

Thus, the central question this series of studies will address is: In a world defined by its technoscientific output, how does technoscience influence, shape, and challenge the ways societies play, experience, and consume the multiple manifestations of sporting competitions? To reveal these tensions and explore what is at stake for the future evolution of
sport, the following case studies examine the complex and convoluted ways sporting cultures maintain the primacy of the body by purposely and inadvertently downplaying or derailing the power of technoscientific artifacts. By highlighting sport technoscience and its impact on athletic competition, this book inherently creates a dialogue that destabilizes the primacy of the body within sporting narratives as well as reveals the importance of technoscience for the stability, sustenance, and maintenance of sporting cultures.

**Technoscience and Sport Meritocracy**

Over the past fifty years, sport has undergone such massive technoscientific transformation that fans, athletes, governing bodies, and equipment manufacturers struggle to manage the technoscientific sporting worlds they have created. In a compartmentalized and simplified world, equipment manufacturers create and athletes use new technologies that test the limits and boundaries delineated by sport governing bodies while simultaneously upholding the public's expectation of fair and equal competition. Yet we inhabit a world that is far from ideal, and technoscience can breach cherished narratives that validate the primacy of the human body within sporting competitions. Some may believe that sport is about character, masculinity, or a test of physical and mental resolve, but at its core, sport is a social practice and cultural activity. On the surface, it seems as if these interpretations have very little, if anything, to do with technoscience. But over the past century, a forceful wave of sporting technoscience has transformed the social and cultural phenomenon of sport from an athletic endeavor to a technoscientific proving ground. The silent and powerful infiltration of technoscience into sports training, competition, and ideology raises a host of important and increasingly pressing questions for the future of athletic competition. Is technoscience a medium through which athletes can express their physical ability, or is it a network of tools used to undermine the tradition of sport? Can technoscience, in the name of character, ethics, and tradition, effectively determine who should and should not fairly compete? Does technoscience create a false sense of security that rule breakers can be monitored and caught?

So how did we get here? And where is that here? That here is a location where a heightened sense of morality and authenticity drive public
discourse about sport. That here is a site where corporate institutions invest significant sums of money to produce the next game-winning device. That here is also a place where certain technoscience is seen as undermining the purity of the game. Leo Marx, in the Machine in the Garden, highlights the social, cultural, and psychological shock people experience when modern industrialization intrudes on their pleasant, peaceful, pastoral landscapes. Technology forced society to uncomfortably rethink its relationship with natural-world beauty in an age of mechanized production. In similar ways, technoscience is forcing sport to reassess the place of man-made material artifacts on the competitive field. The sports field was once a pastoral place of athletic leisure but has potentially become a site for expressions of twentieth-century technoscientifically inflected mass individualism.

As Marx implored us to delve into what it means to have the rural countryside altered by technology, I am asking us to consider what is socially and culturally at stake when sport is reshaped by our technoscientific creativity. This tension does seem somewhat ironic in a world powerfully defined by its scientific and technological invention and innovation. In most cultural spaces, technoscience is seen as opening windows to an improved future. Though scholarly and nonacademic critics, from Lewis Mumford to Michael Pollan, have attempted to destabilize these progressive narratives, technoscience is still seen predominantly as a gateway to a “better” future. Over the past twenty years, though, the unbridled enthusiasm for technoscience in sport has started to wane. If one surveys major sports journalism outlets such as Sports Illustrated, Sporting News, or ESPN The Magazine over that period, it is hard to miss the extensiveness of technoscientific treatments, materials, and artifacts that enable athletes to perform in ways that transgress the agreed upon parameters of fair and equal competition. In the same time period, nearly every major sport has participated in rewriting their rulebooks to contain, delimit, or repel some form of technoscientific innovation. In this context, the looming question is, has technoscience gone too far?

What is “too far” depends on the history and tradition of a sport. From where I sit, as a scholar who researches and teaches about society’s interactions with technoscience over the past two centuries, the “too far” question has been asked since humans began using technology and science to alter ways of living. It is a fundamental question that lurks behind the
In the United States, some may see the resuscitation of craft industries such as leatherworking, artisanal foods, and digital marketplaces (e.g., Etsy) as a reaction to the loss felt by the mass production of everything. Those in the handcraft movements would contend that the resurgence of craftsmanship has been conjured up by a desire to return to a bygone era in which society and the material artifacts of that society were not only better and longer lasting but also more pure and authentic. Late twentieth- and early twenty-first-century cultural reevaluations of the mechanization, digitalization, and the eventual Googlization of everything are mirrored in the world of sport. Though critical resistance to technoscience always has been present, many contemporary critics direct their concerns at the perceived loss of sport’s history, tradition, culture, and identity. The questioning of technoscience has become even louder as competitions migrate from demonstrations of athletic ability to multilevel-marketed entertainment extravaganzas where every performance needs to be quantified in an effort to understand how that performance adds or subtracts value from a specific athletic enterprise.

