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The Influence of Science and Technology on the development of
modern “codified” sports

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The influence of technology on the development of modern “codified” sports

Introduction

This work aims to demonstrate that modern “codified” mass sports are a consequence of the industrial revolution, and that their growth and success has been influenced by several new technologies and inventions which caused some significant “turning points” in their organization and practice.

In modern industrial society, the development of sport practice has been influenced top down and bottom up, which means that the demand for sport has come both from governments, interested in sports as a factor of individual and collective health and a way to improve spirit of cooperation and national pride, and from society, interested in finding new activities and events for the “leisure time” generated for the working masses by the new labour organization of the industrial era.

As we will see, the innovations that influenced the evolution of modern sports came both from the governments, from their research and investments, and from the many national and multinational enterprises and communities, which quickly understood the relevance of sport for the modern mass market.

The modern sport culture took the move from the new levels of attention dedicated by Renaissance artists and scientists to the human body, then increased its importance during the Age of Enlightenment and Positivism as a mean to organize and improve the education of the masses, and took a final shape in the age of industrial revolution when leisure time and mass gatherings became a common standard around the world, through internationalization and globalization.

This evolution has been accompanied by a steady assistance provided by science, research, technology, mass equipment production, but also by politics and media, which were essential in keeping high levels of attention for physical activity, sport competitions and sport events as means to assure healthy nations and communities (also on the base of equal opportunities) and the pervasive persistence of a spirit of competitiveness, which is deeply enshrined in western culture, which has been exported worldwide also through the British Commonwealth.

The industrial revolution generated a new organization of work, a reduction of the working hours and the consequent new organization of leisure time. This process was accompanied by a new urbanization trend and new logistic systems which connected residential areas, factories and sport infrastructures in a more efficient way. Among the consequences there were sport teams organized by factories, by labour organizations and even by catholic organizations which aimed at assisting workers like the YMCA. The concentration in urban areas of a growing amount of paying spectators for sport competitions transformed sport competitions in a much appreciated and emotional show which attracted media operators (at the very beginning newspapers and magazines but then also television and eventually internet) and the gambling operators, starting an international obsession for performance measurement and records, which have been pushing forward a global sport industry that has reached, according to some analysts, a total value of nearly 700 billion dollars.

The growth of the modern sport industry has been widely favoured by new means of transportation, like bicycles, automobiles, trains, ships and airplanes, which on one side provided a new mass mobility which allowed the organization of ever-growing national and international competitions and the other side became a new tool for competition like cycling and car racing, branches which have been deeply influenced by innovations in aerodynamics, engines, gears, rubber and other materials.

The search for records led also to a deep research in the field of physiology and to the growth of doping technologies, which have been accompanied by new sophisticated training and nutrition systems.

All this process generated a global professionalization of sports, as a consequence of the demand for more constant performance and a regular planning of the events, but also a professional production of sport equipment with the involvement of former athletes and the development of multinational industries specialized in sophisticated sport apparel.

Finally, the impressive economical dimension achieved by sports has also attracted the interest of sponsors that are not directly involved in the sport competitions, but which try to improve their global image associating their brand to the positive message delivered by sports to the community of consumers, like it happens today with banks, insurance companies, beverage makers, car makers, real estate developers, some of which are among the main sponsors even in non-professional competitions like the Olympic Games.

Chapter 1:

The philosophical roots of modern sports: Renaissance, the Age of Enlightenment and the Positivism

The ancient Greek civilization, more than twenty-five centuries ago, was the first to understand the importance of the physical development of each individual, not only aimed at military goals, but also as a mean for a young citizen to achieve the moral and intellectual virtues required by the society. The Greek city-states considered a “Hero” a citizen that led and won a battle or, at the same level, a winner of the Olympics. It is interesting to notice that in the ancient Greek language the word “*heros*” meant servant, therefore a person being at the service of the community; there was a focus not on the individuality, which in this case of the winner seemed more natural, instead something useful conveyed to the life of the whole society.

It is also relevant that Greece had never contemplated the culture of physical education detached from the scholastic education. The well-known Gymnasium was a place where all male infants could exercise themselves in many different athletic disciplines. The facility was always coupled with an antique form of gym, as location for the purposes of the growth of the youth.

The benchmark was the Apollonian concept of beauty matched with a honest soul. They used the word “*kalokagathia*” (*kalos kagathos*), which meant “beauty and kindness”, therefore a valorous person who bore all the most important virtues. Furthermore, Greece adopted the word “*paideia*” (*paídos*), which meant “youth”, as an educational and pedagogic model to comply with in order to become a perfect citizen. Inside this model was prescribed the gymnastics as fundamental for each future member of the community (Brunamontini, 1989).

One of the most important movement, which came back to the Greek ideals, was the renaissance. The two most important treaties were written by Leon Battista Alberti and Giovanni Dominici.

Alberti, one of the most significant versatile intellectual of those years, wrote the essay “*Libri della Famiglia*”, four books focused on the good organization of a family. He wrote about the education of children and the care of the body and mind. He thought that it

was beneficial for an infant to live in a villa in the countryside (opposite to the trend of that period, where people started to move to urban areas), for many reasons: the child would have learnt to train his body to help the family with housework, therefore becoming more robust and agile; secondly, he would have begun to love the nature and grew fond of the animals, which were, in Alberti's opinion, important activities to develop personal virtues. About the care of body, he said: "il corpo è cosa buona e grande, adoperolo in cose oneste, utili, lodate e grate e cerco conservarlo quanto più posso, lungo tempo sano, robusto e bello[...]l'esercizio è necessario ai giovani, utile ai vecchi, e colui solo non fa esercizio, il quale non vuole vivere lieto, giocondo e sano".

Giovanni Dominici was a catholic cardinal and archbishop of Ragusa in Dalmazia (Republic of Venice). He wrote "Regola del governo di cura familiare", an essay on the education of children and the soul and physical ability of each person. It can be considered an innovation because it was one of the first clerical to confirm the importance of pedagogy and create a connection between the spiritual and real world (Brunamontini, 1989).

Many intellectuals of the Italian renaissance humanism helped reinvigorating the ancient Greek tradition and there was an upswing of pedagogy and gymnastics.

They recalled the fact that it was the greek doctor Galenus during the second century A.D. to separate physical activity and medicine, stating that "the art that leads to a stable condition of health is clearly different from the one that cures a patient. (Galeno, 2020, p. 43), adding also that four are the branches that modify our body: surgery, pharmacy, diet and physical exercise". Galenus, in his works, mentions also the words of Plato in his essay "Gorgia": "I say that the main arts are two: the one that deals with the spirit, I call it "politics", while the one related to the body can be called with only one name: considered that just one is the cure of the body, two are its parts: one is gymnastic and the other one medicine". Furthermore, Galenus claimed that not all gymnastics was good, meaning that it should be done in the correct way, limiting its excess. Moreover, he suggested the "play of the small ball", because it complied with the requirements of a healthy exercise and it lent to each individual grace, elegance and harmonious proportions (Galeno, 2020).

The first treaty of sport medicine was written by Girolamo Mercuriale, named “De Arte Gymnastica”, it was published in Venice in 1569. Mercuriale lived in Italy during the middle-age and was a follower of Galenus, in fact in his essay he followed Greek and roman medical principles. In his treaty he developed several subjects linked to physical activity, like medicine, pediatrics, therapeutics and toxicology.

Another important author of the Italian humanism was Pier Paolo Vergelio, a pedagogue who lived between the fourteenth and fifteenth century. It is essential to remember Vergelio because he gave rise to a new pedagogy that from Italian city-states (in particular from the Republic of Venice, where intellectuals benefited of much more freedom, compared to other locations in Europe) spread in whole Europe.

He wrote one of the first and most relevant treaties about “liberal studies”, named “De ingenuis moribus et liberalibus studiis”, dealing with the education of infants (especially children of well-known citizens, as Umbertino, twelve years old, son of the aristocrat family which administrated Padua at that time). He thought that there were two essential pillars in education: the family and the school (“humanitas”). The family was essential to teach the infant ethical principles, in order to shape his personality and move him away from negative behaviors that once acquired, become difficult to eradicate; the second important aim of the family was to discover the real vocation of the baby, to find his role in the society after adolescence. Instead, concerning the school, he recommended a “curriculum studiorum” of liberal studies, including subjects like philosophy, history, art, and drawing, with the final aim of training “free-individuals”, who will fulfill a relevant position in the community. Concerning physical education, Vergerio, claimed the importance of two types of movement: the first should be soft until puberty, and then be expressed in many activities like fencing, running, jumping, wrestling, archery, horseback riding and swimming; the second consisted of those leisure activities which helped reinvigorating the body and that each person could practice during the day, like the “play of the ball”, fishing and hunting (International Standing Conference for the History of Education, 2015).

What’s more, the artists of the Renaissance age were not satisfied, when drawing the human body, with copying the nudes of antiquity, and in order to better understand the shape and movement of the human body they were interested in anatomical dissection.

Traditional courses of instruction for aspiring artists often included a study of human anatomy, and the Florentine Academy of art was the first to institute an obligatory course in anatomy, in which artists copied directly from cadavers and skeletons. Thus, artists were exposed to medical knowledge imparted during public anatomy sessions, and became part of the Florentine Guild of Physicians and Apothecaries. Even the famous Italian artists Michelangelo and Leonardo, according to their biographer Vasari, were regularly performing their own dissections and demonstrations. Leonardo anatomized more than 30 bodies for the drawings in his notebooks, and was the first of his age to invoke mechanical principles to explain the action of muscles, bones, tendons, and ligaments (Singer, 1950).

Also in the case of Michelangelo, according to Vasari, his “ Last Judgment”, with its 300 human figures inspired by his anatomical studies, was intended to represent “The most perfect and well-proportioned composition of the human body in its most varied positions”. (Garabed, 2000).

This kind of scientific and artistic revolution seems to have been started already by the end of the 13th century at Bologna, by Remondino De Luzzi (1270-1326), an Italian physician and professor of surgery, credited as “ restorer of anatomy” because he reintroduced , after centuries of Christian opposition, the practice of public dissection of human cadavers, writing the first modern anatomical text, “ Anatomia corporis humani”, written in 1316 and published in Padua in 1478, which remained the sole textbook on anatomy for over 250 years (Gurunluoglu, et al., 2013).

According to Burkhart, a Swiss historian expert about the Italian renaissance period, it's impressing how Italian intellectuals of the humanistic movement were able to convey many sport disciplines and physical exercises to all the future European countries (really similar to the same sports that we practice nowadays). Moreover, he thought that the first intellectual who outlined the gymnastics as an independent discipline (separated from medicine), was Vittorino Rambaldoni from Feltre. He first came up with the expression “universal man”, which meant health of body, strength of character, wealth of mind; in fact he focused much on physical education because he thought that his pupils must firstly develop the body, necessary condition to achieve the proper mind and heart. In Mantua, he taught to students coming from different social levels, teaching them the same subjects, allowing them to attend the same courses, and educating them

equally. He developed a rich sport program of healthy physical education, accurately linked to the development of willpower and character. He encouraged his students to stay as much as they could outside, doing sport activities like ball, running, jumping, throwing, wrestling and single gymnastics exercises, in order to strengthen the body in bad weather condition and release natural exuberance thanks to sport competitions (Brunamontini, 1989).

Also Geronimo Mercuriale, a professor in medicine who was active in Padua, Bologna and Pisa in the 16th century has to be mentioned for his book “*Artis gymnasticae apud antiquos celeberrimae, nostris temporibus ignoratae*”, published in Venice in 1569. The title itself underlines the need for the society of the time to rediscover the Greek and roman value of physical exercise. In fact the book is a history of the attitudes and practices of the Greeks and Romans , quoting 120 different works of ancient authors, in regard to diet, hygiene, bathing and exercise, and their effects on health and disease. This work proved to be popular and went through six editions, the last printed in Amsterdam in 1672. It was the first illustrated book on the relation between medicine, sports and the role of exercise in gaining and preserving health (Peltier, 1984).

The Age of enlightenment begins during the first quarter of the eighteen century. It is known as one the most important period in history, focusing on the development of individual rights and society. There was an exceptional growth in many different fields, from science and sociology to economics and law. The pedagogy is not an exception. Among the most important philosophers of that period, Rousseau was the one more interested about the nature of education. According to his principles, each man or woman consists of a soul and a physical body. Therefore, there would never be a full development of the individual whether one of these two is still underdeveloped.

Another philosopher of the Enlightenment Age, John Locke, was guided by empiricism. God provided us with a body, therefore, in absence of it we would not survive. Following this assumption, he claimed that through a proper use of the physical education, people can avoid many pathologies. He thought that the final aim of education is to give the child all the means to develop virtues, using the power of reason to overcome desire. Nowadays it seems weird, however the recommendation of Locke to parents was to dress the child not too warmly and to use only light shoes, in order to strengthen the

body of the infant. What's more, he suggested to teach children how to swim since their first years and to spend as much time as possible outside. He said: "the more they are in the air, the stronger and healthier they will be" (Brunamontini, 1989).

Jean Jacques Rousseau was partially influenced by Locke, he thought that physical education was a way to stimulate the child to reach his real nature, which is primitive, instead of rational.

The most important writing of Rousseau is the "Emile", in which he explained why the western system of education is flawed and how a child should be educated in order to become an ideal citizen. Rousseau was certain that each child should be allowed to learn and develop according to his natural inclinations, in particular, he spoke about "natural" education, which meant an education that will create natural human beings. Emile exercised early in the morning because he needed to strengthen the body and, by consequence, a strong body was the basic requirement for a healthy soul. Moreover, he stated that natural education through gymnastics is a useful contribution to the development of moral traits of the infant. Finally, he stated that each school should have a proper area for the training of the students (Brunamontini, 1989).

According to Rousseau's recommendations, Emile exercised early in the morning to improve strength. A strong body was the basic requirement for a healthy soul. Therefore, Emile was taught to run with bare feet, to jump high and climb walls and trees, and had to master such skills as jogging, swimming, stone throwing, archery and ball games (Demirel & Yildiran, 2013).

In Rousseau's opinion, the child's education had to be purely negative: it had to keep the child's mind inactive as long as possible while exercising the body and the senses, and it should avoid verbal lessons in favour of experience; the essential thing would be to make the child a good healthy animal, prompting him to pursue the fulfillment of his desires in the natural environment. If there had to be a school, then Rousseau wanted every school to have a gymnasium or an area for training (Collins, 1976).

Another important writing of Rousseau was the "Treaty for the polish government", in which he stated that a reform of school program of physical education is needed to steer a social and political revolution: according to his idea, the nations were moving to a mass society and the States were shifting from a feudalistic society to nationalistic monarchies (Brunamontini, 1989).

At the end of the eighteenth century, following the enlightenment age and the division of power, for the first time in history the need to conceive and contain the masses emerged. One of the most disruptive period in history was happening, and by consequence, a social and political revolution in Europe had taken shape. That was the end of feudalism and the birth of nationalistic monarchies, the latter combined with a maturation of an important feeling of the State and the native land.

Furthermore, even though later than in Great Britain, European countries were passing through a technological development never seen before, which led to many discoveries and inventions, like power loom, steam engine, machine tool and train. Considering the important inventions in the military field, there was an appreciation of masses as a tool to protect the national sovereignty.

The positivistic movement, which was spreading mainly in European countries like France, Germany and Italy, linked to the necessity to develop and promote healthy and robust youth and gave rise to an emphasis on gymnastic as a mean to create a strong and prepared army.

Positivism was a philosophical theory that held that all genuine knowledge is either positive - a posteriori and exclusively derived from experience of natural phenomena and their properties and relations - or true by definition, that is, analytic and tautological. Thus, information derived from sensory experience, as interpreted through reason and logic, forms the exclusive source of all certain knowledge. Sociological positivism holds that society, like the physical world, operates according to general laws. Introspective and intuitive knowledge is rejected, as are metaphysics and theology because metaphysical and theological claims cannot be verified by sense experience (Macionis & Gerber, 2010).

This movement aimed at overcoming metaphysical thoughts and, instead, focus on the real world and real things.

The positivism message "Kein Metaphysik mehr", challenges the power of the spiritualism and the unknown. It aimed at recognizing the dominance of science.

Moreover, the takeover done by Napoleon Bonaparte at the expense of other European countries (German countries and Prussia), was another reason to shift the focus to the

physical improvement, in order to have well-prepared youths and armies ready for a potential war (Dietschy & Pivato, 2019).

The pedagogue Johann Bernhard Basedow, born in Hamburg in 1724, was a teacher who first, after many centuries, re-discovered the idea of Gymnasium and tried to replicate it. Interested about cutting-edge theories on education disseminated by intellectuals like Locke and Rousseau, he founded the first German Gymnasium, named Philantropinum, in 1774 in Dessau.

The Philantropinum's main focus was on practical activities and a pragmatic approach to teaching. On the one hand, scientific subjects like anatomy and physics were emphasized. On the other hand, handicrafts activities were considered really important as well, so all students had to learn manual works like carpentry, help in the garden and in the shop. The teachers had to use a non-authoritarian approach, stimulate the creativity and self-direction through purposeful activities of pupils and let them learn through games. All students had to do physical activities and go hiking (Britannica, The Editors of Encyclopaedia. "Johann Bernhard Basedow". *Encyclopedia Britannica*).

Contrary to the contemporary fashion, students of the institution in Dessau had their hair cropped short; they were not allowed to wear neck-ties, and they had to wear their shirt with open collar. Their clothes were loose and comfortable. They bathed in cold water and slept in hard beds. In food and drink they followed a natural diet. Classes lasted only half an hour, and between classes children were always allowed to have half an hour for refreshment. The playing of wind instrument was encouraged for the reason that it develops the strength of the lungs (Virag, 2019).

The innovative thought of Basedow was that the best way for a country to achieve political and social reforms, was firstly through a school reform. His idea was that if knowledge is properly conveyed, this will lead to the perfection of man and his institutions. The school had to prepare children for a patriotic life of service to the community. Since school functions for the individual, it performs a service also for the state.

The two most important German pedagogues, which took inspiration from the innovative work on physical education of Basedow, were Guts Muts and Jahn.

Johann Guts Muts was a German pedagogue and educator, called “grandfather of gymnastics”, because he was the first to introduce systematic physical exercise in the school curriculum and he wrote the first course book of gymnastics. His most important essay was “Gymnastics fuer die Jugend”, published in 1793, a really innovative text focused on new physical exercises, many of which invented and designed by himself. From the text it’s possible to sense how Guts Muts analyzed the classic Greek physical education, in fact many of the exercises that he recommended were the same as those on ancient Olympics. In particular, he listed twenty-nine different exercises, divided in two parts. The first, the same five exercises as the Greek pentathlon: the stadion (a short running race), javelin throw, discus throw, long jump and wrestling. In the second part there were all the exercises invented by him, which concerned many different disciplines, like climbing, dancing, jumping, running, swimming and so on (Todd, 1992). It is interesting that in one chapter of the textbook, named “Ball mit Freistaeten”, he explained this new discipline, which was the forefather of modern baseball (Hershberger, 2015).