Though not writing about technoscience and sport, journalist Howard Bryant captures one aspect of what fans love about sport when he writes that “meritocracy . . . is the basic draw of sports: your best against mine, the scoreboard oblivious to pedigree, race, class or gender. The promise of pure competition is perhaps the biggest reason we watch.” Bryant also indicates that this idea is a fantasy. He concludes that sport meritocracy is “a lie. Merit remains what it has always been: a myth. Pedigree, race, class, gender, politics or something as simple as good looks might not determine sports outcomes as it might, say, Ivy League admissions, but it has always affected the final score—especially if you happen to monitor more than just points.” What makes technoscience so troubling is that it threatens this meritocratic ideal. Fame-altering technoscience disrupts the construct of meritocracy. Sadly, a pure meritocratic sporting world probably never existed, but since the mid-1960s the pace at which technoscience has impacted sport and the degree to which it became more visible increased substantially. Herein lies the perception problem with technoscience in sport.

In the span of a few decades, many sports quickly migrated from century-old equipment and “natural” materials such as wood and wool to
new laboratory-created substances such as carbon fiber and spandex. Sports such as golf and hockey began the process of abandoning wooden club shafts and sticks in the early 1970s, and by the turn of the twenty-first century, wood had virtually disappeared. Similarly, wool, known for its wicking properties, had been the chosen athletic clothing material for most of the twentieth century, but newly engineered fabrics replaced wool for a host of reasons such as flexibility, lightness, and breathability. The seemingly quick transitions across all sports heightened a larger sporting public’s understanding of the use of technoscience. But in certain areas, the new advanced technoscience became a problem when it was seen as playing an increasingly important role in the game and undermining sporting meritocracy.

**Framing Technoscience**

The idea that technoscience is part of sport is familiar and not particularly controversial. Even for the most casual viewer, it is understood that someone applied scientific and technological knowledge to create the equipment that athletes use. But the place of science and technology in sport has profoundly changed over the past several decades. For instance, recent Olympic Games have been showcases of technoscientific ingenuity. During the 2008 Beijing Olympics, broadcasters reveled in comparing Michael Phelps’s eight gold medal performance with Mark Spitz’s seven gold medals received in 1972. The comparison of Olympic medals probably intrigued most viewers, but for me the nearly unacknowledged visuals were much more interesting. The mustached, sagging stars-and-bars-suited Spitz with a full head of hair contrasted starkly to the smooth-shaven, hydrodynamic, full-bodysuit-wearing Phelps. Multiple media outlets picked up on these differences but did not push further to examine what they meant for swimming or the larger world of sport.

To more fully understand the evolving relationships between technoscience and sport, studies need to move beyond basic observations of historical variation to inquire what is at stake for the future evolution of sport in an age where scientific knowledge and technological artifacts outstrip original aims of sporting competitions. To acquire this holistic viewpoint, it is necessary to understand what it means for publics as consumers, athletes as users, engineers and scientists as producers, and governing
bodies as regulators to see, experience, create, and legislate technoscience’s growing omnipresent reach into sport.

Drawing from actor network theorists such as Bruno Latour, it is imperative to think about sport as a community of human and nonhuman actors to more fully examine how technoscience functions as a relational form of life among and between different segments of sporting cultures. The present volume focuses on publics, governing bodies, competitors, and technoscientific actors as the four main groups constituting sporting communities. Publics include those who consume athletic competitions. They can be fans, detractors, journalists, media critics, or casual viewers. These groups often respond most vocally when technoscience seems to sublimate the physical body to a device and give one competitor an “unfair” advantage. Conversely, very little apprehension is seen when governing institutions implement technoscientific monitoring devices or systems, such as instant replay, to increase refereeing accuracy as a means to support a version of “fair” play.

Sporting publics have a great deal to say about what, where, how, and when technoscience influences their beloved athletic competitions. Though publics can be extremely vocal, sport governing bodies, in their charge to create, manage, and defend a whole spectrum of sporting practices, ultimately determine what is and is not permissible within sporting competitions. Since sport governing bodies define the parameters of competitive play, they possess the power and authority to legislate technoscientific use. This legislation ranges from basic specifications, such as the legal dimensions and air pressure of a football, to outright banning certain technoscience, such as in the case of a “corked” baseball bat. Governing bodies and publics have a symbiotic relationship. Governing bodies need the publics to consume competitions just as much as the publics need to trust that the governing bodies will continue to maintain the elevated position of the athletic body within sporting competitions.

Competitors and technoscientific actors are less critically engaged in commenting on the growing role of technoscience in sport. Competitors receive validation primarily through winning. The rewards structures of elite-level and professional sports demand athletic excellence. Where small variations can mean the difference between winning and losing, elite-level athletes ferret out every possible option to gain a competitive advantage. In this regard, it has never been in any competitor’s best interest to have a
level playing field. Though one can argue that sport is the last bastion of meritocracy, competitive sport necessitates gaining and exploiting inequalities. Mismatches between a taller player and a shorter player, a heavier player and a lighter player, or a faster player and a slower player can produce highlight-worthy plays. Fans see these mismatches as just part of the game, and great players and teams take advantage of these natural discrepancies. In the human drama of sport, fans revere athletes and celebrate the plays where a competitor overcomes her genetic limitations and competes well against a seemingly superior athlete. Doing the seemingly impossible makes sport exciting and draws the public into the narratives of sport. Yet fans and governing bodies do not hold the same esteem for technoscientific mismatches as they do for bodily incongruities.