His following book, “Spiele zur Uebung und Erholung des Koerpers und Geistes” published in 1796, can be qualified as the first pedagogical game-book of Germany and is divided into the following major chapters: ball games, playground games, marble games, skittles games, games involving poles and rings, winter games, parlour games, night games, individual games and further games. He is also known as the author of the first book on instruction in swimming, “Kleine Lehrbuch der Schwimmkunst”, which appeared in 1798 (Virag, 2019).

Guts Muts was also positively influenced by Rousseau on the subject of youth education. But, even though he agreed with most of Rousseau’s ideas, he thought that social progress was positive and that the human nature in some cases can commit errors, leading youngsters to a bad end; therefore, there must be a supervision.

The so called “father” of modern gymnastics, Friedrich Jahn, born in 1778 in Prussia, was stunned about the situation that his country and Germany were passing through. Napoleon’s army command over Europe, especially his troops’ occupation of Prussia, let Jahn come up with the belief that gymnastics had to be aimed at military purposes in order to free the homeland from the invaders.

The works of Jahn were based on two principles: the “koerperkultur” and “die Turnen”. The meaning of the former is “culture of the body” with the focus on the physical stamina, pedagogy’s aim was to develop will, personality and discipline. Moreover, physical culture was a mean to create consciousness of the native land, to affirm the country independence from foreign States and ethnicities and to defend traditions, customs and the language (“Deutshes Volkstum”), protect German folklore and ban foreign terms).

The “Turner”, also called “Turnverein” (gymnastics association), was a place similar to a gymnasium, which was considered, in Jahn’s opinion, the best location where youths could be educated and trained to become members of a community. They had to wear the same uniform and practice the same exercises. There was limited room for open-air activities and creativity, fantasy and entertainment were suppressed (Krueger, 2021).

Jahn invented in 1810 the parallel bars, which were constructed from two bars nailed on two tree boles, with the use as auxiliary apparatus for trainees’ preparation for the vaulting horse. This tool later evolved into an important gymnastic apparatus, which also was designed as a mobile tool with adjustable height, that held primary place in the German gymnastic system and instrumental gymnastics (Kaimakamis, et al., 2010).

Unfortunately, the increased focus on the perfect body and military goals was one of the cause of the several ethnic genocides of the twentieth century. At the beginning of the twentieth century, in whole Europe, the book of the Danish educator Jorgen Peter Mueller, “Mein System” became very well known. In it he explained how to improve individual and collective health through meticulous hygienic and dietetic rules, physical practice and mental exercise. The Nazis took serious inspiration from Mueller and Jahn to develop their criminal program of eugenics and ethnic cleansing.

However, in other European countries the development of educational gymnastics didn’t follow the military scheme: the most relevant cases are France and Sweden.

In France, the influence of the Age of Enlightenment was still profound and the pedagogical method developed by Rousseau and the philanthropic movement left its mark. The main principles of the gymnastics were the liberty of the individual, respect of the personality and a just degree of naturalness. The educational method was mitigated compared to the German one, which was much tougher, and more similar to the Swedish, which adopted systematically scientific principles.

The French gymnastics movement was carried out by two educators, Amoros and Clias. Amoros was a Spanish army teacher, who moved to France and started to teach gymnastics at school. Influenced by Swedish and German gymnastics, he was one of the first educators to introduce music during the physical activity, aimed at improving rhythm and increasing the capacity of lungs, and he also worked along with scientists of the civil society in order to improve the gym equipment and tools. It seems that Amoros was the first to introduce, during his time in Paris, the feminine exercise called “flying course” (later developed by Clias) (Todd, 1992).

Clas was a Swiss educator concerned more on the pedagogical side of gymnastics in the strict sense, directed at the tasks and risks of life. He was interested about infants and how they adapt to the urban life, some better than others. He thought that the gymnastics is linked to nature, meaning that all gymnastics exercises arise from animal behaviors aimed at utilitarian purpose, and so, gymnastics should have utilitarian goal as well.

The last country, which deserves a mention, is Sweden, because one of the most important physical educators of Europe between eighteen and nineteenth centuries was Swedish: Pehr Henrik Ling.

Probably, after Guts Muts, he was the person who brought more innovations to gymnastics, many of which are still nowadays used in Europe and in other continents. Guts Muts had a consistent influence on him, in fact Ling was enthusiastic about his educational method. Ling started to travel around Europe to learn new different ways to approach and teach gymnastics to youths. Particularly important was his travel to France, where he began practicing fencing and understood the usefulness of physical exercises to solve chronic physical problems; in fact, he suffered from rheumatism and tested on himself the benefits of massage and passive body movements, like stroking, pressing and kneading.

After coming back to Sweden, he started teaching fencing and conveyed the benefits of sport and passive movement also to his athletes. He created a list of systematic exercises called “medical gymnastics, aimed at strengthening the body as well as the mind” (Melnick, 2015).

The forms of movement initiated by Ling were divided into active, passive and duplicated. Active movements were all those that presupposed the muscular activity of

the person being treated. Passive movements were when one or more gymnasts performed a movement with a patient body part without the latter helping or offering resistance; finally, duplicated movements were resistive movements that either the gymnast or the patient performed. The legitimacy of the method was founded on every movement being based on contemporary knowledge of a person's anatomy and physiology (Wanneberg, 2018).

For all his life, he worked in a very scrupulous and detailed way, day after day, step by step, to improve his exercises. Some of the most important gym tools that we still use indoors were developed by him: box horse, wall bars and beams; he also is recognized as developer of calisthenics (exercise many muscle groups with minimal equipment, most free-body) and one of the first to nurse rachis.

The impact of the Swedish Ling gymnastics for the development and physical education in Europe spread worldwide, and the Ling's gymnastics can still be seen practiced in schools in Asia and parts of Europe, and has been described as one of Sweden's biggest cultural exports.

Chapter 2: De Coubertin and the Olympic games

Pierre De Coubertin, was born in France in 1863, in an aristocratic family, which later guaranteed him the title of baron, as he was usually called, baron De Coubertin.

Even though his parents, following the aristocratic tradition, drew him towards an ecclesiastic career, based on theological studies, he had a great passion for diplomacy and preferred to study at the faculty of Political Sciences and Philosophy, during which, he developed good diplomatic skills and also discovered a particular interest for sport pedagogy (Brunamontini, 1989).

During his adolescence, De Coubertin grew up in a negative season for France, due to the crucial defeat of the French army against Germany in the battlefield of Sedan in 1870, and the humiliation that followed. This fact helped developing in his mind a patriotic sentiment, according to which he hoped to see France again as one of the most admired country in the World.

Moreover, De Coubertin was amazed by the records of the Victorian England and he was particularly impressed by reading the essay "Notes sur l'Angleterre" written by Hippolyte Taine, which gave rise to a common French anglophile sentiment. Enlightened by these beliefs, he claimed that the high development of English economy and society was brought about by its educational system and in particular thanks to the sport education (Dietschy & Pivato, 2019).

He was so positively impressed, that as soon as he had the occasion, during his studies in 1883, he visited England to better understand what was happening in that country and in order to better analyze that phenomenon called "athleticism" that was glorifying England. He visited many colleges, also one of the most important for the development of modern team sports, the college of Rugby, directed by Thomas Arnold, one of the father of the English well-known team sports. He came back even more convinced that the prominence and economic wealth of the British Empire was, firstly, based on an education focused on team sports, which allowed to develop intellectual properties and the consequent social development. Furthermore, he thought that competitive games adapted well to the changing modern times, because they were similar to the competitive principle of economic life as developed in England.

Once back to France, one of his first move was to promote the sport and athletics in the secondary school, which began compulsory in the following years (Weber, 1970).

Even though De Coubertin found the opposition of many influential politicians and aristocrats in France, he took advantage of his social connections to spread the number of athletic clubs among high schools and colleges in order to create an association of clubs. Following his steps, in 1889 the USFSA was founded (Union des Societes francaises des sports athletiques). In his thirties, de Coubertin became secretary director of the USFSA, the Association of athletic French clubs, therefore, this allowed him to develop the sport in France (Weber, 1970).

After this step, De Coubertin had the numerical power and social relevance to develop a global athletic movement, in the name of the rediscovery of the ancient Olympics, and promote France as the country that made this possible, allowing France to regain the high global status that it had in the past.

Luckily, during that period, thanks to the work of Ernst Curtius, a German archeologist, the ruins of Olympia were coming back to light and the news about ancient Greece and its Olympics proliferated. Moreover, at half of nineteenth century, the age of global exhibition started, and the one of 1889 had to be hold in Paris, which was a great occasion to promote France as one of the technologically-advanced leading countries in the world.

He waited for the right moment and during the fifth anniversary of USFSA in front of French authorities and the members of French clubs, he presented a report about the importance of physical exercise in the modern world. Explaining the topic on peace and globalization, he did a proposal: reorganize Olympic games, open to athletes coming from all over the world. He said:” let rowing, running and fencing athletes meet, this is the free market of the future”. He, then, said:” great inventions, like train and telegraph, allow people to live a new experience, all ethnicities are finally able to meet and, consequently, they are also glad to compare each other. The global expositions allow goods and products coming from the most distant zones in the world, to be showed on one single place. Why shouldn’t athletes meet, considering that emulation is the basis of the sport, and maybe also its source?” (Brunamontini, 1989).

De Coubertin thought that while the ancient Greek Olympics contemplated uniformity, which was an attraction for the spectator, who knew what he would see and what he could expect, on the other hand, in the modern Olympics the spectator would take

pleasure of variety and novelty, for two reasons: firstly, the facility and rapidity of transports have intensified curiosity; secondly, the duration of the life of a person has not been prolonged in proportion to the facts attracting his attention, and thus, he finds no pleasure in seeing things twice (De Coubertin, 1900).

The final goal of de Coubertin was to “globalize” sport, organizing the new Olympic Games because he thought that Olympia and the Olympics are symbols of a global civilization, which overcomes boundaries, and that is superior to nations, cities, heroes and ancient religions. He said:” Olympic games will dignify and strengthen sport, they will guarantee independence and create the conditions to carry out its educational role in the modern society.”

The first cornerstone of Olympic games was the international congress of USFSA organized in 1894 in Paris. Its name was “International congress of Paris for the reactivation of Olympic games”, and the main subjects were amateur and professional sport activities, and Olympic games. In particular, they discussed about: definition of these two concepts, suspensions, value of objects as rewards, betting and amateur sport (Brunamontini, 1989).

Despite De Coubertin preferred amateur sport, because he thought that the most natural form of sport was the one done by youths just with the aim of playing, he had the great intuition to understand that not all disciplines were done by amateurs or could be done by amateurs, and in order for all disciplines to be performed at the Olympics, they were divided into amateur and professional sports, with the only important task to draw a clear demarcation line between the two types (De Coubertin, 1900).

The effort of De Coubertin led to the creation of the strongest global sport organization, the IOC (International Olympic Committee), composed by the National Olympic Committees of more than 200 member nations, which organizes since 1896 the Summer Olympic Games and since 1924 also the Winter Olympic Games.

The IOC has become since then the greatest global sports organization with 4.1 billion dollars of revenues already secured, according to its financial statement 2020, for the time span 2029-2032. A relevant role in its activity is played by its main sponsors which are companies not directly related to sport activities, like AirBnB, Alibaba, Allianz,

Bridgestone, Coca-Cola, General Electric, Intel, Omega, Panasonic, Procter & Gamble, Samsung, Toyota, Visa.

The total revenues by Olympiad grew from 3 billion achieved in the time span 2001 and 2004 to 5.7 billion in the time span 2013-2016. The 2020 revenues achieved 600 million in the single year and 90% have been devoted to promote Olympic sports around the world and 73% of these revenues came from broadcasting rights for Summer and Winter Olympic Games and Youth Olympic Games, 18% from marketing rights and 9% from other sources. The IOC has a very strong financial position with total assets amounting at 5.7 billion dollars, of which cash and other financial assets at 5 billion (IOC, 2020).

Today the Olympic Games are undisputedly the biggest sport events in the world, and have achieved an incredible dimension of over 10.000 athletes gathering for the competitions with 300 individual events in 28 different sports and 42 different disciplines with around 10 million tickets sold to spectators and a worldwide television audience of billions of people.

All the major cities of the world compete to host the games even if the tenders issued by the IOC have become in the last decades more and more risky and complicated. In fact, even hosting such a global event has become part of the technical challenges and achievements of sport. To host the Olympic Games cities and nations have to face the challenge of taking the burden of very high costs, in three major categories: general infrastructure (for example transportation and housing to accommodate athletes and fans); specific sport infrastructure required for competition venues; operational costs including general administration, opening and closing ceremony and security. The challenge is so high that prior to 2000 only 18% of the bids submitted for the Summer Games came for the developing world or the former Soviet sphere of influence.

The latest requirements are very high: the host city needs to have a minimum of 40.000 hotel rooms and an Olympic village that can house 15.000 athletes and officials. The cities need to have both internal and external transportation facilities, that can get tourists to the city itself and then to the individual sport venues within the region. All the sport facilities need to be built or redesigned: for example, existing soccer stadiums are generally incompatible with a full-size Olympic track, because including space for such a track would cause an undesirably large separation between the fans and the playing field. Once the facilities are in place, also the spending for operations is very

hard to face: for example, in 2004 the Athens Olympic Games had a security expenditure that topped 1.6 billion dollars. As a consequence, Olympics have consistently produced final costs that exceeded their original budget. From 1968 to 2012 every single Olympic Game ended up costing more than originally estimated. On the average, the games were always 150% over the original budget, with Montreal 1976 and Sarajevo 1984 exceeding the initial estimate by more than ten-fold. For example, the 2012 London organizer originally won the bid in 2005 with a cost estimate of 2.4 billion pounds, which ended up with a final cost of 8.7 billion pounds (Baade & Matheson, 2016).

Chapter 3:

Sport and the expansion of leisure time in modern society

In the ancient Greek and Roman society, the time free from labour and engagement was defined as “skole” and “otium”, with the minimum time spent in a condition of non-necessity during which it was also possible to develop free philosophical thinking. In fact, the Greek and Roman society, were economically organized around the labour of slaves and servants together with war, robbery and military expansion.

Work was not considered a socially relevant condition. The condition of the citizens who are not subject to necessity was more prestigious.

According to these basic concept of free time, the English word “leisure” derives from the French “loisir” recalling the Latin concept of “licere” with the meaning of a condition of licence meant as absence of constriction.

The British concept of “leisure” becomes the modern version of “skole” and “otium” with the meaning of a condition in which people can act taking a certain distance from necessity and with contemplative aims.

During the twentieth century, the concept of leisure will be associated to a condition in which people focus on themselves, on their self-realization, through an autonomous consumption of time (Lo Verde, 2014).

Among the many leisure activities, sports, considered as competitive and institutionalized activities that involve physical exercise or the use of complex physical skills by players motivated by internal and external recognition (Coakley & Pike, 2009), start achieving a relevant role in society with the age of industrialization.

The origin of the word “sport” comes from the Latin verb “deporto” which refers to a deviation from the main destination, trying to express the intention to take a distance from the main course or obligation. The word can be found also in the ancient French language as “desport”, with the same meaning it has inherited in present times.

Leisure and sport on a large social scale can be both defined as consequence of the European industrialization process. Industrialism has been the first organized and standardized process for the production of goods in very large amount. Life in industrial cities became suddenly very different from the past with a new kind of time organization connected with the rhythms of production .

Together with urban space, even the sense of time will be modified and the typical working day will be organized on the base of a balance between time and money, where it becomes even interesting for many enterprises to guarantee a certain amount of free-time to be spent in rest and regeneration in order to allow the working class to recover from the physical stress (Cross, 1993) (Corbin, 1995).

In fact, the first country to drive the industrialization process, Great Britain, was also the first to perceive the need of a new balance between working time and leisure in coincidence with its great economic expansion since the first half on the eighteenth century. That was an age of great prosperity for the country, which had taken the place of Spain and Portugal in the dominance of the seas and had become the first global commercial power.

As a consequence, between 1750 and 1850, the working day of the labour class has been reduced from 14 to 11 and then 10 daily working hours (which became only 8 hours in 1919), and the working days of the week from 6 to 5 and a half (Cross, 1993).

This is confirmed also by the extensive research made by Huberman and Minns in 2007, and by the PWT 9.1 report of 2019, where it appears evident that the same trend has been followed by all the industrialized nations, U.S., U.K, Germany, France, Belgium, Sweden, Australia: the average working hours per worker over a full year have been more than halved between 1870 and 2017, descending from more than 3000 working hours a year to less than 1500 (Huberman & Minns, 2007).

At European level, between the beginning and the end of nineteenth century, in spite of the progressive working hours and working days reductions, the overall productivity kept on growing, with five time multiplier of the European GDP.

However, until 1850 in almost all Europe it was impossible to have the benefit of paid vacation. Only in 1871, with the British “Bank Holidays Act”, the first four days of paid vacation have been granted by law, and Italy and France were among first countries to recognize paid holidays for workers in 1927 and 1936 (Lo Verde, 2014).

The sudden growth of American and European wealth generated a new demand for entertainment during the big amount of leisure time that the industrial revolution “unchained” among the residents of big cities.

According to this new kind of demand, between 1850 and 1920 the “modern sport” becomes an organized activity, starting from disciplines like horse racing, rowing, swimming, football, boxing, cricket, rugby, lawn-tennis and others.

An essay by Vamplew (Vamplew, 2016) explains that what was required in the factories was regular hours and above all, long hours. Unit overhead costs could only be reduced if the growing volume of machineries and other capital equipment was intensively employed, but it was no easy task to persuade the labour force to accept the new work discipline. The development of an increased range of consumer goods was vital as a demonstration of a better material life which hard work could bring. Increased imports, the emergence of the products of industrial revolution and the shop window effect of the company stores served to instill the consumption habit in the workforce; once the

workers had accepted that they wanted a higher consumption standard and that, at the same time, leisure would cost them money, this enabled working hours to be extended. When the “razionalization” of working time, improved by the use of steam and mechanization, increased productivity, this enabled employers to concede to demands to lessen the working week for their labour force and to pay them higher wages. Thus, the real contribution of industrialization to the development of sport lay in the increased incomes and increased leisure time that productivity brought. This helped to create a mass market for spectator sports by setting Saturday afternoon free of work, thus providing a time slot into which gate-money sport could fit. What’s more, for those who preferred to be active rather than watch other play, the increase in disposable income allowed the purchase of sporting equipment.

The same author underlined that mass market for sport required not only spending power and time in which to spend it, but also a concentration of population and ease of access to the venues. This came with urbanization and the development of inter-town and intra-town transportation, a requirement that was not fulfilled by early urbanization.

In fact, through the industrial revolution, according to Dyer and Day (Dyer & Day, 2017), urbanization became very fast: the statistics on urban growth in this period suggest that the total population of England and Wales which was already urban based by 44% in 1831, rose to over 80% in 1911. Although London had the biggest concentration, cities such as Manchester (textile industry), Birmingham (metal trades), Glasgow and Liverpool grew to over 500.000 citizens, while Sheffield, Leeds, Newcastle and Bristol all developed into mass urban centers after 1850s.

Also in northern America, as written by John Rickards Betts, industrialization and urbanization were responsible for the changes and developments in sport: the manufacturers, seeking cheap labour, encouraged immigration; factories were most efficiently run in larger towns and cities; urbanization brought forth the need for commercialized spectators sport, while industrialization gradually provided the standard of living and leisure time so vital to the supporter of all forms of recreation. Moreover, as the USA became more commercially minded in the decades after the secession war, many of those who lived in rapidly growing cities became concerned over

the sedentary habits of clerks, office workers and businessmen, and this led to a growing interest in physical activity. Furthermore, concentration of the business community in the central part of the cities was increased also by the telephone switchboard and other instruments of communication. Therefore, less and less open land remained for the youths living in the heart of big cities and to meet this challenge several public institutional agencies expanded their athletic facilities (Betts, 1953).

In the US, beginning in the 1830s, the pace of urbanization accelerated greatly. During that decade, the urban population increased by 63%. Between 1840 and 1850 New York grew from 202.000 to 814.000 citizens, Philadelphia from 160.000 to 566.000. the town of Chicago in 1833 had only 300 inhabitants, but it grew to 109.000 in 1860. By 1870 one fourth of the national population was urban. This led to new urban connection and transportation systems like the street cars and cable cars, and by 1890 electrically powered trolley cars. Boston and New York even had subway by 1904. All these intra-urban transportation systems were soon connected with sport stadiums, parks and popular playing grounds (Riess, 2013).

A new era in the social life of the big cities was inaugurated also with the development of the incandescent bulb by Thomas Edison in 1879. Within a few years, starting from USA, electric lighting helped lure players and spectators alike to Y.M.C.A.s, athletic clubs, regimental armories, schools and college gymnasiums as well as sport arenas. Basket and volleyball, originated in the Y.M.C.A. in 1892 and 1895, were both developed to meet the need for indoor sport on winter evenings and took enormous advantage from the more brilliant electric lightning available for their matches, and much of the urban appeal of indoor sport was directly attributable to the revolution which electric lighting made in the night life of the metropolis (Betts, 1953).

Another relevant consequence for sport brought by industrial revolution was the initiative by several philanthropic employers, including chocolate makers Cadbury and Rowntree, the chemist Boot and the soap manufacturer Lever to provide sport facilities for their workers. In London, for instance, by the 1890s many of the banks, railways companies, insurance firms and utility providers were offering sporting facilities to their

employees including grounds, clubhouses, boating houses and rifle ranges (Vamplew, 2016).

As a matter of fact, according to Chance (Chance, 2012), by 1920 the modern factory, both in the USA and in the UK was defined as a professional, social and economic institution, with a well-developed welfare system, close workers involvement, and organized by professional management system. Thus, with the expansion of industry in the suburbs or in the countryside, companies had more space to dedicate to recreation. Some provided recreation ground that offered football, baseball, cricket, hockey, bowls and tennis, and even state of the art pavilions with swimming pools and gymnasia. According to corporate leaders, these benefits added economic, social and cultural value to the company by contributing to a more healthy, stable and productive workforce and enhancing the company profile in the local and public realm. At Cadbury, for example, sporting provision was extensive. By 1936, at the company recreation ground there were 15 football pitches, 10 hockey, 5 netball, 14 cricket, 53 tennis courts, 5 bowling greens and croquet lawns, 2 putting courses and a lake for modern yachts; the site hosted approximately 51 associations and rugby football teams, 26 cricket, 37 tennis, 26 bowls, 36 hockey and 23 netball teams. The Boots company sport ground added even an 18-holes putting course and a running track for athletic to the many other ordinary facilities.

As mentioned above, a relevant role inside the quickly growing urban areas was also played by the “muscular Christianity movement”, which was a mid-nineteenth century English philosophy that focused on harmonizing ones mental, physical and spiritual dimension. It advocated clean sports and exercises to develop moral, devout and physically fit men, and this philosophy fitted in well with the Victorian disdain of libertine behavior. The muscular Christian philosophy was a cornerstone of the Young Men’s Christian Association (YMCA), an evangelical association founded in London in 1844. The YMCA was brought to the United States seven years later to help farm youth to adapt to urban life in a moral environment. By 1860 the YMCA movement supported moral athletics and gymnastics as a safeguard against the attraction of objectionable places of resort. And soon established facilities were white collar males could enjoy exercises with their peers in a pleasant environment. By 1892 there were 348 YMCA gyms, 144 full time physical education leaders and about 2.500 members of this

organization, and it helped to boost investments in urban gyms and playing grounds, generating plenty of team sport events (Riess, 2013).

In general, sport appeared to have a role in harmonizing labour-management relation, and it was also viewed as a way of reducing workers militancy and ensuring industrial peace. It is interesting to consider that one of the most famous British football club, West Ham United, was started in 1895 as the Thames Ironworks Football Club by the owner of the factory. The founding came shortly after a big strike and was part of a joint program to improve “cooperation” between workers and management. Similarly, in 1896 a baseball team in Paterson, New Jersey, by the prominent mill owner and republican politician Garrett Hobart. During the same decade Andrew Carnegie established professional baseball and football team near the Bessemer steel work in Braddock, Pennsylvania following a strike in his plant. Fifty years later approximately 20 million employees in the United States were involved in industrial sport programs. Even in Germany, industrial sports were well established in the late 1920s under the coordination of an employer’s organization known as Dinta, which had the role of developing Werksportvereine or company sport club. Especially in fascist Italy and Nazi Germany, the organized workers’ leisure was controlled by the government through the programs named “Dopolavoro” and “Kraftdurchfreude”.

In a similar way, also labour organizations, driven by workers, started to promote autonomous sport organizations, for example, in 1893 nationwide workers’ societies for gymnastics and cycling were formed in Germany; in 1897 a labour swimming society was formed in Berlin, and one year later a Socialist Wheelmen club was founded in the United States; in 1913 in Belgium Gaston Bridoux succeeded in bringing together representatives of the Belgian, English, French, German and Italian Labour Sport Federations to create the Social International of Physical Education. These workers’ sport movements tried to provide working people with the opportunity to participate in healthy and enjoyable physical activity, doing it in a positive working class atmosphere. This sport environment had to be basically different from “bourgeois” sports, keeping the participation as open as possible (Wheeler, 1978).

Chapter 4: Role of “codified” Sports in the industrial society

Johan Huizinga in 1938 in his work entitled “Homo ludens” recognizes in the game the genuine expression of the “gratuity and spontaneity” of human actions: human beings are above all “ludens”, “players”, and not only “faber”. Human beings generate symbols, among which there are the ones generated by and through games, especially in the ritualized form “competition for something”. This kind of competition has a relevant “socializing” role in terms of making individuals members of a society, as outlined by the classical authors, telling which was the importance of leisure competition for the involvement in the society of the young Greek and Latin generations (Huizinga, 1938).

Roger Caillois (Caillois, 1958) gives a first definition of “formalized” sports as “ludus”, which have a more evident presence of rules to which the participants have to obey. In his opinion, modern sports should be classified in the concept of “agon”, a term referring

to competition, rules, executional techniques, performance rituals, measurable achievement, celebration of victory.

Coakley and Pike (Coakley & Pike, 2009) tried to classify several ways of interpreting the function and role of sport in modern society: the structural-functionalist approach underlined the function that sports have as mean of social values like respect of the rules in the competition and, consequently, in everyday social life, or values like cooperation with others to reach a common goal. Sports are necessary institutions to learn the values that are considered appropriate in a society. This kind of approach leads to the conclusion that sport gives a contribution to develop the kind of characters that are considered important for a better functioning of society and therefore supports those sport politics which recommend plans that favor the diffusion of sport with high level of competition and programs enhancing physical education together with the foundation of center of excellence for the athletic preparation of a selected elite of future champions (Lo Verde, 2014).

On the other hand, the theory of “conflict” inspired by the marxist philosophy, outlines the fact that the sport activities become a social environment in which the attention and emotions of the working class and of the lower classes are distracted by entertainments offered by medias. According to this vision, mass sport events are mainly organized by corporations, which are only interested in the perpetuation of style of life and consume that enhance their growth. In this way, sport would become another kind of opium that confuses the people avoiding the acquisition of the level of consciousness that would be necessary to understand how an economical and social system really works.

This kind of theory focuses especially on the negative aspects of sport, emphasizing the commercial aims of their structure which have negative consequences for the athletes themselves and for their fans, who build up an idea of “competition”, “victory”, “prize” and “champion” that should be reviewed not only because it is very far from De Coubertin’s idea, but also because based on an economical system that favors only few people. The aim of this review should then be to give back to the professional athletes, as “workers”, the control of their own job reducing the wait of the economical interest of big corporations, improving the game value of the sport instead of the show.

The spectators themselves should be seen as people who belong to a community looking for simple fun and entertainment instead of a mean to support famous athletes and generate economical profit.

Another theory analyzing the role of sport in society is the so called “critical theory”. According to this theory, it’s wrong looking at society as a homogeneous and monolithic system and that it is not realistic to search for a single model that explains the social development and change. For this reason the sport organizations, according to this theory, become environments in which culture and organizational methods are generated, multiplied and changed. Thus, sport is more than the simple reflection of society, because it’s a social structure that has an influence on social relationship and organization. This theory tries to understand how the experience of sport participation is influenced by the power dynamics in a society and how it can oppose to the dynamics of privilege; or even how the idea of sport itself can be related with a different aspects of social and economic success and how it can be associated to entertainment, attention for health and for the social and individual psychophysical well-being.

One more theory dealing with the social role of sport is the so called “feminist theory”, which criticized the fact that sport activities are mainly “gender activities”, meaning that aims and organizational trends are mainly based on “male” values and experiences, highlighting qualities and characteristics related to the dominant aspects of masculinity that can be found in society. Therefore, in the sport environment masculine mood and behavior will be recognized as the only that are adequate to a winning career. Aggressiveness and competitiveness become the typical qualities of an athlete, of a coach, of a manager of a sport team. Thus, this kind of theory aims at transforming sport, modifying from inside the patriarchal and masculine structure of games and competitions that are still present in sport culture and in many sport organizations, for example stressing the fact that through sport it might be also possible to change rigid gender qualification habits and spread an idea of “competition” that has to be made “together” with other people instead of “against” other athletes. This kind of interpretation leads to a more decoubertinian concept of “participation” to sport activities instead of prevailing at all costs.

Mead, Blumer and other scholars of the sociological school of Chicago developed the “symbolic interactionism” theory, according to which human beings generate interpretations of reality through social interaction and use this interpretation not only to understand reality, but also to take decisions. Therefore, to understand how social organizations work and how they can change, we have to understand which interpretations are generated in different social situations and how these interpretations are absorbed in different cultures.

With reference to sport this kind of theory focuses on several aspects as, for example, the analysis of the processes through which people are involved in non-professional sport activities; on which value people connect to sport and to sport experience and how all this changed through time according to age and life cycle; or on how the “sport culture” of professional and non-professional athletes can be developed and how this can influence on the decision in the social sport sphere or in everyday life.

The last main social theory dealing with sport can be found in the scripts of Elias and Dunning (Elias & Dunning, 1986) and it is called “figurational theory”, according to which to understand society in its complexity we have to analyze the “configurations” on which it is based, among which also sport and leisure have to be considered. From this point of view, Elias analyzes the civilization process of the European society as a process in which conflicts have been “civilized” through parliamentary discussion but also as a process in which public aggressiveness has been controlled through the less violent modern version of sport that has achieved an “industrialized” structure. Therefore, sport is considered very important in these kind of studies, because it becomes a “collective invention” that provides society with individuals with a very high level of “controlled emotionality”, making it possible to keep under control all the aggressiveness that is generated by society and that in the past used to take the shape of war or fierce and bloody confrontation.

Chapter 5:

The growth of organized sport in the age of industrial revolution

Among the several interpretations of the birth of “organized” or “codified” sports in industrial era, there is an interesting paper by McPartlin, who outlines the fact that in Great Britain traditionally, while hunting was a pastime of the nobility, ordinary people indulged in rudimentary forms of cricket, football, boxing, wrestling, jumping and weightlifting as well as footraces. These pastimes were often barbarous and brutal, taking usually place on church holidays. When the industrial revolution began, wealthy manufacturers started sending their sons to the rapidly expanding public school. There they came into contact with traditional games and sports which were just beginning to feel the wind of change that was blowing through the hole of English life. Dr. Thomas Arnold, headmaster of the college of Rugby was one of the first who believed that games were good for character as well as for health. These games were gradually civilized and the most violent and dangerous elements removed, often by verbal agreement between the captains before the game started (McPartlin, 1961).

For example, Thomas Hughes’ “Tom Brown’s Schooldays” published in 1857, in which the stories of rugby college are told, a college in which rugby and football were practiced with great dedication, had a strong influence in the development of football among educational institutions. Therefore, most of the schools had also their sport team: Eton, Arrow, Charterhouse, Westminster, Shrewsbury, Marlborough and Wellington, each with their own version of football (Lo Verde, 2014).

As transport became easier, thanks to the opening of railways, the schools began increasingly to play against each other and the need for standard rules became pressing. Between 1850 and 1900, a regular orgy of organizations took place. In 1846 the first rules for soccer were drawn up at Cambridge University and in 1863 the Football Association was formed. John Charles Thring, a former student of Shrewsbury, teacher at Uppingham, developed the first “code” of football rules in his writing “The simplest game”, made together with Henry de Winton, published in Cambridge in 1848, which was the first version of the “Cambridge University Rules” published in 1863 (Lo Verde, 2014).

Boxing has been practiced in one form or another almost since the beginning of history, but it was the discipline of the rule laid down by the marquis of Queensberry in 1867 and the formation of the Amateur Boxing Association in 1880, that enabled it to become generally accepted as sport (McPartlin, 1961).

The Marylebone Cricket club, one of the most authoritative bodies for cricket, was formed in 1787 and published the laws of cricket the following year. But it was the invention of the grass mower and the introduction of the heavy roller in the second half of nineteenth century that transformed the cricket to the game as we know it today.

Golf was originated in Scotland and the first Golf Club in England was founded in Blackheath in the early part of the seventeenth century, but the “governing body” of the sport was kept at the Royal and Ancient Golf Club at Saint-Andrews in Scotland. According to McPartlin, golf is a typical example of “codified” sport that spread around the world thanks to the British Commonwealth international network and has been improved, like many others sports of the “codified” kind, through innovations introduced by other countries.

If we consider swimming for example, a great deal of its rules is owed to the British Amateur Swimming Association, formed in 1869, but much of the credit for the evolution of modern techniques must go first to Australia, where the crawl came from and to the United States and Japan (McPartlin, 1961).

As a consequence of this internationalized “codification” activity, this is the time in which opportunities of sport meeting are institutionalized, generating championship, annual competition, sport parties that become opportunities finalized to generate a public of paying spectators, with the consequence of starting a kind of “passive leisure” that will gather people in open spaces first, and then, in halls where the public could listen to radio or television broadcasted sport events.

To give an example, the FA Cup final match in Great Britain in 1876 had only 3.500 spectators, but in 1901 there were already 114.815 spectators watching the final match

between Tottenham Hotspur and Sheffield United at the Crystal Palace stadium. An event that was supported by a complex system of means of transportation like buses, trains and trams coordinated with the advertising of the impressive event on a dozen of newspapers, including “The Times” (Lo Verde, 2014).

The growing sport industry was among the first to exploit the technological innovation in communication systems, at first through the telegraph and then through radio broadcasting. The newspaper “Daily Mail”, for example, was founded at the end of nineteenth century, especially to spread the news concerning the sport achievements of that time. The industrialization of sport will be inflated by a “mythology” of the athletic achievement with a constant record of performances.

The successful growth of organized sports generated the concern of some moralists who wanted sport to be a tool of integration and pacification (like De Coubertin), avoiding the risk that the commercial and competitive side of the sport activity could become the most common and accepted in popular culture. For this reason, several sport movements were founded by organizations that wanted to favor the diffusion of sports among workers together with pedagogical functions of the activity. These movements were connected with activities of unions and were gathering groups of workers with the main aim to increase the number of sport infrastructures dedicated to workers. The German Social-democratic party was the first to become a benchmark for other political movement in this field (Lo Verde, 2014).

Other political initiatives aimed at the internalization of sport, like the socialist international association for Sport and Physical Culture (which later became International Sport Organization of Luzern), which tried to oppose to the growing nationalism and militarism that was spreading all over European nations.

In 1921 the third international session of the socialist party funded the “Red International Sport”, where it was declared that sport was a “field of political confrontation” and that a goal of the sport movement of workers was to give a contribution to the fight for revolution, like it happened in Russia with the October Revolution.

Some of these movements were totally opposing competition and didn’t even take part to the game organized by other workers movements like for example the “Games of the Unions” in 1925.

Among the first organized associations there were the “Gymnastics” ones, often funded as an imitation of the “Turnen” patriotic Prussian educational model developed by the pedagogue Friedrich Ludwig Jahn, which had both a function of physical education and spiritual preparation with the trend towards martial education (Lo Verde, 2014).

In his essay “From ritual to record”, Guttmann brilliantly summarizes the difference between modern sports and the ones of previous eras in 7 characteristics: secularism, equality of opportunity to compete and in the condition of competition, specialization of roles, rationalization, bureaucratic organization, quantification, the quest for records.

Modern sports are secular, because before the industrial revolution, as Carl Diem wrote in his history of sports, “all physical exercises were originally cultic”. In the ancient Greek civilization, even the Olympic games, like the Puthian, the Isthmian, the Nemean, and the Athenaic, were sacred festivals, a religious act in honor of the deity; In modern sports, the bond between the secular and the sacred has been broken, the attachment to the realm of the transcendent has been severed. Modern sports are activities partly pursued for their own sake, partly for other aims that are equally secular.

The second distinguishing characteristic of modern sports is equality, in two senses: everyone should, theoretically, have an opportunity to compete; the condition of competition should be the same for all contestants.

In fact, there is little doubt that modern sports now embody the principle of equality, and sports are rationally organized on the basis of the universal principle of achievement. If participation to the contests is limited on the base of caste or race criterion, the principle of best achievement , which is paramount according to the principles of industrial society, would be hindered.

The third characteristic is specialization.

To improve achievements, like it happens in the industrial world, specialization becomes a must. Given the internal logic of modern sports, specialization and professionalization are inevitable. For example, American football players are divided nowadays in twenty-two positions, not counting the “special” teams, which are restricted to placekicks, kickoffs, kickoff receptions etc.

And the crucial factor in professionalization is not money but time, in the sense that it has to be considered how much of a person’s life is dedicated to the achievement of athletic excellence.

The professional is, in fact, any athlete specialized to the point where some single athletic excellence is for some long period of time his main purpose in life.

The fourth characteristic is rationalization.