Publics often equate technoscience that enhances an athlete’s performance with cheating. The intellectual creativity exhibited by engineers and designers can transgress the boundary between natural and artificial. These are the sacred yet ever-moving lines that determine what is and is not acceptable. Increasingly, sport’s financial, social, and cultural reward systems propel athletes to seek these advantages, the benefits of which have become increasingly more visible. In sporting worlds, where the differences between finely tuned athletic bodies are very slight, athletes gravitate to new and emerging technoscience—hopefully to which their competitors do not have access—to gain an upper hand. Athletes have symbiotic relationships with the technoscientific actors who develop the devices that can, in the most ideal situations, give an athlete a better chance of winning. In this role, technoscientific actors design, develop, and create game-changing artifacts or systems. Technoscientific actors produce devices that may give athletes the biggest competitive advantage while simultaneously creating value for a consumer product brand. However, these devices must not run afoul of the public’s desire to believe that bodies are solely responsible for winning sporting competitions or a sport governing body’s need to maintain the illusion of balanced and technoscientifically limited playing conditions. Major sportswear brands, such as Nike, Adidas, and Puma, are extremely effective in walking this sociopolitical tightrope. However, smaller companies that manufacture specialized products can struggle to stay out of the crosshairs of governing institutions’ regulatory aim.
These four constituencies—publics, governing bodies, competitors, and technoscientific actors—maintain an uneasy equilibrium regarding technoscience. Historically, they preserved this equilibrium fairly easily, but the efficacy of technoscientific augmentation increasingly tests the public’s trust and governing bodies’ ruling authority. This reality places multiple sporting cultures at the nexus of a new set of tensions between man and machine. Currently, there exist three primary options for any new competition-changing technoscience: acceptance, banishment, and denial. Denial tends to create more problems, so endorsing or prohibiting technoscience are the only two reasonable options. Sadly, technoscience in sport is increasingly becoming about the push and pull between the “authentic” athletic body and “artificial” machinelike technoscience. The relevance of technoscience in sport will only increase, and the ways in which sporting cultures incorporate or suppress technoscience will define the future of athletic competition in the current century.

**Framing the Athlete**

How does one define a pure athletic performance? The idea that one could discern, measure, and verify an authentic athletic performance is highly problematic. Yet sport governing bodies work very hard to institutionalize processes and protocols to convince the public, as well as athletes, that though they may not reach the point of unequivocally adjudicating authentic athletic performance, these organizations can legislate systems of rules—undergirded with technoscientific tests—that will produce, to the best of their ability, fair competition. The idea of testing the body’s performance and using mechanistic metaphors to describe its action has a long history. In the first few sentences of the introduction to Thomas Hobbes’s *Leviathan*, he wrote: “For what is the heart, but a spring; and the nerves, but so many strings; and the joints, but so many wheels, giving motion to the whole body.” Mechanical views of the body, as illustrated by Hobbes, encourage mechanistic interpretations of the body. The body can become a test site, and the compression ratios of the body’s “springs” can be measured as effectively as genetic material can be tested and evaluated. The process of quantification to make evaluative assessments about bodies can be a useful way to understand basic physiological differences, but the utilization of technoscience for bodily assessment has an equally dark history.
Science and technology have been used as fulcrums to boost deleterious racial, social, cultural, gendered, and genetic agendas. Donna Haraway, Katherine Hayles, and many others have written thoughtful critiques of what it means to struggle with conceptualizing the body as a machine as well as its integration with machines. The framing of the body as a machine has profound implications for the future of sport when efforts are being made to create a larger gap between athletic bodies and the devices that competitors use. By subjecting athletic bodies to a host of technoscientific tests for admission to competition, sport governing institutions may not be that far from the technoscientific actors that might view athletes as running and walking laboratories.

What does it mean for athletes, fans, and governing organizations to conceptualize, understand, and accept the human body as an analyzable and endlessly improvable piece of equipment? Jan Rintala argues that this progressive vision dehumanizes and alienates athletes from their bodies and their chosen sporting community. This analysis makes sense in a worldview embedded in historical notions of gentlemanly athletic competitions of the early twentieth century. But this perspective becomes increasingly less relevant in sporting cultures that dismiss the dynamics of dehumanization and alienation because technoscientific interventions are necessary to keep sport safe, rebuild injured bodies, maintain an upward slope of human performance, make the game more entertaining, and sustain public trust. Not surprisingly, these agendas fit lockstep with the Olympic motto of “Citius, Altius, Fortius,” or “Faster, Higher, Stronger.” As the drive for bigger, stronger, and faster moves forward, there will be more insistent concerns that science and technology have gone too far. In a technoscientific era, athletic competitions may no longer be between humans on the playing field but instead battles between well-funded technoscientific teams. Will athletic competition transcend the athlete and become a competition between the best scientific knowledge and technological methods applied to the human body? Will sport become a medium to display the latest technoscientific innovations?