Modern games are rationalized in Max Weber's sense of "Zweckrationalitaet", in the sense that there's a logical relationship between means and ends.

Moreover, in modern sports new rules are invented and old ones abandoned whenever the participants decide that ludic convenience outweighs the inertia of convention.

Basketball, for example, was invented "artificially" by James Naismith on December 21st, 1891, at the YMCA's training facilities in Springfield, Massachusetts, just because young people needed some sort of winter game that might be played indoors. It was an instant success: the game was introduced to the Chicago University in 1893, and in 1896 YMCA had already developed a national Basketball tournament.

The fifth peculiarity is Bureaucratization.

In fact, modern sports are ruled by bureaucratic organizations, whose elected administrators have the function to make sure that the rules of the game are really universal.

Sportswriters today may refer, for example, to the heads of the national Football League, or the National Collegiate Athletic Association, or the Federation Nationale de Natation as the high rulers of sports.

As we have already seen, the Marylebone Cricket Club, founded in 1787, gradually became the ultimate and international authority in all matters pertaining to Cricket, standardizing the game in all aspects, with precise regulations for the weight of the ball, the width of the bat, the distance between wickets etc.

Quantification is also very typical of modern sports, and counts as sixth main characteristic: modern sports have the inevitable tendency to transform every athletic feat into one that can be quantified and measured. The stopwatch itself, invented around 1730 to time races, is a symbol for the development of modern sports. Electronic timers today measure in hundredths and even thousandths of a second, and these differences are perceived by spectators and athletes as very significant.

The accumulation of statistics on every conceivable aspect of the game is typical of all main team sports and of track and field sports nowadays.

This takes us to the seventh peculiarity: if one combines the impulse of quantification with the desire to win, the result is the concept of the record.

A record is also the abstraction that permits competition not only among those gathered on the competition field, but also among them and others distant in time and space. According to Guttmann, the record is not only a number in the “ record book” or on the television screen, but a symbol of our civilization, a unique form of modern immortality, a commitment to break the bonds and limits of humanity (Guttmann, 1978).

Chapter 6:

The influence of modern transportation technology on sport

After the beginning of the industrial age, the possibility of exploiting the growing amount of leisure time was enhanced by the new means of transportation available by the urban society and by the working class.

The age of train transportation, which will become a mean of mass transportation, starts in Great Britain in 1825 with the first Stockton-Darlington railway, followed by the first permanent railway between Liverpool and Manchester in 1830, with the speed of 15 km/h.

While initially promoted as a freight line to link the port of Liverpool to East Lancashire, this first steam powered line had 65% of its revenue coming from passengers traffic in the first year of operation. The opening of this line marked the start of a 40 year development in the railway infrastructure that saw the 51 miles of track in 1829, extending to 15.736 miles by 1871 (Dyer & Day, 2017).

Thus, it will be the railway to start the global process of distance shortening, making the world smaller and no longer depending on days of navigation or horse riding. For the first time in human history, it becomes possible to move on land without the help of living beings (horses, camels, donkeys).

Trains will change the relationship between big cities and their hinterland, allowing a big number of people to gather quickly at relevant distance from their residence to use their leisure time attending big events of common interest, among which sport events and competitions became a point of attraction.

According to Betts (Betts, 1953), in USA, already in the years preceding the civil wars, horse races were encouraged by the development of the railroad network: in 1838 Wade Hampton was transporting race horses to Charleston by rail; in 1839 the Nashville railroad was carrying New Orleans crowds to the Metairie Course; in 1845 the Long Island railroad carried 30.000 passengers to the fashion Paytona race at more than 0,30 cents each. And it was a railroad which encouraged the holding of the first intercollegiate rowing race between Harvard and Yale in 1852. Baseball clubs were organized throughout the east and Midwest during the decade and the National Association of baseball players was formed in 1857, soon after both sections had been connected by rail. Chicago had its first baseball team in 1856, two years after it was linked by rail to Baltimore and Portland. In the 1886 edition of "Spalding's Official Baseball Guide", the Michigan central railroad advertised:" the cities that have representative clubs contesting for the championship pennant this year are - Chicago, Boston, New York, Washington, Kansas City, Detroit, Saint Louis and Philadelphia. All of these cities are joined together by the Michigan Central Railroad. This road has enjoyed almost a monopoly of Baseball travel in former years".

Another new factor of mass mobility at the beginning of the industrial age is the bicycle, which became quickly the favorite mean of transportation for workers, urban middle-class and artisans.

According to Amitabha Ghosh (Ghosh, 2021), the innovation brought in society by the introduction of velocipede first, and bicycle after, was surprising. To reach the root of the problem that led to this invention one has to go back to the explosion of the Tambora volcano on the small Indonesian island of Sumbawa. This eruption caused a disastrous effect on the global climate; in northern America, Europe and China there was a sudden lack of crops, resulting in famines, epidemics and social upheavals. In 1816 and 1817 there was no summer in Europe and the continent experienced severe winters and heavy rains. The famine condition across Europe made maintaining a horse very difficult. A very large number of horses perished, making transportation a severe problem. As a consequence, in June 1817 Baron Karl von Drais of Baden in Germany patented a two-wheeled device, he called the “Laufmaschine”. It became known as “Draisine” and later as “velocipede” and was reproduced in England, France and USA (Ghosh, 2021).

The idea to switch from a three or four wheels driving machine to a two-wheeler machine came to Drais' mind by observing ice skaters, indeed the balancing system used on a “Draisine” resembled the balancing technique the ice skaters (Malizia & Blocken, 2020).

An expert in using the velocipede could achieve a speed up to 15 km per hour, which made this kind of tool an interesting substitute of the horse. When the users started to take both the feet off the ground, they were surprised to realize that the device could remain stable when in motion. Then in 1860s, when Pierre Michaux and Pierre Lellemont designed a bicycle with pedals on the front wheel, the device became a commercial success. In the second half of the nineteenth century the urge to develop bicycles became prominent as everyone realized its great potential. First of all the design of the spoked wheels was changed and the thin spokes were kept under pretention in order not to make them buckle under the rider weight. Furthermore, to provide a torsional rigidity to the rim-hub, the spokes were not radial but tangential to the hub.

The bicycle was then improved in 1885 in Great Britain by Rover, who, with his “Rover safety bicycle”, reduced the size of the front wheel introducing a mechanism able to multiply the human power transferred to the pedals (Ghosh, 2021).

In addition to that, cycling was also revolutionized by the vulcanization of rubber in 1839, patented in 1844 by Charles Goodyear, and the pneumatic tire, developed by Dr. John Boyd Dunlop in Belfast in Ireland in 1888. These innovations will provide a much better level of comfort both for cycling as for car production. (Betts, 1953).

Just to give an example of the trend, in Italy the number of bicycle grew three times between 1890 and 1910 from 200.000 to 605.000 units, reaching 1.300.000 units in 1919 (Lo Verde, 2014).

As a consequence of these innovations the bicycle became also one of the favorite “sport technologies”, or tools for sport activities. The bicycle tourist became soon the bicycle sportsman. The first official bicycle competition will take place in Paris in 1868, two years later there will be the Florence-Pistoia and in 1892 the first Liege-Bastogne-Liege will take place in France. The first “Tour de France” will start in 1903 and the first “Giro d’Italia” in 1909. In Italy since 1888 the bicycle competitions became so strong that they were “institutionalized” with the help of the newspapers of that age.

Also in USA the bicycle was reputed to have developed into a hundred million dollar business in 1890s. Much of the advertising made by competing manufacturers was focused on the mechanical improvements and the speed records of their products. Between 1878 and 1896 the mile record on a bicycle in USA was lowered from 3’57” to 1’55”. The racing machine of 1878 was a heavy and crude tool, while the latest bicycle when the record was made, was less than one-sixth its weight, equipped with scientifically calculated gearing, pneumatic tires and friction annihilators. In fact, the bicycle introduced certain technical principles which were carried on into the motor car, in particular, ball bearings, hub breaking and tangential spoke (Betts, 1953).

Scientists and technicians found out soon that aerodynamic resistance in cycling counts for about 90% of the total resistance when running on a flat road faster than 40 km/h. in the late nineteenth century there were already studies and aerodynamic equipment applied to cycling, and the inventions of disc and four-spoke wheels were the first example of aerodynamic solutions. Even new bicycle were proposed, like the recumbent bicycle in 1895 and streamline cabins in 1913. It was clear that the most important aerodynamic force in cycling is the drag force and the main force of aerodynamic drag is the body of the cyclist, which generates from 60% to 82% of the total drag, depending on the position on the bicycle. It became also clear that the muscular power efficiency, defined as the ratio between the energy transmitted to the crank and the chemical

energy in the food is between 20% and 30%: the remaining energy is dissipated into heat (Malizia & Blocken, 2020).

One of the earliest known mathematical cycling models is presented in the book of Bourlet, published in 1894. It describes four sources contributing to the total resistance, namely: bicycle passive resistance (including chain losses, drive train and wheel bearing friction); rolling resistance; resistance due to vibrations; aerodynamics resistance.

As a consequence of this technical evaluation, the first streamline enclosure for bicycle were patented in 1913 by Bunau-Varilla, who called their invention "Velo Torpille". The time trialist Marcel Berthet, tested the "Velo Torpille", breaking several records. In 1913 he rode the five kilometers on the Paris Vel D'Hiv indoor track in 5'39"3, thus achieving an average speed of 53.1 km/h, which is about 6 km/h faster than he could achieve on a standard racing bicycle of his time. But we have to wait until 1953 for the first wind tunnel test for cycling performed by Kawamura, and then Nonweiler in 1956. The wind tunnel experiment led also to streamline tubes and monocoque frames, in fact, only in late 1970s airfoil-shaped tubes stated to be used for time trial bicycle frame. These studies led also to improvements in the design of the handlebar. The aerodynamic design of handlebars followed two strategies: optimizing the handlebar shape in terms of its aerodynamics, with a most streamlined shape; and optimizing its shape to enable the cyclist to take a more aerodynamic posture, both in terms of reduced drag coefficient and reduced frontal area, without substantially limiting his power output. The effect was improved also with the introduction of aerodynamic helmets to reduce the air turbulence behind the head of the rider.

The importance of aerodynamics in cycling was clearly demonstrated by Moser's world hour record, achieved using a bicycle and a position developed by means of wind tunnel tests and using a special set of so called "lenticular" wheels (Malizia & Blocken, 2020).

After many improvements in the field of speed, modern bicycles had an additional revolution through the success achieved by the so called "mountain bike", which has also become an Olympic discipline.

The interest for mountain biking took the move from a different social need, which was the opposite of the search for speed: the need for full immersion in nature out of the ordinary and regulated paths of congested cities, it will be a consequence of mass mountain tourism and environmental sensitivity of post materialistic culture (Porro, 2013).

It originated among a small group of friends in Marin County, California, who repurposed Schwinn cruisers from the 40s and 50s for off road use. By cutting off decorating fenders and racks, they turned bikes originally intended as paperboy delivery bikes into “clunkers” suitable for descending steep paths. Eventually, they began racing organizing the world’s first downhill bike racing. Early on, the riders realized this new sport required custom frames that were purpose built for off-road riding. Mountain biking today is a major force in the bicycle industry: a 2013 study found out that mountain bikers are more likely than other riders to participate in multiple forms of bicycling, tend to spend more on bikes and equipment than road riders, and spend about 1.500,00\$ on mountain biking annually (Bopp & Piatkowski, 2018).

According to the typical mechanisms of sport trend, when a lower social class takes possession of a sport practiced by an upper class, the latter feels the need to distinguish itself in some way and it tends to look for a different favored activity. Considering that, between 1870 and 1880 only aristocrats could run in the streets by velocipede, while in the first years of the twentieth century also the working class could afford to buy and run a bicycle, the aristocrats and high-bourgeois chose the recently invented automobiles as their favorite hobby and sport.

After the invention of the bicycle the idea of such a vehicle for more passengers was soon to follow quite naturally and the first step towards that was the development of tricycles, and it became a fashion among the well to do families to go to social functions in tricycle. As a consequence, the idea of a four-wheels vehicle followed the tricycle. The steam engines were already running all over the world, and attempts were made to power tricycles and four-wheels vehicles with steam engines. Soon came the internal combustion engine, which was applied to this vehicle (Ghosh, 2021).

One of the technical reasons the gasoline engine became quickly successful, especially in the US, is the fact that the petroleum industry was focused on producing kerosene for lighting, and gasoline was a by-product of the refining process for which a useful application had to be found. Gasoline had been the plague of the refiner since the beginning of the industry: too explosive to be burned as boiler fuel and dangerous contaminant if much of it were included in kerosene, it was usually led away from the refinery and burned in open air. As the electricity industry began expanding during the

last two decades of the nineteenth century (especially for electric city lighting, replacing the kerosene lamps), it presented a major challenge to the oil industry, whose main product was kerosene for lighting. Thus, the oil industry was in desperate need of a new market, which was suddenly represented by gasoline cars (Hadjilambrinos, 2021).

The first patented gasoline car was the “Benz Patent-Motorwagen”, discovered by the German engineer Karl Benz in 1886 (there were many others prototypes discovered earlier, however no one of these had been patented).

Few years later, the first cars were already a great attraction, and competitions (like for the bicycle in previous decades) were a way to promote the new mechanic tool. The first motoring contest took place in 1894 from Paris to Rouen, organized by the Parisian newspaper “Le Petit Journal”. Sixty-nine cars took part to the selection event, which lasted for 50 km and selected those participants and cars which could join the final main race. The Paris-Rouen race length was 127 km and applied different type of companies and cars, from well-known ones like Peugeot to amateur firms (Rémi Paolozzi, 2003).

Even though the pioneering work of engineer Benz and other cutting-edge German companies on the internal combustion engine, looking at the car innovation in its complex, France was the state of the art country in this field in Europe. Thanks to many car manufacturer which were already developed in France, like Peugeot, Renault, Panhard and de Dion, it was possible to test many innovative features and mechanic adjustments to the vehicles.

In few years, absolute mechanical innovations as super chargers, front-wheel drive, power steering, air brakes, water cooled brakes, automatic transmission, overhead cams, catalytic converters, four valves per cylinder, four-wheel drive and electric starter were developed, technical innovations that in many cases came from car races (Kollins, et al., 1990).

In fact, the beginning of car races was an occasion to experiment and improve the prototypes and fix recurrent issues of the automobile.

The oldest open road endurance (it means that the aim of the race was to test the durability of the equipment and the endurance of participants) automobile race was the “Targa Florio”, funded in 1906, attended in the mountains of Sicily close to the administrative center Palermo. Until 1920s, it remained the most important race in

Europe, considering that some of the most important nowadays, like “24 hours for Le Mans” and “Mille Miglia” were not established yet.

In the States, during the 1890s the Haynes, Duryea, Ford, Stanley Steamer, Packard and Locomobile car manufacturers came out in quick succession, and the Pierce Arrow, Cadillac and Buick were to follow in the next years. In 1895 Herman H. Kohlsaat publisher of the Chicago Times-Herald, sponsored the first automobile race on American soil. The European races inspired American drivers to take to the racecourse and the experimental value of endurance or speed contests was immediately recognized by pioneers manufacturers (Betts, 1953).

Even Henry Ford, who invested in racing, had to admit in later years:” I never thought anything of racing, but the public refused to consider the automobile in any light other than as a fast toy. Therefore later, we had to race. The industry was held back by this initial racing slant, for the attention of the makers was diverted to making fast rather than good cars” (Betts, 1953).

The following years witnessed the establishment of Automobile Club of America races, the Vanderbilt Cup and the Glidden Tour. Reporting on the third annual Glidden Tour in 1906, “Scientific American” defended American cars, often considered inferior to European models:” the tour has demonstrated that American machines will stand fast driving on rough forest roads without serious damage to the cars of their mechanism. Engine and gear troubles have disappeared, and the only things that are to be feared are the breakage of springs and axles and the giving out of tires”.

Daytona Beach soon became a center for speed trials, and tracks were built in different parts of the nation, the first of which was at Narragansett Park in 1896.

In the years just prior to WWI auto racing obtained a truly national popularity with the establishment of the Indianapolis Speedway, and the emphasis on speed and endurance spurred manufacturers to build ever faster models and advertisers to feature the record performances of each car (Betts, 1953).

To give an idea of the pace of the international technological evolution concerning cars and races, we have to consider that average speeds around a circuit increased roughly by 20% between 1903 and 1914, by roughly 38% between 1903 and 1927 and by 78% between 1903 and 1939. thus, whereas for thirty years average speeds had gone up between 1-2% per annum, between 1934 and 1939 they increased by over 8% per annum. Similarly, whereas 1903 and 1933 the average engine power for races had been

increased from 70 h.p. to 210 h.p., between 1934 and 1937 it was dramatically increased to over 600 h.p. (Pomeroy, 1952).

In the years following the first car races, various forms of motor racing emerged, including rallying, stock car racing, off-road racing, touring car racing and drag racing. The two most popular and prestigious forms of motor racing, however, became sport car racing and open-wheel racing. The latter refers to a type of a single-seater racing car, in which the car's wheels remain uncovered, and the car carries aerofoil front and rear wings in order to create downforce, thus permitting extremely high speeds to be achieved. The highest and extreme form of open-wheel racing is currently Formula One and this has been the case since the Formula One World Championship was inaugurated in 1950 (O'Kane, 2011).

Formula One car racing has become the leading global car racing event series thanks to the intuition of Bernie Ecclestone, a driver and racing team owner who had the prescience to understand how globalization, the enduring appeal of fast cars and the distributive power of broadcasting, could create enormous value for Formula One. The turning point in the organization of car racing events was the institution of FOCA (Formula One Constructors Association), driven by Ecclestone, and the following negotiation he made with the most important broadcasting companies to secure sport television rights in the interest of FOCA (Skinner, et al., 2018).

Chapter 7: Sport in communist societies and doping

According to James Riordan (Riordan, 2007), communist countries, in the first half of the 20th century, developed a model of sport for community modernization, employing sport for utilitarian purposes to promote health and hygiene, military defense, productivity, integration of a multiethnic population into a unified state, and international prestige-what could be called “ nation-building”.

In most communist states sport had the revolutionary role of being an agent of social change, with the state as a pilot.

Under the influence of Marxist philosophy that stressed the interdependence of the mental and physical states of human beings, many communist states emphasized the notion that physical is as vital as mental culture in human development, and that it should be treated as such both for the all-round development of the individual and, ultimately, for the health of society.

Many communist societies had also an urgent problem of integration. Some of them were loose confederations of diverse ethnic groups, with different colours, languages, traditions, religions, stage of economic growth: USSR, for example, had over 100 nationalities within its 290 million people.

Most of these societies simply took western sports from town to country to promote a patriotism that transcended petty nations and ethnic affiliation.

Besides, many communist states were born in war and lived under the constant threat of war, terrorism and subversion, and sport was therefore often subordinated to the role of military training, and the role of the military in sport was further heightened by centralized control of sports development.

Thus, most of the communist states had a nationwide fitness program with a bias towards military training, modeled on the Soviet “Prepared for Work and Defense” – “Gotov k Trudu i Oborone” - system.

Nevertheless, it has to be considered that the program was originally modeled on the standards set by Lord Baden Powell for the Boy Scout “ Marksman” and “ Athlete” badges.

Regular participation in physical exercise was to be one mean, inexpensive and effective, of improving health standards rapidly and a channel by which to educate people in hygiene, nutrition and exercise; But other aspects of social policy related to sport were interesting for communist states, like combating crime and juvenile delinquency, fighting alcoholism and prostitution, attracting young people away from religion.

And one more aspect of the use of sport for social policy was fore these states the kind of contribution it can give to the social emancipation of women, especially in communities in which women have, by law or convention, been excluded from public life and discouraged from baring face arms and legs in public (Riordan, 2007).

John N. Washburn, in one of the first papers dealing with Ussr and sport, reminds us that the leaders of Soviet Russia used the definition of “fizkultura” (physical culture) to express their concept of a utilitarian and socio-political function of sport. The decree made on July 13th, 1925 by the Central Committee of the All-Union Communist Party interprets this concept as follows:

“Physical culture must be considered not only from the standpoint of physical education and health and as an aspect of the cultural, economic, and military training of youth, but also as one of the methods of educating the masses, and in addition, as a means of rallying the broad masses of workers and peasants around the various party, soviet and trade unions organizations, through which the masses of workers and peasants are to be drawn into social and political activity” (Washburn, 1956).

Also Victor Zilberman wrote about the Soviet sport system in one of his papers (Zilberman, 1982), stating that in Ussr the combination of elite athletics with mass participation was considered sustainable and was recommended. He stated that physical education in schools was an important part of the Soviet sports movement in order to encourage mass participation and the selection of real athletic talents.

Education and sport were considered as two means of developing loyalty to the State and Party, and of developing such qualities as discipline and collectivism.

Among the founders of the Soviet educational system there was Lenin’s wife, Krupskaya, who suggested that the Soviet schools should prepare all-round, developed, spiritually disciplined men; to achieve this, people have to be healthy, brave, and physically prepared.

The Soviet educational system was very centralized, for the Soviet Union, with its large territory and population, required such centralization.

Instructions were passed on to the ministries of republics, to regional, city, and district educational departments, and ultimately for implementation to school directors and teachers.

Much of the accomplishment of Soviet physical education and sport should be attributed to the rating systems of the All-Union Sport Classification, and GTO (Gotov k Trudu i Oborone - Ready for Sport and Defense), which facilitated mastery in sport and mass participation in all areas of the sport movement.

The All Union Sport Classification is a system of norms and requirements according to which athletes are awarded ranks, titles and categories in different sports. It covers 56 sports and used to be updated every four years after the Olympic Games, with a ranking divided into juniors, seniors, candidate for master of sport, master of sport of the Ussr international class, grand master, merited master of sport.

The goals of the GTO and the All-Union Sport Classification systems were similar in that they encouraged people to participate in the sport movement, but they are different in other respects: the GTO was created to increase mass involvement in sports, and to provide the requirements for physical education in the general school as well as the physical exercise program for the military and for the collectives in rural and urban areas; The All-Union Sport Classification System, on the other hand, was used to raise the proficiency of Soviet athletes essentially to the level of winning major Soviet and international sport competitions.

According to that system, students used to compete mainly in 13 sports: Basketball, volleyball, water polo, cycling, gymnastics, track and field, swimming, diving, table tennis, lawn tennis, soccer, shooting, canoeing.

A similar situation developed in Eastern Germany (MDR.de, 2021), a communist state generated by the separation of Germany after World War II, which had to decide what to do with the sport organizations it inherited from the Nazi institution called "Nationalsozialistischer Reichsbund fuer Leibesuebungen", the Socialnationalist Federation for Physical Education.

The Government of Eastern Germany decided to change the old organizations into social bodies that were organized by municipalities and led by politics.

Thus, the old traditional sport associations became organizations led by public enterprises (Betriebssportgemeinschaften) or sport clubs which had no own capital, as this was kept by the public, political entity depending on the municipality or public enterprise.

In 1948, with the founding of the German Sport Promotion Organization (“Deutsches Sportausschuss”) a controlled development of sport, based on long term planning, was started in all the country.

Since the state was interested in enhancing its influence in all sport activities, especially because of sport relevance in international affairs and visibility, in 1952 an additional institution for sport was founded, the Committee for Body Culture and Sport (Komitee fuer Koerperkultur und Sport), which focused, for propaganda reasons, on the main competitive athletic sports and on top champions. The strictly selected sports that had to be supported by the national sport system were athletic, swimming, gymnastic, soccer, boxing, biking, handball, volleyball, basketball, rowing.

In order to boost all these activities even a high school for body culture was created in 1950, which served, together with the other institutions, to influence the development of sport in a scientific way based on careful long term planning.

The government decided from the very beginning to focus only on competitive sport because it recognized its importance for inner and for external politics: it was already popular since the beginning of the 20th century, it used to attract all those who were longing for some free time, it improved public health, it provided positive examples for youngsters and gave a good opportunity to inspire a national identity.

A new and unknown state seeking for international recognition could get stronger visibility and reputation through high achievements in international sport competitions. At the same time, the “ fight of classes”, in times of cold war, could be carried on also through international sport events.

Therefore, the systematic selection began from kindergarten and schools. The promising selected children were forced to register for a sport club, and nor them nor the parents could oppose. On the other hand, to be selected was felt as an opportunity to reach world-class levels and therefore to get the permission to travel abroad to the West.

And the training centers offered advantages as well: better medical assistance, privileges in school and work, social recognition, and plenty of useful contacts.

Since the State was mainly interested in the kind of sport that could provide international medals, especially the Olympic ones, the financial resources were mainly driven to the sports which could guarantee opportunities of success for the eastern German athletes, who were stimulated to achieve international top levels through an unofficial system of prizes or of material help (support for the building of their house, or buying a car, or finding the wanted work place or university). For example, an eastern German Olympic winner received 35.000 Marks from the government in 1988.

As a consequence of this effort, East Germany became between 1970 and 1980 the leading country in a relevant number of Olympic sports, but in order to keep its leading position, endangered by many new advancing countries, the quantity and quality of the training planned for its athletes seemed to be no longer enough.

Therefore, it became necessary to find new ways to improve the levels of performance of the eastern German athletes: whole groups of medical experts, biochemists, biomechanics, physiologists, physicists were engaged to improve physical achievements by any possible mean.

Thus, together with the use of new technical tools (artificial water streams in pools, Hyperbaric chamber, synthetic slopes for ski-jumpers etc.) the path was open also for technologies which could influence the change of substances and hormones in the body, which led to well addressed doping systems, based on the science of protein synthesis, considered that an athlete could not absorb 10 steaks and 3 liters of milk a day in a natural way.

Of course the use of doping was hidden and unofficial, even if many spectators were surprised by the masculine voice of eastern German female swimmers, and doping controls at international competitions have been for long time ineffective because athletes were pre-controlled by eastern German experts, before every international competition, at the Central Institute for Sport Medicine in Kreischa.

The level of chemical and hormonal doping adopted by East Germany was only discovered after 1989, when the communist government collapsed.

Both the soviet union and Eastern Germany can be considered clear examples of “state-sponsored” doping technology in sports.

According to the report of Michael Kalinski (Kalinski, 2017), who was chairman of the department of sport biochemistry at the Kiev State Institute of Physical Culture in the former Soviet Union, in 1972 the soviet state central institute of physical culture published one hundred seventy copies for a limited use among selected sport functionaries and disseminated a classified document that outlined the secret soviet research on steroids and recommendations for using steroids in sport. The document contained a series of scientific reports providing the time and dosages for administration of androgenic-anabolic steroids of human athletes and data from experiments conducted at the research laboratory of training, programming and physiology of sport performance of the state central institute of physical culture in Moscow.

Another procedure, blood doping, was developed in the former USSR, which involved the effort of the central institute of emathology and transfusiology, led by the Russian scientist doctor Nicolai Volkov. Blood doping was pervasive in the USSR during 1970s and 1980s and was used by many soviet athletes in the 1976 and 1980 Olympic games. Doctor Volkov was awarded a gold medal of Russia Sport Committee for his research.

This trend did not stop in Russia after soviet times. With the doping scandal that started after the Sochi winter Olympics in Russia, a commission of the world anti-doping agency (WADA) led by professor Richard H. McLaren, established a universal understanding of how sport competitions had been hijacked by Russia through doping manipulation. An institutional conspiracy existed across summer and winter sport athletes, who participated with Russian official and ministry of sport and infrastructure, such as the Russian anti-doping agency, center of sport preparation of national teams of Russia, and the Moscow laboratory, along with the FSB (Russian security service) for the purposes of manipulating doping control.

The swapping of Russian athletes’ urine samples was occurring at Sochi. Over thousand Russian athletes competing in summer, winter and Paralympic sports, could be identified as been involved in or benefiting from manipulations to conceive positive doping tests.

Nevertheless, it was eastern Germany which achieved the highest level of state-driven doping in history.

According to Paul Dimeo in his paper “Sport Under Communism: behind German miracle”, reasonable estimation suggest that in the east Germany sport system, around ten thousand athletes at the elite level were expected to take the banned steroid “Oral-turinabol” to support their training and performances (Dimeo, 2013).

Also Alan McDougall, reminds that with this kind of systematic procedures the 1976 Olympic games in Montreal, the Communist German Democratic society, home to just 19 million habitants, won 90 medals, and it finished second in the medal table behind the soviet union and head of both USA and Germany. In that occasion responding to reporter’s question in Montreal about the deep voices of the woman swimming teams, the east german coach Rolf Glaeser simply remarked: “they didn’t come to sing, they came to swim”.

This was the result of the east German 1969 “High Performance Directive” (which focused attention and money on specific Olympic sports), of the integrated talent spotting system, and of the introduction of the state plan 14-25 (1974), the key document in the GDR’s clandestine doping program, which included the infamous distribution of 5 mg blue tablets of the steroid “Oral-turinabol” to unsuspecting minors (McDougall, 2013).

As Reported by Cantarella and Miraglia (Cantarella & Miraglia, 2021), the most famous example of this forbidden and hidden practice is Kormelia Ender, the champion of Eastern Germany, at the time of the communist regime, who became at the Olympic games of Montreal in 1972 the first champion of swimming to win 4 gold medals in a single edition of the games.

At the age of 18, having discovered after her impressive victories the kind of treatment she had been subjected to, Ender refused to proceed further with the doping program, and her career finished.

At that time, Eastern Germany knew very well that giving anabolic steroids to athletes would have provided the greatest sport achievements especially in female sport, a branch in which the margins for increasing performances were higher in comparison with male sport, which was more advanced in terms of training techniques.

It was Christiane Knacke, eastern German bronze medalist in swimming at the Moscow Olympics in 1980, who revealed, after Germany's reunification in 1989, the reality of doping under the former regime.

She made the strongest accusations to her former state sport organization, telling about the pills and injections she had to take at the swimming pool trainings since she was 13. A treatment that made her gain 15 kilograms of weight and a lot of muscular mass. But the bones, on the opposite, became very fragile, to the point she had to put a prosthesis on an elbow that had suddenly broken down. And her problems were transmitted to her children, she told her daughter had been for 18 months in life danger because of the steroids she had to take.

Knacke decided to give back all her medals during the court case that was hold in 1997 in Berlin against her managers, trainers and medical assistants, when she also declared: "these medals are dirty, poisoned by your drugs and by a corrupt system. They have no value at all and they are only a terrible humiliation for the German people" (Cantarella & Miraglia, 2021).

Another well-known case, in that of Heidi Kruger, who was a shot putter and who testified in court that she had been given steroids at an early age, being told that they were "vitamins". She suffered from a process of "androgenization" or "virilization" and subsequently had gender realignment surgery and is now known as Andreas Krueger. (Dimeo, et al., 2011).

Werner Franke, microbiologist and cancer researcher from Heidelberg University, mentioned in his studies also the case of shot-putter Margitta Gummel. In 1964, Gummel achieved the fifth place in the Olympics games without using anabolic steroids. From July to October 1968 Gummel daily received two pills with five milligrams of "Oralturinabol", a fact proven by a secret document of the GDR regime. Within a short period of time the athlete could improve her record performance from 17.86 to 19 meters. In the Olympic Games in October 1968 in Mexico, she won the gold medal and set a 19.61 meters world record. In the year 1972, Gummel already consumed all together 1.450 milligrams. The next generation of GDR athletes even consumed twice the amount or more (Barsuhn, 2007).

In fact, Franke and Berendonk in their study on individual doping cases on eastern German female athletes, criticized the health consequences for women given androgenic

drugs. They listed the potential side effects of steroids and described serious instances in which female athletes in the GDR's program, suffered short and long term health problems. Some of these side effects were documented in scientific research, such as muscle tightness, body weighting increase, muscle cramps, irregular menstruation, acne, hirsutism and alteration of libido. Others are noted as having been reported through Stasi (secret German police) collaborators: three deaths, gynecomastopathy, liver damage and deepening of the voice (Franke & Berendonk, 1997).

On the other hand, it has to be considered that in general, doping technologies have a long history in sport and athletes of the communist world were not the only to use these methods.

According to the paper of Yesalis and Bahrke, in the last third of the nineteenth century, the use of stimulants among athletes was a commonplace and there was no attempt to conceal drug use with the possible exception of some trainers who guarded the proprietary interest in their own doping recipes.

For example, boxers used "strychnine tablets" and mixes of brandy and cocaine to improve their resistance, French bicycle racers took mixtures on a caffeine base, Belgians preferred sugar cubes dipped in ether or alcohol containing cordials, and the sprinters specialized in the use of nitroglycerine.

The first fatality attributed to doping was reported in 1886: Arthur Linton, an English cyclist, is said to have overdosed on "tri-methyl" during a 600 km race between Bordeaux and Paris (Yesalis & Bahrke, 2002).

The age of scientific organotherapy began in 1889 when Charles Edouard Brown-Sequard, a prominent physiologist and neurologist reported how over a three week period he had self-administered injections that contained "blood of the testicular veins, semen, juice extracted from a testicle".

These experiments, even if not productive of really relevant effects, started the research trend that led scientists to isolate in 1935 the testosterone hormone, highlighting the basic nature of its anabolic effects. Shortly thereafter, both oral and injectable preparations of testosterone were available to the medical community. This laid the foundation for the subsequent use of testosterone as an ergogenic aid (Yesalis & Bahrke, 2002).

In his paper "The Male Hormone", De Kruif (De Kruif, 1945), raised expectations for the newly synthesized anabolic steroids. He reported that testosterone "caused the human body to synthesize protein and to be able to build the very stuff of its own life".

In 1958 Ciba pharmaceutical company added "Dianabol" (methandrostenolone) to the existing drugs and the news of its efficacy spread by word of mouth during the early 1960s to strength-intensive sports from field events to football.

By the early 1980s, also the use of human growth hormone (hGH) was well established among the sport community's drug menu, becoming the "state of the art" strength and size drug in the free world.

Amphetamines as well, which were first synthesized in 1887, have been widely used as stimulants. Cycling played a central role in the explosion of stimulant use in sport after world war II. Of 25 urine samples taken from riders in 1955 race, 5 were positive to stimulants. In the 1960 Rome Olympic games, Knud Jensen, a 23 years old Danish cyclist, collapsed during competition and died. Autopsy revealed the presence of amphetamines. One year later, another cyclist, Yves Mottin, died from excessive amphetamine use to days after winning a race.

A summary of the doping history in professional cycling was given by Willy Voet, a long time team masseur, who described the three drug eras of this sport: amphetamines in 1960s and 1970s, anabolic steroids and cortisone in 1980s and thereafter hGH and erythropoietin (EPO).

Among the situations related to the use of stimulants, also the chronic problem of the cocaine use among US National Football League (NFL) has to be mentioned, while on the opposite, with a different purpose, even golf, a sport with a clean image that is thought by many to be synonymous with integrity, reported the use of sedatives and tranquillizers for their calming effects by such players like Doug Sanders, Dave Hill and Al Geiberger. In the 2000s the new calming drugs on the golfing menu are beta blockers, which moderate the effects of adrenaline and decrease heart rate (Yesalis & Bahrke, 2002).

Another dramatically innovative technology was, since the late 1960s, blood doping, which means the reinfusion of an athlete's own concentrated oxygen-carrying red blood cells or those of a typed-matched donor, shortly before competitions. This procedure has

been widely adopted by European distance runners, cyclists, cross-country skiers and biathletes (Yesalis & Bahrke, 2002).

Among the latest and most surprising attempt of science and physiology to intervene on human athletic performances, also the western German “air-clyster” affair of 1976 has to be mentioned: a technology that tried to improve swimmers’ hydrodynamics by pumping air into their bowels, that should have been used for the Montreal Olympics, but was abandoned during the pre-races because the athletes could not keep the air until the competition (Meier & Reinold, 2013).

In conclusion, also physiology, biology and chemistry have always been playing a relevant role in sports, influencing human performances and the environment of competitions and of betting.

The reaction to this trend was the pressure by national governments which led to the creation of the WADA (World Anti-Doping Agency) in 1999, participated and funded on a 50-50% basis by governments and the IOC (International Olympic Committee), which showed different levels of commitment by politicians and governments, depending on a wide range of causes. According to some analysts, Canada and Australia for example, played lately a leading role in the global development of anti-doping probably because of their position as second rank sporting powers playing in the shadow of grater sport countries (USA, Russia, Germany, China). Their action to suppress the potential of doping in the race for sporting excellence might be read as a way to reduce their distance with these sporting powers. This has been the case also with France, probably because the country hosts, and therefore has to protect, one of the biggest and most lucrative yearly sport event: the Tour de France. The French action echoed also national anxieties related to a progressive loss of status in the field of elite cycling due to the rise of new cycling powers like Australia, Denmark, Germany, Ireland, Spain and the United States.

WADA is based in Lausanne, Switzerland, and it had a total revenues of 36,6 million dollars in 2020, of which 18 million given by IOC and the rest as a contributions by single governments, among which emerging sport countries gave a more relevant contribution, like Canada with 750.000 dollar, China one million, India one million and

Saudi Arabia half a million. All this funding is used in support of scientific research, intelligence and investigation activities.

Since 2001 WADA has already invested 83 million dollars in breakthrough activities in anti-doping science aimed at keeping sport “clean”. It has developed and constantly improved tests to detect EPO (erythropoietin), human growth hormone (hGH), genetic doping etc.

In 2004 it started publishing a list of prohibited substances and methods, which is yearly improved. WADA also harmonizes and improves worldwide analytical capabilities in anti-doping laboratories and continues to lead the improvement of the Athlete Biological Passport (ABP), a powerful anti-doping tool which monitors selected biological variables over time to reveal the effect of doping in addition to traditional doping detection substances and methods.

WADA’s activity has become more intense year after year, and the number of samples it collected from athletes worldwide has increased from 257.000 in 2016 to 314.000 in 2019 (WADA, 2020).