This book explores these questions, but not in an attempt to argue for a version of technoscientific agency or to examine how technoscientific props up or undermines certain sporting communities. It instead is focused on the workings of technoscientific within sporting cultures. Specifically, why, within global communities that have embraced both the creative and
destructive power of technoscience, do fans, governing bodies, and competitors prefer to push technoscience into an instrumental corner? A partial answer to this question is that revolutionary technoscientific advancements can become unwanted challenges to the tradition, history, and essence of a sporting culture.\textsuperscript{19} Clearly, this is reasonable since most sports are activities with deep-rooted and cherished cultural traditions. This is not to say that the participants of sporting communities do not see and understand the power of technoscience, but to maintain the generations-old narrative of sporting competitions and the motor-over-machine parable it must be agreed that technoscience remains neutral, and therefore instrumental. If not, technoscience and the associated network of human and nonhuman actors must be embraced as equal participants within the formation and maintenance of games people play. If technoscience is fully accepted as equivalent to the human participants, these games become less about the athletes and more about the devices, objects, and artifacts in use.

**Framing Sporting Cultures**

The studies presented here explore how technoscience, in multiple manifestations, participates in both the stabilization and disruption of narrative equilibrium within sporting cultures. One of the most dominant narratives of sport is that all athletic competitions should be fairly decided between competitors on a field of play. This simple premise is deeply loaded. Similar to meritocratic ideals, concepts of what is and is not a fair athletic competition drive this narrative.\textsuperscript{20} If nothing changes conceptually, technoscience will continue to develop as a node of power that shapes what sports are and will be. For most of the twentieth century, technoscience maintained a fair balance between competitors. It was part of the regulatory infrastructure, exemplified by agreements on the rules governing categories such as weight classes, event distances, and equipment. More recently, technoscience has become more divisive, raising concerns among athletes, fans, and governing bodies about how it will redefine championed narratives of pure athletic ability.

This analysis specifically uses the term *narrative equilibrium* because it substantively explains the cultural exchanges that take place between the various members of the sporting cultural groups explored. Cultural narratives of sport recount the physical triumphs, mental strategies, and
anguishing losses that demand seeing, understanding, and interpreting sport as a human-centered activity. A rich tapestry of cherished historical narratives holds the history of sport together and links celebrated players, transformative games and series, and tradition-laden stadiums to a collective identity fostered by governing bodies, fans, technoscientific actors, and competitors. Each of these groups narrates in its own way. Sport governing bodies narrate through legislation. Fans narrate through beloved stories of triumph and defeat. Athletes narrate through competitive performances. Technoscientific actors narrate through the creation of material artifacts that become part of competitive play. Sporting cultures have equally strong narratives about the authenticity and primacy of the body. Statements such as “she is a natural,” “he was born to play,” or “she has the gift” firmly reinforce the belief that within sporting competitions, natural bodily talents can separate the best from the rest. Many fields of inquiry, from sport psychology to genetics, study how to extract as much performance as possible from these “natural” athletic bodies. Though equally familiar pronouncements about an athlete’s drive, motivation, or work ethic are sometimes deployed to explain why an athlete can be competitive with seemingly inferior physical attributes, it has been difficult to undermine the idea that champions at the elite level are born and not made.

A narrative approach is also a useful way to understand how social and cultural formations bring life and meaning to material objects. In writing about narratives of material culture, Ian Woodward indicates that narratives “come to life by being embodied in objects [that] frequently structure the very way narratives unfold.” Furthermore, “objects acquire cultural meaning and power in the context of stories or narratives that locate, value, and render them visible and important. Without such narrative storylines . . . an object is rendered virtually invisible within a culture.”

This reading of material objects can be effectively applied to technoscience and sporting cultures to examine and explore the ways in which publics, competitors, sport governing bodies, and technoscientific actors narrate the meanings of technoscience into and out of competitive fields of play.

An important aspect of the narration of sport is the politics, and the multiple dynamics of technoscientific “fixing.” Sporting cultures can deploy technoscience similar to the way Lisa Rosner writes about the ways in which individuals and institutions unsuccessfully use technology to resolve convoluted social and cultural problems. Sport governing bodies
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have used technoscience to fix imbalances in sport, as in the cases of improved timing devices, instant replay, and ball tracking, or just to make sure that all players use equivalent equipment. Technoscientific fixing in a sporting context has also been about fixing meaning. Ian Woodward contends that the desire to narrate and fix objects is prevalent “in settings and spaces where the meaning of objects is open to interpretation or debate, or where people are anxious about . . . the meaning of objects.”

This tension over the meaning of technoscientific objects is so powerful because it can influence a sport’s social and cultural identity.

Knowing, understanding, controlling, or fixing the meaning of technoscience relevant to a game is deeply important because the specific use or nonuse of technoscience helps to shape and define a specific sport’s culture. The ways in which sporting cultures narrate technoscience is important because these narrations channel historical and nostalgic forces through the circulation and exchange of stories. The power of these narratives is that they inform old and new members of a community about the sporting culture’s history, as well as impart the valued perspectives and interpretations regarding the place of technoscience within a specific game. This consistency becomes deeply meaningful for making historical comparisons of records, athletic performances, or teams.