The debate about which external means of performance enhancement in sport are legal/acceptable and illegal/unacceptable is becoming more and more complicated also considering that doping as technology comes from the demand of elite sport women in their endless upward race. The discussion will evolve in future along the lines of what can be considered healthy/unhealthy, natural/artificial or endogenous/exogenous, and it will be the result of the balance of forces in the tension between social brakes and accelerators (Alix, 2019).

Chapter 8: Professionalization of Sports

The progressive engagement of professional athletes in sport is based on two main drivers: the growth of demand for a more constant performance in sport in order to be able to generate a calendar of a series of events which had primarily the aim to make the number of spectators and betters grow; the quick growth in economical relevance of mass sports, which was generating a real industrial and commercial network attracted youngsters belonging to popular social levels who were interested in wealth and fame. Therefore, with the birth of the “sport industry”, many young artisans and workers of the lower class could expect to see their life change, selling the sport skills they had achieved, thus starting a trend of “social mobility” towards the upper class that had never been possible for them in the past.

This kind of process started to be a benefit also for national political organizations and governments, which exploited the achievement of high athletic positioning in international competition by the youngsters of their nation, could generate a “sport mythology” which was very useful for a certain model of national identity based on the idea of the offensive and defensive capacity of the nation. Success in sport was also exploited to generate social consensus around the government institution. Therefore, the growing investment made by government in sport organizations aimed at receiving a positive response, not only by the growing number of fans, but also from the entire public opinion.

Along with the birth of professional sports, several factors start to increase the dimension of the sport system: the sales of the event tickets, the sales of advertising rights to sponsors, the sales of commercial rights to medias and other resources related to the sale of the “sport image” of a team or of a single player.

According to Coakley and Pike (Coakley & Pike, 2009), the social and economical condition that favor the diffusion of the sport commercialization, are the following:

1. The presence of a market, in which the economical advantages are considered the most important values by athletes, owners of the team, sponsors and spectators;
2. The presence of densely populated urban areas, which ease the participation to massive gatherings;

3. The diffusion of a lifestyle that is sufficiently high to allow to many people to have enough time and money for events that are not directly related with a productive function;
4. High concentration of capital, public or private, that can be invested in the building of stadiums or other big infrastructures for events;
5. A common culture in which the lifestyle is oriented to consumption and in which the values of status symbol and material success are highlighted.

In this kind of environment anything that belongs to the sport universe can be sold and commercialized: athletes, teams and brands, but even the participation to collateral events. Therefore, the success of commercial sports depends on the sales of symbols and emotional experiences to the audience, and then the sale of the audience to sponsors and medias.

To better understand the connection between professional sport, mass media and sponsor it is also important to consider how the selection system of the athletes has changed and which are the paths to approach the profession that in many countries start from schools, colleges and universities and in others from sport associations and federations or a particular selection inside the armed forces. Besides, it has to be considered that in this dominant sport system, the career of the professional athletes is usually short (in American football, basketball or baseball, the average agonistic career has a length between three and seven years, but the majority of players don't last more than one or two years) (Lo Verde, 2014).

The career of a professional player is usually influenced also by some social conditions: the Olympic athlete belongs in most cases to the middle-upper class (Collins & Buller, 2003), and 80% of Olympic games participants had attended a private school. The access to Olympic competition is surely related to sport merit, however this is at the same time based on the opportunity to attend during the own free-time qualified teams or sport institutions. Also according to Pierre Bourdieu (Bourdieu, 1980), the choice of the kind of sport depends not only on the amount of time and money available by any individual, but also on the evaluation of the social cost and benefit related to the kind of activity.

Bourdieu makes a difference between the “utilitaristic” use of the body, typical of the working class, in comparison with the use of the body as project and as “final goal” typical of the middle class. From this point of view, the athlete becomes therefore a professional, as a result of a process of social construction, that leads to the achievement of a position in the star system, but inside a social system with a different power relationship among the ones that control a part of the resources and the economical power, a part of the resources and the political power and the ones who control cultural resources and power.

The first group is made not only by the sport teams which select the athletes, but above all by the big corporations which have important role of sponsors, and which in many cases have an influence on the decision of the sport team. For example, having a new star in a team can be an asset, not only for the sport team, but also for the corporation which acts as sponsor. In fact, the corporation’s image gets associated to the fame of the athlete, while on the opposite, to get rid of non-satisfactory performer can be an advantage both for the team and sponsor.

The second group is made by the international (CIO, FIFA, UEFA etc.) and national (CONI) sport institutions, which controlled part of the political power to regulate sport activities and also the career of each single sport professional (for example, consider what happened to Tommie Smith and John Carlos at the Olympic games of Mexico City of 1968, after they expressed their solidarity to the Black Panther Party of Malcolm X on the podium showing the black fist. After this fact, they have been cut off from any other professional sport event).

The third group is made by media operator which gave a relevant contribution to the creation or destruction of a professional career. Journalists, anchormen and experts of different kind are in the condition to regulate, filter and lead the flow of information and interpretations which allow to influence the opinion on the different professional roles in the world of sport, from athletes to sport directors and referees. Besides, the same policy makers end up with influencing decisions whose consequences are relevant for the whole sport world, or on the contrary with using sport through the media as a tool to generate popular consensus.

According to Guttman (Guttman, 1978), this concept of modern sport focused on specialization, rationalization, measurement of results and demand for records can be

considered as a logical output of the rationalization process of the whole modern society. It's simply the consequence of the involvement in the process of rationalization of the whole western culture of which sport is a relevant part.

Even Brohm (Brohm, 1978) criticized the strict relationship between events and sport activities and the interest of the big entertainment corporations that lead to a "taylorization of the body". However, these critics should consider that, from the 1950s even in the socialist countries the same growth patterns have been adopted and also in those countries the experimentation has been affected by deep distortions in the name of success, even through use of doping procedures of athletic preparation that have often revealed to be alienating for the young athletes.

In the middle of the eighties Hardgraves (Hardgraves, 1987) described five different aspects of the relationship between capital and sport through commercialization:

1. The maximization of profit as it happened in boxing or horse racing;
2. The attempt to keep financial health through some survival techniques like for example, fund raising;
3. The production of goods and services, which around sport, allow to proceed the process of enrichment of corporations, which produce sport equipment and clothing, sell events and run the betting;
4. The availability of sponsorship opportunities and advertising which favor the indirect accumulation of capital;
5. The attractiveness for investments that sport generates for reasons that are not directly economical but that have an economical impact (in Italy, this is the case of many investors interested in becoming head or "patron" of many football teams, which can be justified only with the personal prestige, social position and public visibility guaranteed to the investors through media).

What seems to be clear is that behind the competitive global sport professionalism there is always a significant strategy of economic investment, a political care for the institutions which operate for the athletic preparation, a careful selection of human capital on large scale, an investment in equipment and infrastructure for athletic

preparation. These are always strategies that take the move from an idea of sport meant as “high performance” (a not simply sport for all or “fitness sport”), and this depends on the fact that this kind of sport commitment is more easily marketable and more useful for the creation for national sport brands, which is politically very important to position a country in international relations.

A typical scheme of this kind is Great Britain’s system for the selection of the athletes. At the base of the selection process there are the young athletes who attend schools with the possibility to practicing a sport or the sport clubs. The athletes who show some peculiar skills and capacities that allow them to emerge as excellent performer in a certain sport are selected among them. But only those who reach the standards that are requested to have access to national and international competitions are selected as Olympic athletes and only some of them are going to be “Olympic medal”.

This selection model has been based on several initiatives, for example raising more funds through lotteries and betting controlled by the government.

A specific plan aimed at selecting and preparing Olympic champions, the UK Sport’s World Class Performance has been started in the middle of the nineties with the result of raising the British representative at the Olympics from the 36th place of Atlanta 1996 to the 3rd place at the London Olympics of 2012.

Another plan, the Talent Identification and Confirmation Program, prepares groups of selected athletes in a timeframe of six or more years from the Olympic podium, both for Olympic and Paralympic games.

As a consequence, Great Britain increased the resources dedicated to the preparation of the champion from 58 million pounds (Sydney 2000) to 258 million pounds (London 2012), spreading these resources among sports for which the placement in the Olympic medal system was promising and reducing it for competitions in which Great Britain did not excel. All this financial effort has been combined with an investment in the process of professionalization of the instructions and a tougher application of scientific innovation coming from medicine and sport science (Lo Verde, 2014).

All the financial resources aimed by nations and sport teams to professionalize sport activities have involved plenty of “state of the art” technologies to measure and improve

the performances. Also the latest IT (Information Technology) innovations have been vastly adopted in order to reach several goals.

For example, virtual reality (VR) and augmented reality (AR) have started to be applied to professional players through the use of headsets for acclimatization and visualization before competition, and feedback on performance, as well as brain training style activities. This technology reduced the physical stress on athletes using a virtual environment to train, play and improve decision making.

The co-founder of Google Sergey Brin has been pushing forward the use of Google Glass, which displays information in a smartphone-like format hands-free, and can directly interact with the internet. The growing need to keep performances steadily under control has generated apparel embedded with sensors, like the ones developed by OMsignal, which track the wearer's biometrics, such as heart rate, respiratory rate, movement and distance. Data appear in real time through a smart device "app".

Another example of real time monitoring is the technology generated by the concussion protocol introduced by the NBA's team Golden State Warriors. It was stimulated by an on-court need, enabled by a novel technology, championed as an organizational welfare policy, promoted as an exemplar innovation to other teams, and employed as a tactical device. SyncThink's "EYE-SYNC" concussion assessment system records and analyses player eye-tracking impairments, thereby providing a mechanism to ensure that collisions have not affected player judgment.

For a similar aim, Unity High School in Tolono, Illinois, introduced helmets to their football team containing "Head Impact Telemetry System" (HITS) technology. It wirelessly relays details of collision along with other telemetry to software for monitoring and analysis.

These technologies are extremely precious considered that also the Australian Institute of Sport estimated that over 100.000 sport related concussions occur annually in the country, with 60% requiring hospitalization. The elite sports digital arsenal nowadays can count also on a software, based on chips on which Intel invested significantly, through which baseball pitchers can have their throwing actions automatically

examined for vulnerability to rotator cuff injuries and other biomechanical inefficiencies. Swimming coaches are employing a similar technology (SwimIO) to improve stroke techniques.

In kayaking, the company Motionize has generated paddle sensors that report to a smartphone app about the athlete's strokes, movements, speed, distance, energy expenditure and motion. This technology is typical of the new IOT (Internet of Things) trend in digital devices for remote control (Skinner, et al., 2018).

Sport technology is being increasingly used to record match results and provide a statistical information. Computers do this more accurately than humans and provide a way to have more reliable information. This is seen in "goal line technology" or "decision-aid technology" being used in sports such as tennis that enable replays to see where a ball actually lands on a court. In baseball, there are remote umpires who are referred to, in difficult decisions, that can use advance technology to check decisions. In football, two major "decision-aid" technologies are utilized: Hawkeye, which enables the tracking of play on a football pitch, and GoalRef, which uses a chip within the ball to track where it goes.

In addition, computers and use of data analytics to recruit players enables more information to be analyzed on their strengths and weaknesses making more objective choices. The use of IT has enabled a more holistic understanding of how athletes perform under pressure (Ratten, 2019).

Even the World Surf League has introduced such technological innovations, like a free downloadable app, launched in 2015 that provides real time surfing information, and wearable technological gadgets to measure sport performances such as Fitbits have brought more and more people to connect sport to innovation (Ratten, 2018).

But the biggest investments and resources in scientific aid to sport professionals have been deployed in the field of training, and especially in "strength and conditioning" techniques and nutrition.

In modern sport, behind every athlete, team, and victory there are many professionals engaged in helping athletes, coaches and teams to reach success.

This includes strength and conditioning coaches, sport nutritionists, athletic trainers and physical therapists, sport medicine and specialty physicians, biomechanical specialists, data-analytics professionals, and sport psychologists from a performance standpoint.

In high-level sport, success is often determined by how effective the performance-enhancement team is in applying the latest sport science and psychology to athletes achieve peak performance to make them effectively execute the coach's plan.

Nearly all competitive teams employ strength and conditioning specialists and sport dietitians or sport-nutrition consultants to help prepare their athletes.

The history of modern "strength and conditioning" science began in 1969, when Boyd Epley was hired as the university of Nebraska's first full time strength coach, obtaining impressive results for the university football team. In 1978, he founded with other 76 strength coaches from across the U.S. the National Strength and Conditioning Association (NSCA), and today there are over 30.000 NSCA members in 72 countries.

Strength and conditioning programs are generally based on principles of specificity, overload, progression and variation.

Specificity of training involves designing programs that target the muscle groups, energy systems, movement patterns, speed of movement, and muscle actions needed for a specific sport or athletic competition, overload is achieved by modifying load, sets, repetitions and rest periods of various exercises, while progression involves the systematic increase of a training stimulus over time to promote positive training adaptations. Planned variation of types of training and exercises is also an important way to prevent plateaus in training adaptations and overtraining.

The annual training period is commonly referred to as a macrocycle, divided into shorter phases according to periodization methods.

A mesocycle is made of a training phase of 2 to 8 weeks, with includes a general physical preparation phase, a specific preparation phase, a precompetitive phase, competitive phase and peak phase. A microcycle of 1-2 weeks generally requires individual training sessions with dynamic warm up, flexibility training, cardiovascular conditioning, speed and agility training.

Numerous studies indicate that incorporating these types of conditioning programs into the annual training program increases strength, power, speed, agility, and muscle mass in male and female athletes.

In the field of nutrition, scientific research linking nutrition to athletic performance began appearing in the literature already in the mid-1800s. For example, Michel Eugene Chevreul discovered creatine in muscle in 1832, Justus Von Liebig suggested that protein was the primary source of energy fuel during exercise in 1842 and, in 1847, that creatine increased in muscle 10-fold after exercise. He also proposed that consuming a meat extract he developed could increase strength, performance and health.

Scandinavian scientists found out in the 1920s that the diet influenced carbohydrate and fat utilization at rest and during exercise. During the middle of nineteenth century many different studies revealed the role of vitamins and minerals in health.

The development of the muscle-biopsy technique by Bergstrom in 1962 paved the way for studies to understand how macronutrient ingestion affects muscle glycogen, phosphagens, exercise capacity, recovery and training. In addition, Robert Cade created Gatorade (a special drink based on the tests made on the Florida "Gators" football team) and showed that ingesting a glyucose electrolyte solution (GES) helps prevent dehydration and improve performance.

In 1976 Dr. Mel Williams published a book on nutritional aspects of human physical athletic performance summarizing the literature on the subject and during the 1980s a number of academic programs added sport nutrition to their plan of studies. In the 1990s several teams and universities hired full-time dietitians or collaborated with sport-nutrition related research groups. As a consequence, in the U.S., the International Society of Sports Nutrition (ISSN) was founded in 2003.

Performance nutrition programs typically provide assessment of diet, body composition, energy expenditure to help sport dietitians and coaches set goals for athletes. Sport nutritionists help athletes understand the importance of diet for performance and help them make wise food selection. They are also responsible for pre-game-day nutrition and hydration, postgame meals, and recovery nutrition practices (Kreider, 2020).

Chapter 9:

Female emancipation and sport innovation

When the baron Pierre De Coubertin founded the modern Olympic Games in 1896, women were not allowed to take part to the competitions.

His words on the issue were the following: “At the Olympic games, the role of a woman should be above all to crown the winners. A female Olympic competition wouldn’t be practical or interesting, it would be anti-esthetic and incorrect” (Cantarella & Miraglia, 2021).

This point of view, shared in the past by many societies, governments and institutions, made it very hard for women to enter the modern world of sport and athletic activities. The path toward a full emancipation of women in sports and through sports took centuries, and all kinds of cultural, social, medical and religious prejudices had to be overrun step by step.

Among the authors that have been focusing on the specific needs of female physical education, we have to consider the system developed by Heinrich Clias. After teaching in Swiss and training Swiss military army, he arrived in England, hired by British military which was impressed by the physical condition of his students. Clias’ system was based on remedial and hygienic exercises, divided in four groups: the lower extremities (walking, running jumping), the superior extremity, complicated exercises (parallel bar, wrestling, running and skipping with a hoop and the use of the “Flying Course” exercise) and different methods of swimming. His most innovative works are those about women exercises. He thought that the “flying course” was the best exercise for women: it consisted of a pole, ropes and a series of trapeze-like handles: the women had to grasp the handles as they ran. He also wrote “Calisthenics” or “Exercises for beauty and strength for young women”, which has been published in 1829 and was an absolute state of the art treaty because it explained in detail the exercises which were particularly tailored for women.

After Clias’ departure from London, some of his scholars kept on focusing on exercises for women. The most important was G.P. Voarino, who wrote “ A Treatise on Calisthenics Exercises, Arranged for the Private Tuition of Young Ladies”. His essay on

female exercise contained 64 exercises designed and appropriate to women. The exercises were aimed at upper class sedentary women, and he recommended his system for its ability to modify the female form; an efficacious system “for counteracting every tendency to deformity and for obviating such a defect from figure, as are occasioned by confinement within doors or by those constrained positions which young ladies habitually assume during their hours of study”.

This work was followed by J. A. Beaujeu, who introduced gymnastics to Dublin in 1824 and ran a female gymnasium in addition to his work at the Hibernian Military School. He was assisted by his wife, who became an important link in the introduction of women gymnastics and Calisthenics to America because in 1841 she opened a school for the teaching the exercises in Boston. In his work “A Treatise on Gymnastics Exercises or Calisthenics for the use of Young Ladies”, he appeared to be the first to recommend in writing that women wear appropriate gymnastic dress for their exercise sessions. These costumes should consist of:” a pair of muslin or cotton trousers, a little close above the ankle; they should take care to tighten their garters but slightly, in order that the bending of the foot or knee may not be impeded, and that in running, these parts may acquire without impediment, all the strength and elasticity of which they are susceptible” (Todd, 1992).

One of the first opportunities of female emancipation in sports was offered by the quick success of biking as mass physical activity. The bicycle wasn't only a mean of transportation, it was a tool for conquering freedom, both for men and women.

France was among the first countries where bikes had modified some social habits. Women changed their clothing to be able to use the bicycle, instead of the usual long gowns they started to wear large trousers and ceased to wear the troublesome corsets that used to limit their movements (Cantarella & Miraglia, 2021).

Even in the States, since the second half of the 19th century women used to wear “bloomers”, a kind of trouser, perfect for biking, that was very narrow at the ankle (a part of the female body that according to old decency rules had to be hidden), a new fashion launched by Amelia Jenks Bloomer, editor of “The Lily”, the first magazine for women published in NY since 1849.

This kind of dress, also called “freedom dress”, “rational dress” or “American costume”, had full trousers gathered at the ankle and on top of those a skirt cut-off just below the knee. The upper part consisted of a fitted dress with open sleeves, buttoned from the waist down but left open in the bodies to show a full sleeved blouse underneath and a sash belt (Warner, 2006).