Determining if the 1927 New York Yankees were as good a team as the 1998 Yankees requires standardized metrics. Comparing track and field athletes such as Jesse Owens, Carl Lewis, and Usain Bolt necessitates a belief that each athlete ran under roughly the same conditions. Historically, these sets of culturally sustained collective beliefs avoid fully engaging the changing nature of sporting technoscience because it can potentially destabilize sporting culture’s narrative consistency. In the case of Owens, Lewis, and Bolt, the dominant narrative is that their athletic performances can be compared because of the pure athletic simplicity of running. In comparing the 1927 and 1998 Yankees, similar rationalizations are made. The game, at its core, is simple. To compete, all players must master throwing, hitting, running, and catching. The strategies used by players and managers have not appreciably changed over the decades. Combined, they present a strong narrative coherence on which a sporting culture can hang its traditions. Yet it is hard to maintain that the conditions, playing fields, and, most importantly, equipment were the same over time.
If one peels back the outer layers of these narratives, a critical evaluation of sport technoscience can compromise sporting culture’s narrative stability. Owens did not have access to the Puma evoSpeed Electric Bolt Tricks track spikes that Bolt wore at the 2016 Olympics or the benefit of competing on the speedy Mondotrack WS synthetic track on which Bolt won his third consecutive round of gold medals in the 100 m, 200 m, and 4\times 100 m races. Furthermore, Owens did not have access to decades of scientifically proven training methods to prepare for competition. The impacts of these elements, unlike 100 m times, are not easily quantifiable. Moreover, track and field has invested in timing as a constitutive element of comparative equality. Thus to compare athletes over time, game-altering technoscience must be eliminated from the narrative because it precipitates more questions than it answers and may potentially create narrative indeterminacy, where no athlete or team can be compared over time because the conditions of the games were so incommensurable.

Sporting cultures respond to technoscience in varying but deliberate ways. Regularly, the response is directly related to technoscience’s relationship with the body and its perceived impact on the authenticity of a sporting competition. When technoscience, which is initially accepted as inconsequential to a specific sport, is seen later as altering the competition, the common response has been to ban the technoscience instead of examining and reevaluating the terms, rules, belief systems, or traditions of a game. But of course, banning any technoscientific product is never simple or straightforward. In her important work on sport, body, and technology, Tara Magdalinski argues: “Although some technologies find a comfortable place in sport, those that are categorically rejected as inappropriately intrusive include any that threaten to fundamentally alter the body and its capacity.” Magdalinski’s observations and analyses are spot on, but it is important to move beyond merely examining technoscience and its relative distance from the body to understanding and reading the proximity of technoscience to the body against perceptions of authenticity.

Rather than investigating the tensions around the fear of the technoscientific altering of bodies—as in the case of performance-enhancing drugs—these studies examine the social and cultural processes by which technoscience, revealed as more than instrumental, moves from exciting and new to problematic and criticized, and, finally, vilified and banned. This is a crucial transformation in the technoscience and sport dialectic.
In this regard, this book explores the ways in which sport governing bodies, competitors, publics, and technoscientific actors respond to new and emerging technoscience when one or more of these groups no longer views a respective technoscientific object as instrumental.

**Interpreting Technoscience: Judging Artifacts and Evaluating Bodies**

To gain a fuller understanding of the multiple ways publics, sport governing bodies, technoscientific actors, and athletes negotiate the evolving relationships between sport and technoscience, this book is divided into two three-chapter parts: “Judging Artifacts” and “Evaluating Bodies.” Each section explores the evolutionary ways in which different constituencies within sporting cultures negotiate their relationships with the technoscience living within sporting competitions. The interactions described in part I investigate the social and cultural processes by which technoscience reaches a point deemed threatening enough that it must be removed from a sport. Moreover, these sections ask, does banning technoscience really solve the larger problem or does it motivate new technoscientific innovation?

Part II explores how testing techniques and regimes can support or undermine cherished narratives of the sporting body. Specifically, the studies discussed in this book examine how technoscience is deployed to conclusively determine what bodies are and are not permitted to compete. The chapters in both parts elucidate how technoscience unvalues historically valorized sporting narratives. Part I explores swimwear, athletic equipment, and prosthetic limbs to elucidate the ways in which sporting cultures have managed and negotiated new and emerging technoscience. Part II examines gender verification testing, the demise of direct drug testing, and the rise of indirect drug testing with the athlete biological passport (ABP) to explain the problems with technoscientific testing as a determiner of whether an athlete should or should not be allowed to participate in a given sporting competition. Though no discussion of technoscience in sport can be exhaustive, this book aims to present a coherent snapshot of the evolving place of technoscience in sport.
Judging Artifacts

For artifacts of sport, one must begin with the premise that most sports are played with some type of equipment. Though the form, materials, and style of equipment changes over time, these objects have generally been seen as inconsequential. Outside of color, style, or branding, these artifacts typically do not rise to a level of interest or concern. However, equipment has become a problem when it is perceived to give an athlete a significant competitive advantage. The past few decades of elite-level swimming have been defined by the evolution of swimsuit technology.28 When competitors first began wearing full-body compression fast suits in the late 1990s, the rhetoric about these suits was that they were “faster.” Nevertheless, there was not much science outside of proprietary research performed by racing swimsuit manufacturers. Early scientific studies did not fully support the idea that these new suits were markedly faster because a host of issues, from body shape and size to a swimmers stroke, ultimately influenced speed. Though the suits made swimmers more streamline, they also supplied motivation for swimmers to work harder because they felt that the suits gave them an appreciable competitive advantage.29 Consequently, confidence, rather than technoscientific innovation, potentially could explain the initial boosts in performances.