Considered that the biggest impediment to female physical activity had been for centuries the corset with its “tight lacing” that damaged women health and internal organs, The most important result of the dress reformers’ work was the “health waist”, a firm sturdy underbodice cut to the natural waist without steels of any kind, which gave what was believed to be a much needed support to the back. It was designed with shoulder straps and could have lightweight boning, but broke from the strapless and tightly shaping tradition of the corset. It bound the torso, but not as rigidly as the shaped corset. In fact, in an era when even doctors regarded the corseted body as the ideal female form, this garment really represented a relevant reform.

Eventually, the quest for more comfortable female clothing started by the bicycle revolution, paved the way for the transition from tight-laced corsetry to the modern brassiere, which is considered the final step in female sport emancipation (Porro, 2013). As a consequence of the positive biking trend also among women, Belgium was the country that hosted the first world female biking championship in 1896 in Ostend, which was won by Helene Dutrieux, one of the first women to become a versatile sport pioneer.

Another sport which provided new practice opportunities to female champions was tennis, which used to be typical of the upper class, were emancipation of female athletes was easier.

Born in Paris, the tennis champion Suzanne Rachel Flore Lenglen (1899-1938) became the first international star in female sport, with a record of 341 victories in tennis matches and only 7 defeats. She can also be considered one of the first “ influencers”, as she inspired new trends in female fashion: at Wimbledon she appeared on the playing ground with naked forearms and a gown just under the knee, changing forever the traditional clothing patterns.

She's been a pioneer in the sport-business relation as well: in 1921 she became the first champion to act as "testimonial" of one of the most famous French fashion brands, Jean Patou, a company that can be considered the founder of "sportswear".

The final stroke to the boundaries imposed to female sport was given by Alice Milliat (1884-1957), born in Nantes, she's been the real pioneer of female organized sports, and thanks to her strength, pride and perseverance women have been finally accepted in the international world of sport.

She was a good swimmer and was fond also of canoeing and soccer. After having organized in England the first female soccer tournament in history, she decided to openly challenge the Olympic Movement of De Coubertin, founding the first Female Olympic Games, organized by the International Female Sport Federation, with the participation of delegates from France, UK, Italy, Norway and Switzerland.

The second edition, in 1922, reaches the relevant number of 300 participants, and Milliat tried to obtain a formal recognition for her athletes by the ordinary Olympic Committee.

This will happen in 1924, when De Coubertin, concerned by a commercial competition of his games with the Female Olympics, makes an agreement to admit inside the Olympic Games also female competitions in the field of athletics or "track and field".

Thus, the Olympic Games in Amsterdam in 1928 became the turning point: women obtained an enormous symbolic visibility in these games with 101 athletes competing in athletics, but their access was limited to 100 and 800 meters run, relay race, jumping and disc, while men could already count on 22 different competitions in athletics (for example, women had to wait until 1981 to be admitted to the Olympic marathon).

Nevertheless, the Amsterdam Olympic games, with 275 female athletes on the whole, 10 percent of the total number of participants, were an incredible political success, which anticipated just for few months the obtainment by the suffragettes of the extension to female citizens of the voting rights in UK.

From the economical point of view, in some professional sport activities, the fight between sexes became also a fight for money.

This happened especially in tennis, a spectacular sport of which Billie Jean King, born in Long Beach in 1943 has been one of the greatest champions.

Billie Jean was already one of the strongest players at the age of 17, in 1966 she became the number one at international level.

Nevertheless, she soon realized that men were making much more money in tennis professional tournaments than women: when she won Wimbledon, in 1968, she received a prize of 750 pounds, while Rod Laver, who won the trophy among men, got 2000, and when her colleague Margaret Court received 15.000 dollars winning the Great Slam, Laver, as male winner, got 100.000.

According to Billie Jean's words, at that time "everybody could make more money than women in tennis, even the tournament organizers earn more than a female player."

That's why in 1973 she took the decision to found WTA, the Women Tennis Association that still organizes today the global tennis tournament circuit for women, of which she became the first President.

The quick growth of WTA increased dramatically the dealing power of female players with sponsors and television. As a consequence, Martina Navratilova was the first player to reach a yearly cachet of 1 million dollar, and today the strongest female players can obtain a cachet of over 10 million (Cantarella & Miraglia, 2021).

Since the nineteenth century, some sports seemed to be more appropriate for women than others. From this point of view, an interesting case in women's history of sport is represented by the success that "netball" had in New Zealand and in some other countries of the British Empire since its invention as a descendant of "Naismith's basketball". In fact, the rules of this game took the move from some American young women students who, observing one of the early basketball games, decided that they wished to play the game as well. However, after the first experiment, changes were made to the rules in order to physically "de-power" the game, thereby making it more suitable for women. As the physical nature of most sports was felt to be undesirable for women participants, only games that were considered appropriately feminine were approved for women participants. The desire to remove all physical contact from the version of the game for women, meant that some of Naismith's original basketball rules needed altering. The center jump ball to begin the game and to restart after each goal, was replaced by a center pass alternated between the two teams. Defensive players were prohibited from attempting to gain possession of the ball from another player in order to eliminate as much physical contact as possible. Furthermore, guarding the

player in possession of the ball was prohibited. What's more, the division of the court into thirds, demarcated by painted lines, was justified on the grounds that women bodies were incapable of handling the strain of playing over a full court surface.

These modifications were at the base of netball's success especially among British women, which were conditioned by the strong behavior rules of the Victorian Age: in fact, in Victorian Britain there were movements that sought to counter the growing trend of increasing, educational, political, economical and recreational freedom of women. The aim of the movement was to convince women that, for the good of the future of the society and race, they should remain in their home. The key argument that has been used to separate masculine and feminine endeavors is that of biological determinism, the belief that men are suited for physical work and mental endeavor while women are suited for domesticity and the "sacred duty of motherhood". Late nineteenth century medical opinion held that women only had a limited amount of "energy or vital force", and that any effort expended in study or exercise would only detract from the amount available for women's true function, that of motherhood. Therefore, netball became the sport for women because it embodied female attributes and was viewed by doctors, reformers, politicians, media and middle-class women as the best team sport for women and girls to play. In other words, netball prospered because it was accepted by influential, decision-making sectors of society. It was able to succeed because it never threatened the patriarchal dominance of sport. By contrast, in sport like hockey, tennis and golf, women were in direct competition with their male counterparts for resources, and consequently, were less successful than netball in terms of growth. In fact, netball was able to use the limited resources available to women sport organizations more efficiently than any others, especially in the countries like New Zealand, Australia and South Africa, where the mild winter climate enabled outdoor recreation in winter. Traditionally, the area available for "women only" recreation is but a fraction of that available for men, and netball adapted to this lack of space remarkably well. Netball uses the least amount of space per player of any of the major sports played in New Zealand and Australia for example. A netball court has the maximum dimension of 30,48 mt x 15,24 mt (464,52 sqm). By contrast, a rugby field is usually 9.928 sqm, a ratio approximately 21,4 to 1 in favour of rugby.

The lack of space for sport has always been a particular problem in heavily urbanized areas where all spaces are at a premium. It is here that the allocation of space for women's

recreation came under most pressure. Male groups almost universally dominated the prime facilities and chose the most convenient time for usage, when any recreational space was shared between the genders. A good example of this phenomenon is golf. Women were generally not admitted in men's clubs, instead having to form their own clubs and being forced to negotiate access to courses controlled by main clubs on less than equal terms.

As a consequence, the female-tailored characteristics of netball, guaranteed such a success and such an institutional support of the game among women, especially in New Zealand, that nowadays, of the total number of netball participants in New Zealand, 99% are women (Andrew, 1997).

But the hardest battle of sexes had to be fought in the field of hormones and gender distinction.

The clear gender distinction is traditionally very important in sports: in order to be able to guarantee correct and equal competitions the organizers always required a clear distinction in the athletes' sex. To have a fair competition in most athletic challenges (with the typical exception of sailing and horse riding) men have to compete with men and women with women.

But this kind of separation is not always simple.

Dora Ratjen, born in Germany, took part to the Berlin Olympic games in 1936, and reached the fourth place in jumping.

The Nazi regime wanted to exploit the games in order to show to the world that the Arian nation was the strongest, so historians think they pushed ahead some of their promising athletes without caring too much for some details. But it was later discovered that Dora was the first proven hermaphrodite that took part to the Olympic games.

Dora grew up in the small German town of Erichshof as a girl, in spite of the fact that since her infancy the doctors told their parents that Dora's body showed both feminine and masculine characteristics.

As a consequence, she grew up as a silent and shy girl, and when as a teenager she discovered sport, she started unchaining all her energy in athletics, and especially in jumping, where her strength made her achieve levels of excellence.

In fact, during the two years that followed the Berlin Olympics, she was able to set in a surprising sequence 3 world records, reaching the new limit of 1,67 meters at the European championship in Vienna in 1938.

But during the triumphant journey back home, two female passengers on the train, impressed by some characteristics of Dora, informed the police about the presence on the train “ of a man dressed like a woman”. Dora was arrested and sent to court. Her European gold medal was withdrawn and her world record cancelled, but she wasn't condemned because her good faith was recognized. Her German colleague Gretel Bergmann commented: “now I understand why Dora never took a shower with us. I thought she was simply shy”.

Dora then publicly admitted to be a man and to feel like a man, she changed her name in Heinrich, and started earning a living as a barman, later accusing Nazism to have exploited her for political reasons.

The problem of natural sexual identity in sport affected also the polish athlete Ewa Klobukowska , who won the gold medal in relay race and the bronze medal on 100 meters at the Tokyo Olympics in 1964. One year later she set the world record of the 100 meters race and in 1966 she won 2 gold medals at the European Games, raising growing suspicion for her impressive strength and masculine appearance.

Therefore, the athletic federation decided to impose a chromosomic sexuality test on her, finding out that she had one more chromosome in comparison with other normal women.

Thus, she was the first Olympic athlete who wasn't able to provide a proper result of a sex definition test: the analysis of the case ended up with the proof that she was in good faith and wasn't aware of her particular condition, and the medical experts even confirmed that she did not get any advantage from her chromosomic situation. Nevertheless, all her records were withdrawn and she was banned from Olympics and professional competitions, and her career ended in 1966.

The problem of gender definition became even more complicated with the case of Mokgadi Caster Semenya, southafrican champion who dominated the athletic scene for nearly a decade, during which she won 2 gold medals at the Olympic games in 2012 and 2016 and 3 world awards, being unbeatable in her discipline, the 800 meters race.

In 2019 a verdict of the sport justice organization states that she is affected by hyperandrogenism, a syndrome according to which a woman has an exceeding production of male sexual hormones, in particular of testosterone.

Through her case, the international sport organization has been challenged to find a clear solution of the problem: they had to impose to Caster Semenya the choice of stopping competitions or to make a pharmacological treatment to reduce the level of testosterone in her body.

But this kind of solution did not stop the debate on this issue: among men the levels of testosterone can vary by 300 percent, but no one ever proposed to generate subcategories among men competitions. Besides, the level of hormone in Caster Semenya was natural and not depending from doping or other forbidden techniques. In future it will be probably more and more difficult to deal with gender differences in sport.

The case of Annet Negesa can be considered as another example of the problems that can arise through gender differentiation in sport.

In 2019 this African champion confessed in an interview that her physical and psychological integrity had been destroyed by the international sport federation, which persuaded her to modify her body surgically, instead of using the ordinary pharmacological therapy. In fact, even if the federation always denied its responsibility for this choice, Annet underwent an operation at the women's hospital of Kampala (Uganda) to remove her gonads in order to maintain a female identity and keep competing in female athletics (Cantarella & Miraglia, 2021).

The long debated issue of gender distinction in sports is a typical situation in which science has played a relevant role in improving the understanding of human physiology in relation to sport activities. Just a century ago, it would have been impossible to clearly determine hyperandrogenism situations, which could have affected the principle of equal and proportionate competition among athletes. As we could see, this field of physiological and genetic research will be more and more involved in the testing activities related to national and international competitions.

Chapter 10:

The role of sport brand companies in sport innovation

During the industrial revolution, much of the popularity for athletic games and outdoor recreation was due to standardized manufacturing of sport equipment, which became more affordable and more popular than in the past.

One of the great promoters and innovators in this field was Albert Goodwill Spalding, born in Byron, Illinois, in 1850. He started his career as a professional baseball player, and his talent for baseball became apparent from his young age: he was only 22 years old when he debuted in the top American league. His deep rooted passion for baseball led him to take part in the creation of the National League (NL) in 1876, introducing rules and standards which are still part of modern baseball. In the same year, he turned to the merchandising of athletic goods, and by the end of the century, his company, A. G. Spalding & Brothers was the nationally recognized leader in this field. Spalding has been an innovator, not only in baseball, where he made significant changes to the equipment used in the sport, gloves, footwear with cleats and uniforms all designed to improve performance, but also in other sports: between 1880 and 1898 Spalding company set an enviable amount of records, creating the first tennis, football and golf ball (the rubber-wound gutta-percha ball, which necessitated the lengthening of golf courses, because it improved the launching range) in the USA and the very first basketball in the world. He started the company with his brother, with an initial investment of only 800\$ and branched out into various sports in 1880 and acquired a virtual monopoly over athletic goods by absorbing A. J. Reach company in 1885, Wright and Ditson in 1892 as well as Peck and Snyder and other firms. To gain an even greater ascendancy over his rivals, A. G. Spalding published also a wide range of guides in Spalding's library of athletic sports, which he used to advertise his products (Betts, 1953).

Spalding was the first sport retailer to integrate vertically backward, when he bought into a manufacturing firm. He also moved aggressively to gobble up vulnerable competitors and diversify his product line. The "Spalding plan" introduced in 1908 aimed to rationalize the market by mandating uniform pricing for retailers and customers (Levine, 1985).

The company was one of the first to divide its sport equipment production in core products, non-core products logical extension and non-core weaker extension: the first

being inflatable balls, backboards, bats, baseball gloves, pads and other equipment essential to the actual playing of a sport; the second, sneakers, cleats, jerseys, uniforms or apparel designed for competition in a specific sport; the third, casual sports apparel or products more recreational in use and less likely to be identified with a specific sport (Cobbs & McKelvey, 2009).

The fast growth of large sporting equipment producers like Spalding was favoured by inventions like the sewing machine, which eased the mass production of sport apparel. and by the fact that the biggest department store began to feature sporting goods. Macy's of New York began with ice skates, velocipedes, bathing suites in 1872, although all sporting goods were sold by the toy department. A separate sport department was established only in 1902, meanwhile Sears and Roebuck and Company devoted more than eighty pages of their 1895 catalogue to sport goods (Betts, 1953).

One of the most interesting case histories in the field of sport goods production is represented by the German company Chemnitzer Sportgeraetebau – Friedrich & Hannak, based near Dresden, which was among the first to focus since 1872 on the production of specialized tools for gyms and physical education, also in consideration of the fact that in 1860 in the German Land of Saxony the physical education had become compulsory in all schools. In 1883 they exhibited also at the World Expo in Vienna, and they quickly achieved international appreciation with a wide range of sport products, from parallel bars to badminton rackets. Their choice to specialize in sport tools, following the international growth of mass sport activities, brought to an immediate success and in 1912 they were able to win the official supply of all the technical sport equipment for the Olympic games in Stockholm, Sweden. By 1910 more than 1.400 gyms in Germany and Europe were equipped with tools made by "Dietrich & Hannak" (Habelt, s.d.).

During its 140 years of activity, the factory generated several internationally well-known brands like Blizzard, Deha, Turntex, Germina and Fanal.

From the point of view of international contacts of the company, it's interesting to mention the report made by an Italian sport delegation in 1880, after visiting the factory: as reported by an Italian newspaper of that time ("La Ginnastica", 15 September 1880), they were impressed by a three meters high basket with a pole that kept it and

by the game for which the tool was produced, that was called “Korbball”, a first attempt to develop a discipline similar to modern basketball (Crovato & Rizzardini, 2016).

Unfortunately, the company was nationalized by the communist regime after WWII and started to have big raw materials supply problems in the 1950s, which affected the growth of production. In spite of the change of national government in 1990 and the acquisition made by a West German company in 1992, the firm was closed in 2006.

Sport equipment producers had the role to spread innovation around the international sport organizations and consumers, and they often developed ideas and patents proposed by players and sportsmen. This was the case of Fred Taylor, the famous inventor of industrial “taylorism” and father of scientific management, who was obsessed with the aim to conserve resources and enhance worldwide efficiency by systematically eliminating waste.

Taylor learned through sport the “value of the minute analysis of motions, the importance of methodical selection and training, the worth of time study and of standards based on rigorously exact observation”.

His effort to find a balance between mental work and physical exercise, not only involved lawn-tennis and golf, but was extended to other sports like baseball, rowing, skating, gymnastics and cricket. In 1886 Taylor patented a spoon-handled tennis racket that would allow players to more effectively return shot that bounced low to the ground or above their heads. Three years later, he secured a patent for a “double-centered” tennis net with a design that doubled the thickness of tennis nets in the middle, where they fray most quickly. Seven months later, he patented another device, known as Taylor pole” for stretching tightly tennis nets, so that they did not sag in the middle and could be hang at different heights for single and double.

Golf was his true passion, he designed and patented his own clubs. Taylor used an extra-long large headed driver that he crafted himself and he has been given credit for inventing the prototype of the modern-era driver. in 1903 Taylor patented three clubs, the faces of which went backward, at an angle of 55°; these patents had a series of ridges on the face on the clubs, which allowed a golfer to create backspin on a ball, and thus, hold when landing on a green. Today, these club are referred to as the five wood, the five iron and the nine iron. Taylor’s idea for ridges on the face of clubs was both revolutionary and enduring, prefiguring later developments in golf technology; today,

other than a putter, no club is made without grooves. Moreover, designers and manufacturers of golf balls took note of the distractive properties of Taylor's clubs and changed the way golf balls were made.

Taylor focused also on the effort to develop a kind of turf that could not only tolerate inclement weather and heavy play, but be reproduced in any part of the country, using standardized materials. The "Taylor green", a soil that allowed the roots to grow deep below the surface, essentially required no annual expense for feeding and seeding, and required watering only once every two-three weeks. His turf experiments had a lasting impact on the golfing industry. In an effort to provide uniform and controllable moisture to a specific area, Taylor identified a perfect balance of air and water that could be maintained under a putting green. Today his methods still serve as the basis for the US Golf Association recommended PURR-Wick system for new greens (Taylor & Bedeian, 2007).

Another interesting example of sport amateur who converted his passion into a business that generated successful enterprises is Howard Head, the inventor of both the laminate ski as well as of the oversized tennis racket, who, in 1917, has also been officially named in the National Inventor Hall of Fame at the Smithsonian Institute in Washington (Brachmann, 2017).