The real potent change in swimsuit technology arrived around 2008 with the introduction of Speedo’s LZR Racer suit. What made this suit unique was a new application of polyurethane that allowed the suit to reach new heights of hydrodynamic efficiency. By 2009, other companies, such as Arena and its X-Glide suit, pushed polyurethane suits to their technoscientific apex.30 These suits quickly became a requirement for any athlete who wanted to be competitive. Soon after, cries of “technological doping” began to rain down on the sport, and by 2010 swimming’s international governing body, Fédération Internationale de Natation (FINA), banned these types of suits in order to return the sport to the athletes. Yet it remains unclear if banning these devices will curtail technoscience’s power on swimming and its associated equipment.31

Sports that require some form of running necessitate the use of shoes. Yet athletic shoes traditionally have been seen as important, but not as transformative equipment. Famed stories such as that of Bill Bowerman and the creation of Nike’s first waffle-iron-soled running shoe are as
heartwarming as they are innovatively genius, but stories of athletic shoes rarely move to the realm of game-changing equipment. However, shoes can profoundly change the outcome of sporting competitions. From Adolf Dassler’s handmade shoes for Jesse Owens to wear at the 1936 Olympic games in Berlin to the National Basketball Association’s (NBA) ban of shoes by the little-known company Athletic Propulsion Labs, athletic shoes are complex and mildly understood artifacts of sport.

When the NBA introduced a new synthetic ball for the 2006–2007 season, it was the players, not the governing institution, that led the charge for its removal. In an effort to advance the game, the NBA deemed it necessary to use a new, technoscientifically designed basketball. However, the players, who did not participate in the decision to use the new ball, contended that it fundamentally altered the game and made it unsafe. In effect, the players argued that the ball was not an instrumental, mundane, or interchangeable piece of equipment but a central component of how they played the game. Their livelihoods depended on the accurate manipulation of this ball, and as a result they demanded a return to a leather ball because it was the ball they had become intimately familiar with. The players, by rejecting the synthetic ball, also inadvertently chose to express themselves as the rightful keepers of the histories and traditions of the game.

In the world of professional cycling, its governing body, the Union Cycliste Internationale (UCI), has made a concerted effort to sublimate bicycles to the body. Eddy Merckx—the undisputed greatest cyclist ever—and his 49.431-kilometer (30.715 miles) hour ride in Mexico City reveals the sporting culture’s power to diminish the importance of technoscience. The cycling community believed that Merckx had put the record out of reach and that it would potentially stand in perpetuity. Merckx rode a seemingly standard track bicycle, but when Francesco Moser broke the record twelve years later, his bike was far from ordinary. Moser ushered in the age of aerodynamics for elite-level cycling. From 1984 onward, the bicycles—and the athletes themselves—leveraged every permissible technoscientific aid to push the record farther and farther out of reach. By 1996, Englishman Chris Boardman stretched the record to 56.374 kilometers (35.029 miles) while riding the astoundingly aerodynamic Lotus Type 108 bicycle. In response to this and other technoscientific developments of the 1990s (e.g., performance-enhancing drugs) that questioned...
the place of the human body within the sport, the UCI deemed it was time to return cycling to its roots and champion human performance over technoscientific innovation.

The UCI decided to rewrite its record books and wipe away all the hour records that came after Merckx. Merckx, his ride, and his bicycle quickly migrated from a historically valuable record-breaking set of artifacts to represent a fundamental shift in the way the sport of professional cycling would use and interpret technoscience and athletes’ bodies. The UCI deployed Merckx to curtail the public flogging that the drug-challenged sport received in the press during the last five years of the twentieth century. It comes as no surprise that the UCI, in an effort to maintain its brand, returned to its most valued living legend, Eddy Merckx, and to a perceived moment of pure cycling performance and achievement—when a man was truly mightier than the machine. Yet the irony is that Merckx’s machine was far from ordinary. It was the cutting edge of technoscientific design expertly executed by master frame builder Ernesto Colnago. Thus returning a sport to a historically valorized point in time does not mean that it is any purer of a technoscientific moment.

Technoscience can also influence debates and tensions about what it means to be an able-bodied or disabled athlete. Prior to the unraveling of Oscar Pistorius’s heroic story with the conviction for the murder of Reeva Steenkamp, the bilateral transtibial amputee’s extraordinary sporting records were moving and awe-inspiring. His accomplishments within the Paralympics, however, were understood in a vastly different way in an able-bodied Olympic context. Pistorius’s J-shaped carbon fiber prosthetic limbs, designed and manufactured by the Icelandic company Össur, prompted questions about performance enhancement, unfair advantage, and ineligibility. Additionally, and predictably, the world of track and field feared a post-Pistorius, high-tech athlete invasion.

At first glance, it seems obvious that prostheses violate the International Association of Athletics Federations’ (IAAF) ruling of March 26, 2007, which prohibits “any technical device that incorporates springs, wheels or any other element that provides the user with an advantage over another athlete not using such a device.” In fact, many commentators suspected that the IAAF devised the rule to prevent Pistorius’s Olympic bid. The IAAF denied such a motive. Nonetheless, based on testing for an unfair advantage in January 2008, the IAAF determined that Pistorius
was ineligible to compete in the Olympics. The IAAF used a December 15, 2007, report by Professor Gert-Peter Brüeggemann of the Institute of Biomechanics and Orthopedics at the German Sport University in Cologne to reach its conclusion. The most relevant part of the report states that “in total the double transtibial amputee received significant biomechanical advantages by the prosthetics in comparison to sprinting with natural human legs.” Four months later, the Court of Arbitration for Sport (CAS) reversed the IAAF’s decision. Redefining what constituted unfair advantage, the CAS declared Pistorius eligible because its own testing showed that the Össur prosthetics offered no net advantage. The IAAF did not contest the CAS ruling and agreed to allow Pistorius to run if he produced an “A” standard qualifying time before the 2008 Olympics, but, unfortunately, he was unable to achieve that mark of entry. He did, however, qualify for the 2012 Olympic Games and became the first athlete to wear prosthetic limbs in the able-bodied Olympics. This reality only fueled the fear—and excitement—about technoscience reconfiguring athletic competition.

The Pistorius case exemplifies how meanings about embodiment are routinely contested and negotiated. It demonstrates how such challenges reinforce—the concept of fairness—an already-presumed notion of what a sporting body is and should be. Pistorius’s eligibility relies on the processes of normalization that locate and classify bodies as acceptable for competition. But we should not lose sight of Pistorius as yet another in a growing number of examples that expose the failure of the modern sporting paradigm. Indeed, as Pistorius and the CAS’s ruling that allowed him to compete against able-bodied athletes draws attention to the complexity of science, technology, and sport, they also draw attention to the instability of all bodies and, by extension, the inadequate conceptualization of the athletic body as sport’s sacred ground. It seems that sport governing bodies have taken on the responsibility of policing this ground because of their social, cultural, and financial investments in protecting the illusory sanctity of human competition. Ironically, these governing bodies have begun to rely more heavily on the power and authority of science and technology to protect their sports from unwanted, unwarranted, and undermining technoscientific practices and devices.
Evaluating Bodies

Sport is as much about competition as it is about evaluation and testing. During events and training, athletes measure themselves against others. Seeing how one athlete compares to another is a fundamental element that draws publics, governing bodies, technoscientific actors, and athletes to sport. The quest for the most effective evaluative tool, technique, or process supports entire industries. Organizations such as the World Anti-Doping Agency (WADA) and the International Olympic Committee (IOC) have done their best to test athletes within a set of legal, fiscal, geographic, scientific, and technological constraints to ensure that competitions are as fair as possible. But what function does testing serve in sport? There are many answers to this question, but in the sporting context, testing, at least superficially, determines which athletes, or bodies, can and cannot compete or will and will not be sanctioned—all in the name of fairness in sport. Increasingly, governing bodies, publics, and athletes themselves appeal to technoscientific tests to “answer” this question. But should anyone use the results from technoscientific testing to determine who can and cannot compete or who will and will not be sanctioned? Many would argue, absolutely not.

Testing has been deployed to divide sporting competitions by sex. Historically, this has been easy because it is seemingly familiar and simple to understand. When questions arose about sex, it could be tested in the form of gender verification testing. Twenty-first-century variabilities in sex and gender identity, however, make male/female testing seem significantly out of date. Though these tests have been criticized and mildly destabilized, sport governing bodies have not abandoned them completely. What if sex testing within sport performed different work? Instead of using verification testing to distinguish between males and females, what would happen if sporting cultures embraced the continuums of gender and sex to rearticulate these and similar testing instruments to create more interesting and relevant competitions? By winning the 2009 800 m world championship, South Africa’s Caster Semenya raised the possibility of this option.

Throughout Semenya’s career, her powerful physique has raised questions among her competitors about her sex and gender. Initially, the IAAF responded to these concerns by pulling her from competition in the
fall of 2009, only to reinstate her in 2010 with no indication of what decision had been made regarding her sex and gender. Sadly, this situation was not any clearer when she won the 800 m gold medal at the 2016 Rio Olympics. This is unfortunate because in a world where gender, sex, masculinity, and femininity are getting murkier by the day, guidance by one of the world’s largest sport governing bodies would have been a practical data point. It also emphatically signifies the limits of these types of evaluation. Despite many tests, the outcome was no clearer than at the start. But perhaps it does not need to be any clearer because it is the binary structure of sex-based competition that should be questioned instead of an athlete’s body. After several decades of attempting to understand the place of sex and gender in women’s sports, the IOC has given up on gender because sex was seemingly easier to quantify. Science has been so good at quantifying, measuring, and classifying the world, so why wouldn’t it work for sex? This decision seemed scientifically plausible because with most everything in sport, someone has attempted to quantify it. It is disappointing that the IOC did not try harder. It seems as if the IOC learned enough to realize that acquiring an incontrovertible understanding of gender is impossible, so it took the easy way out by recusing itself without even attempting to affirmatively state that both sex and gender are social and cultural constructions rather than definitive bodily categories.

When the IOC and various international sporting federations endeavored to contain the explosion of anabolic agents within sport in the late 1960s, they began the process of developing a robust network of governing body interests, athletic concerns, and technoscientific instruments. Though far from perfect, over the next few decades the anti-doping movement effectively enrolled human and nonhuman actors into these anti-doping networks. Currently, these networks struggle to maintain their position of power and privilege because recent events display how ineffective the entire process is for determining wrongdoing. The list of athletes who have admitted to using banned substances but were never caught, as well as the list of athletes whose mishandled samples or incorrect testing protocols enabled them to avoid sanctioning on technicalities, is long. Though the anti-doping movement bolsters its vision from outward attack by raising its collection, transportation, and testing protocols to forensic science levels, it is questionable if making anti-doping more “technoscientific” will assuage larger public concerns about its efficacy.
Testing regimes allow for the abandonment of the important balance between technoscience and culture. Initially, technoscientific testing supported heavily negotiated ruling decisions, but as technoscientific tools migrate from support mechanisms, to enforcement devices, to, finally, rule-making instruments, sport may begin to lose sight of its social and cultural goals in exchange for reigning in a runaway drug culture that many governing bodies see as undermining, and eventually destroying, the integrity of their sport. If sport is supposed to be a microcosm of our society, let us bring a bit more of society back in and have more collaborative and collective discussion about the place of technoscience within sport.

The primary model of enforcement and deterrence was and still is direct testing. But over the past decade, strides have been made to create new tools that move from the publicly conclusive measures of direct testing to the potentially gray, fuzzy, and publicly indiscernible black-boxed methods of indirect testing. Thus the anti-doping movement appears to be, at least publicly, moving away from red-handed doping confirmations to multiple experts analyzing data sets that allude to some form of misconduct. In an effort to curtail drug use and maintain the illusions of clean and pure sport, sport governing bodies, fans, and athletes appear to have forgotten that technoscientific testing began to support and not define who can and cannot compete or who will and will not be sanctioned. Some sports simply avoided testing altogether until recently. In the United States, 2012 marked the debut of blood testing for HGH in Major League Baseball (MLB). This plan made MLB the first major sporting league in North America to test its players for HGH. MLB can only be given a partial congratulation, however, because though minor league players are tested all year, those in the major league are only tested in spring training and in the off-season. In 2012, the National Football League (NFL) was much further from testing than MLB. Though the National Football League Players Association (NFLPA) agreed to HGH testing in 2011, it spuriously contested the legitimacy of the test, halting its implementation. There seems to be a valid reason why the NFLPA derailed the testing. Former NFL quarterback Boomer Esiason implied that as much as 60–70 percent of NFL players used HGH.45 For testing to be effective, it first must be implemented.

The United States Anti-Doping Agency’s (USADA) case against Lance Armstrong represents the most recent death of the direct testing model. Armstrong has never been sanctioned for having banned substances
in his blood or urine. The evidence wielded against him did not contain any direct testing evidence. Since the USADA was able to take down Lance Armstrong without direct testing, there is conceivably no longer a need for this type of assessment. But will the public accept this change? Anti-doping organizations have so heavily hung their sanctioning authority on the perceived technoscientific power of direct testing that other forms of evidence may not be as convincing. The anti-doping movement persuaded the public to believe that direct testing would provide irrefutable evidence of illegal behavior, but this push did allow the anti-doping movement an exit plan if and when the ineffectiveness of direct testing was exposed.

If Lance Armstrong represents the death of testing, then the ABP is the resurrection. In the early 1990s, EPO became the most potent drug for endurance sport. Its effectiveness in increasing the oxygen-carrying capacity of blood, to unhealthy levels, was unquestionable. The ABP is a response to this and other similar drugs. In 2006, the science, technology, and cultural impetus coalesced in the WADA’s Haematological Working Group. This group supported the broad idea of an “Athlete’s Haematological Passport” and chose a model devised by a group of researchers led by Pierre-Edouard Sottas. Sottas’s group made a case for using statistical classification techniques to develop a more comprehensive method of determining if athletes used blood-boosting drugs such as EPO or increased their performances with blood transfusions. Early on, there was great enthusiasm about the ABP significantly curtailing all forms of doping. The UCI emphasized that new, indirect modes of detection would bring a higher-level technoscientific rigor to effectively uncover offending behaviors. Though other sport governing bodies, such as the IAAF, are buying into this tool, scientists are less convinced of its regulatory power. In fact, very recently international journalists have exposed a problem with this model by showing how a technique called microdosing can effectively subvert the ABP’s testing protocols.

Just as sport is a defining element of the modern world, technoscience’s material and conceptual power influences how societies define themselves and fulfill hopes and dreams about brighter futures. Since the mid-twentieth century, sport and technoscience have become two of the most dominant and defining cultural and societal narratives. Technoscience has been and will always be part of sport, though some may not want to embrace its power. This book is about understanding the power of technos-
science and what that power means for the future of sport. Collectively, these case studies illustrate that in certain instances technoscience must be disciplined and eventually excised from sporting cultures to secure a certain future. What that future of sport becomes is difficult to determine, but until a new understanding of technoscience is embraced, the future of sport will be steeped in traditions, histories, and nostalgias that will continue to battle against technoscience in order to maintain the primacy of the human body in all athletic competitions. The space between sporting traditions, bodily ability, and random acts of life is the messy place where technoscience resides within sport. It delicately dances between athletes’ needs, publics’ desires, engineering visions, and governing bodies’ legislation. The subsequent chapters aim to begin the process of understanding these ever-evolving, culturally embedded technoscientific relationships.