Born in 1914, He graduated in 1936 at Harvard University in engineering sciences, and while he was already working for the aircraft manufacture company Glenn L. Martin, he took a ski vacation in Stowe, Vermont, where he tried ski for the first time. His first performances on the skis were quite unsatisfactory, he had poor balance and fell numerous times while trying to ski. In his opinion, his balance problems, had more to do with the heavy, clumsy, hickory wood skis than his own inability. Therefore, he took the risk of investing a small amount of his own money to begin the production of skis using innovative materials. He started experimenting with material such as aluminum, plywood and honeycomb plastic (which were already used in the construction of airplanes) to serve in the production of a composite laminate ski, and within a year he created a series of seven prototypes, each of which broke when he tested them with a group of skiing instructors during Christmas in 1948. After developing 38 more versions in the following three years, finally in 1950 he succeeded in developing a kind of ski

which was three time more flexible than wooden skis and turned easily in all ski conditions.

In 1944 he patented his invention with the US patent number 2694580, titled “composite wood and metal ski having plastic running surface”: it was a laminated ski having upper and lower facing sheets, with the core material disposed between them comprised of a pair of strips of hard material, each strip having one face secured to the bottom edge of the lower facing sheet, and a coating on the bottom of the lower facing sheet covering a substantial portion of the other strip faces but leaving some faces exposed. The exposed faces on the ski’s corner presented sharp biting edges. This kind of ski had excellent resistance to use while exhibiting improved directional stability (Brachmann, 2017).

With this kind of innovative product, Head started traveling across the country, selling his new skis in ski area parking lots directly from his car or through a network of ski instructors.

By 1955, Head skis were the leading brand Europe and North America, and soon dominated competitions, including the 1964 and 1968 Winter Olympics. The Swiss Olympic Team was using Head skis since 1963, and other national ski teams quickly followed. At the 1964 Olympics in Innsbruck, Austria, Billy Kidd became the first American to win an alpine skiing silver medal in slalom, and he did it on Head skis (Wyrick, 2017).

By 1966, the Head Ski Company, with more than 500 employees, had already an income of 25 million dollar a year, selling 300.000 pair of skis in 17 countries (Latimer, 2016).

When the Head ski Company overgrew his capacity to manage it, Howard Head decided to sell it to the company AMF in 1969 for nearly 20 million dollar. Then he decided to take tennis as a new sport hobby for his leisure, and after many lessons, he was ordered by his tennis instructor to purchase a ball machine for daily practice. This gave him the opportunity to network with the management at Prince, the company that manufactured the ball machine he purchased, telling them what he thought were inefficiencies in the ball machine’s design, and he eventually purchased a 25% in the Prince company, becoming Chief Design Engineer and Chairman of the Board. He was still unsatisfied with his personal performances in amateur tennis and he started to think how his tennis racket could be modified. His knowledge of physics and especially on the polar moment

of inertia, led him to believe that a small increase in the width of the racket itself would greatly increase the size of the racket sweet spot.

Thus, in 1976, he patented a new tennis racket with US patent number 3999756, made of aluminum (and later graphite) instead of the wooden frame. His tennis racket was 20% wider than the old wooden rackets, making the racket's sweet spot 40% larger (Wyrick, 2017).

Luckily, at that time no official rules governed racket size in tournament play, and the new "Prince" racket was approved by the United States Professional Tennis Association. At the beginning the new model was not persuading tennis professional athletes of its efficiency, but the 1978 US Tennis Open provided a sudden visibility for Head's racket when the nearly unknown American female tennis player Pam Shriver used a "Prince" racket to reach the final against Chris Evert.

As a consequence, within two years, Prince Manufacturing controlled 30% of the US market, 25% of the global market and led the world in racket sales (Latimer, 2016).

After massive market success, Howard Head sold his shares in Prince Rackets Company for just over 35 million dollars (Liguori, et al., 2015).

Nowadays, the sporting good innovation of Howard Head still resides in the activities of Dutch-based sport and clothing company Head N.V., a company which continues to develop equipment for the tennis and snow sports sectors.

A disruptive innovation has been brought in the field of sport clothing by the company Under Armour, founded in 1996 by Kevin Plank, a former football player at the University of Maryland. Plank created something that he personally needed, a sport shirt that didn't make him "the sweatiest player on the football field". Plank started looking for wicking fabrics to wear on the field instead of the traditional sweat-laden cotton shirt and he experimented with underwear fabrics to find a light, cool fabric that would work better on the playing ground. Once he found the right textile, he founded the company with the aim to focus on performance wear for athletes, engineered lightweight clothing to keep athletes cool and dry throughout the course of a game, practice or workout. Nowadays, Under Armour uses complex technology to create diverse product ranges for men, women and youths, offering "HeatGear", "ColdGear" and "AllSeasonGear" as product lines, depending on the season. Under Armour positioned itself in the marketplace as high quality apparel, the best available, now taking 75% of

the market share. To foster their innovative culture, Under Armour built a unique brand strategy: they used lesser known athletes to compete with Nike; in their first commercial, they used Kevin Plank's teammate from University of Maryland to appear in an ad for the brand, thus, they started their first marketing campaign championing "the underdog". This drove the culture of "overcoming adversities" and "overcoming obstacles" and by using lesser known athletes that showed character and attitude they were successfully able to work within lower budgets. They kept on driving innovation through creating new products, such as the "infrared" technology, that drives heat around the body and developing new fabric technologies that are constantly evolving (Skinner, et al., 2018).

In the field of textile technology for sport, another revolutionary innovation has to be mentioned: at the Sydney Olympics in 2000, for the first time the company Speedo applied to swimming its futuristic full-body swimsuit presented as "FastSkin", which imitated the Mako shark's skin, being made with thermo micro-teeth on its surface, which have the function of reducing the natural physical turbulence of water around the swimmers body. This kind of texture has the function to reduce resistance around the swimmer's body, gaining about 3% of speed. This corresponds to three meters of advantage every two Olympics pools, a very relevant achievement to generate new records (Porro, 2013).

In the field of sport safety, a company that is disrupting traditional sport safety wear is XTECH, a New Jersey based company, which has developed a new design in sport apparel, using shock absorbing lightweight material for shin guards and shoulder pads. For NFL (National Football League) and High Schools this new form of protective padding is to the 21st century what the flak jacket was to the 1980s (Skinner, et al., 2018).

All these sport apparel innovation efforts have an influence also on other market branches, which refer to what sociologists call "lifestyle", like the diets that are chosen accordingly to the athletes' habits, or the trend in mobility tools that involve human activity (bicycles, surfs, skateboards, Nordic walking sticks etc.).

A relevant part of the economy of the sport universe comes from goods that are used by professional and amateur athletes or general consumers of sport equipment and clothing, including those who don't practice sport but who like to share the "sporty" lifestyle. Adidas, Nike, Lacoste just to mention some, are corporations that don't make clothing only for practitioners but also for consumers who follow the fashion trend that in the last thirty years has been deeply "sportivized", taking from the world of sport many suggestions for the production of large consume clothing (Lo Verde, 2014).

A leading company in the field of sport shoes and apparel is Nike, which has become one of the biggest global player of the branch investing in big sport champions, using them as testimonials to promote their products, like it happened with Michael Jordan for basketball shoes (sport shoes represent 75% of the income of the company) and many others famous athletes for golf, tennis and other popular sports.

Based in Beaverton, Oregon, US, Nike designs, develops manufactures, markets and sells not only footwear but also apparel, equipment, accessories and services for various product categories like running, basketball, football, baseball, soccer, golf, tennis and cricket.

Its global success has led Nike to develop and operate hundreds of factories (nearly 500) in 42 different countries, of which most are Asian (China, Vietnam, Indonesia, Thailand etc.) and employs today over one million workers. Its industrial organization includes also the successful subsidiary brand Hurley and Converse.

According to the data we collected, the company reported approximately 35 billion dollar revenue in 2017, much more than its major competitors such as Adidas (23 billion dollars) and Under Armour (5 billion in 2018).

Its products are marketed and sold through a global network of more than thousand stores in the U.S. and around the world, and almost half of its revenues come from the North American market, followed by Western Europe, Greater China and emerging markets (Argentina, Chile, Korea and Mexico).

Even in the successful case of Nike, this extraordinary growth has been driven by an athlete, Phil Knight, the founder of the company.

He attended the University of Oregon in 1995, while competing as a track-and-field athlete, where he met his coach, Bill Bowerman, who later became the partner of his first company called Blue Ribbon Sports. Thus, once again, at the base of the story of a very

fortunate sports company there are the skills and the experience of some passionate sportsmen. But prior to starting his own business, Knight created a plan to travel around the world in 1962, after receiving his MBA degree. During his long journey, he headed to Japan to make a deal with Onitsuka Tiger, a Japanese shoe manufacturer and the forerunner of ASICS. When Tiger's shoe samples arrived in Oregon, Knight sent two pairs of Tiger shoes to Bill Bowerman, who was very knowledgeable about running shoes. Bowerman was not only satisfied with quality of the Japanese shoes, but he also expressed interest in becoming a partner of the newly founded company Blue Ribbon Sports. They ordered 300 pairs of Tiger shoes and started selling the shoes at high school track meets from their cars.

When the sales of Tiger shoes reached around 3 million dollars, in the early 1970s, Knight terminated his contract with Tiger and started making his own shoes. In 1971 Jeff Johnson, Knight's first employee, came up with the company's name, Nike, named after the Greek goddess of Victory.

The company's trademark, the Nike Swoosh, was designed by a graphic design student for only 35 dollars; today the logo is worth nearly 30 billion. The famous slogan of the company, "Just do it", was introduced in 1988 by Dan Wieden, an advertising specialist, who later became a crucial collaborator with Nike.

In this fast evolution of the company, also Bowerman's role was strategic: He always tried to create the best products for the athletes he trained, and by 1980 he had registered already 8 patents. Mark Parker, current President and CEO of Nike, noted: "Bill Bowerman's legacy at Nike is immeasurable... The products he designed and invented have powered Nike's ascent as the world's leading sports brand, and his commitment to pushing the boundaries to maximize athletes' performance remains at the heart of Nike's innovation spirit."

In addition to technical innovation, Nike started in 1995 very successful advertising campaigns with the help of Dan Wieden, who developed an "emotional advertising strategy", a kind of marketing that creates a mood, an attitude, and then associates the product with that mood. "Emotional branding", according to Wieden's intention, had to engage the consumer on the level of senses and emotions, forging a deep, lasting, intimate emotional connection to the brand that transcends material satisfaction.

For instance, the very first “ Just do it” TV commercial aired in 1988, showed an 80 years old Walt Stack running across the Golden Gate Bridge in San Francisco, telling simply to the audience that he runs 17 miles every day.

But the company became also famous for its copious sponsorship deals with high-profile, leading professional athletes and teams all around the world, providing indirect product experience to the consumers through the various testimonials.

Knight made the first endorsement contract in 1972, with a Romanian tennis player, Ilie Nastase, who was already wearing a pair of Nike shoes and winning tennis matches. Nastase became one of the best tennis players in the world, and this gave Nike a stronger international appearance. Numerous endorsement deals followed: with Steve Prefontaine, a specialist in the 5000 meter run, with Carl Lewis, and Sebastian Coe.

However, it was the signing of Michael Jordan in 1984 that triggered the greatest success in Nike’s sales and publicity.

Knight made a half-million dollar agreement with Jordan when he didn’t even play at the professional level yet, and in addition to the sponsorship fee Nike also launched his signature shoe line, Jordan Brand.

Tinker Hatfield, Nike shoe designer, described the partnership with Jordan as an incredible adventure: “When I started designing shoes in late 1985, athletic shoes were just basic performance footwear...there was no romance, no tuning in with athletic personalities, no design inspiration from outside. They were just done for sports. Then Nike came on the scene.”

When the first Air Jordan was introduced on the market, the Jordan brand alone brought in more than 100 million dollars of Nike total earnings in the early 1980s.

Nike introduced 32 pairs of the Jordan series since 1984, and the Jordan Brand along with Nike accounted for more than 90 percent of the basketball shoe market in 2013.

Knight also signed several additional talents across different types of sport: with Tiger Woods in 1996, enabling it to penetrate the golf industry and expand its sponsorship deals with other leading golfers like Rory McIlroy, Jason Day and Michelle Wie; with Cristiano Ronaldo, Neymar and Wayne Rooney for soccer; with Federer, Nadal and Sharapova for tennis; with national teams all around the globe. It is reported that Nike invested more than 6 billion dollars for sponsorship fees in 2015 alone (Minhong, 2020).

Nike also incubates plenty of entrepreneurial innovation in its Nike Sport Research Lab, where scientists, engineers and designers work with elite athletes and state of the art equipment such as 3D motion capture and environmental chambers to collect the data, analyze it and seek insight that provide the foundation for innovative Nike products. For example, environmental chambers create atmospheres of extreme temperature. Athletes are tested in these artificial environments and the resulting data is used to better inform decision made by Nike footwear and apparel designers (Skinner, et al., 2018).

Matthew Nurse, the director of the Nike Explore Team Sport Research Lab, described the role of the lab as follows: “ Our function is to provide knowledge and insight. We are the global repository for the science of human performance and potential... We quantify athletes’ movements, the environments they play in, the products they use. Then we analyze the results and, if we are able, use that knowledge to make a really unbelievable product”.

Being a very globalized company, Nike has been often accused of exploiting workers of the third world, especially in Asia, to increase its profits margin, but in 1998 Knight initiated some tactics to overcome the pressure from international labour protection activists: in a press conference, he announced six commitments for his company’s working conditions within the global supply chain:

1. All Nike shoe factories will meet the U.S. Occupational Safety and Health Administration (OSHA) standards for indoor air quality;
2. The minimum age for Nike factory workers will be raised to 18 for footwear factories and 16 for apparel factories;
3. Nike will include non-government organizations in its factory monitoring, with summaries of that monitoring released to the public;
4. Nike will expand its worker education program, making free high school equivalency courses available to all its workers.
5. Nike will expand its micro-enterprise loan program to benefit four thousand families in Vietnam, Indonesia, Pakistan and Thailand.
6. Funding will be provided for university research and open forums on responsible business practice, including programs at four universities during the 1998-1999 academic year (Minhong, 2020).

The fact that the globalized supply chain of many TNCs (Trans National Corporations) can be affected by the voluntary or non-voluntary exploitation of labour in countries that are underdeveloped or where the union activists are subject to repression is not new, but it's interesting to consider that the American press gave great resonance to the Nike case, especially taking into account the values of health, freedom, fraternity and international cooperation that sport should express according to Olympic principles. As one Washington Post reporter explained when the "sweatshop debate" reached its highest point of discussion, "Americans don't want the imported products they buy to come as the result of abusive and unfair labour practices overseas", and it's the responsibility of individual consumers to "keep up the call to action". This sounded in American and international press to be even more true in the field of sport-related products, belonging to the everyday lifestyle for millions of people (Greenberg & Graham, 2004).

Although Adidas has been partially obscured by the success of Nike, the case history of this interesting company deserves to be mentioned, especially for the contamination between sport and society trends it has generated in present times. In the 1960s large American rubber companies had dominated the basketball footwear market in the United States for decades. American basketball shoes followed a template that had been in place since the beginning of the twentieth century: lace-to-toe canvas uppers with the rubber soles and toe-caps, and a branded ankle patch. The Converse Rubber Company's bestselling "Chuck Taylor All Star" was introduced in 1917 and by the 1960s still was an American institution that crossed generations. But the traditional canvas basketball sneaker, starting from the 1960s, did not keep up with development in the game for which it was intended. When this kind of shoe was launched at the beginning of the twentieth century, basketball was a quiet, regimented, floor-based sport that emphasized quick passing and shooting from a standing position. Things started to shift in the 1940s. A series of rules changed, the development of the jump shot, and the arrival of black players who brought with them a flamboyant style of play meant that by the 1960s the game was faster, more aerially-based, and more improvisatory. At the same time, players became physically taller, heavier and stronger. The limited support provided by canvas and the lack of cushioning offered by thin rubber sole meant ankle injuries were endemic, and the method used to stitch the uppers caused discomfort and

pain. The players had to use a razor blade on every new pair of basketball shoes to cut the seam over the little toe to prevent the developing of blisters. Despite this, American manufacturers did little to accommodate the changing needs of players. In fact, trade tariff on rubber footwear (erected in the 1930s and designed to protect the American shoe industry from Japanese and Czechoslovakian competition) gave American companies a near monopoly on the domestic market, which discouraged product development. When Adidas entered the basketball market, it was already well established as one of the world's leading producers of athletic footwear. Its history started in the 1920s, with the foundation by Adolf "Adi" Dassler in a small town in Franconia, Germany, and by the 1960s it already dominated elite and professional sports, especially soccer and track and field athletic. Dassler made constant experimentation and collaboration with athletes as part of a permanent quest to produce the best possible shoe for sport, and was constantly engaged in a struggle with his brother, Rudolf, the owner of Adidas main competitor, Puma. Adidas took advantage of the strength of the German chemical industry, which since the late nineteenth century had led the world in the application of chemistry to commerce. West German post war economic revival was in fact underpinned by a stream of technological innovation with far-reaching material impact on human life. Teams of scientists of German and Austrian chemical and plastic firms worked to develop synthetic compounds and new molecules that Adidas used to create innovative and increasing specialized shoes. By the mid-1960s, Adidas shoes set the standard against which all others were judged and were worn by the majority of the world's elite soccer stars and track and field athletes. As a consequence of increasing demand, in 1959 Adidas bought a shoe manufacturer in a village of French Alsace, which started to be managed by Adolf's twenty years old son, Horst, who, after being successful in distributing his shoes at the 1956 Melbourne Olympics, transformed the French factory into an almost entirely separate business. By 1968, Horst controlled a separate administrative hub and eight French factories, and moved beyond track and field and football shoes into areas with wider market appeal, thus, he developed the "Haillet", a technological advance leather tennis shoe, developed in the mid-1960s with the French tennis professional Robert Haillet. With a moulded herringbone sole stitched and glued to lightweight ox-hide uppers, it provided better grip and support than anything else available. Professional tennis offered better marketing opportunities than track and field (because the latter was governed by

amateur rules that prevented the athletes from endorsing products), and in fact, the connection with Haillet and other professional sportsmen could be openly promoted. The “Haillet” also offered a way into the vast American market for casual sport shoes. What’s more, the importation tariffs on rubber sole footwear were lowered in US in 1966 as part of the Kennedy round of trade negotiations and foreign manufacturer had suddenly the opportunity to penetrate wider shares of the American market. As a consequence of the American success of the “Haillet”, Chris Severn, a distributor in California, noted the lack of innovation among American manufacturer and persuaded Horst to respond to the desire for better footwear. Adidas took then the decision to develop their first basketball models, the “Supergrip” and the “Pro Model”, designed according to the modern game and constructed along the same lines as the “Haillet”. Chris Severn proposed the new models to NBA teams, but only the coach of the San Diego Rockets could be persuaded to try them. Their willingness to try something new may have depended on the fact that several players of this team has suffered injuries from slipping, but it might also have depended on the fact that the rockets were the least successful team in the NBA. In any case, Severn’s deal with the Rockets made it possible to expose the new shoes to other teams when they played against the Rockets. In fact, the following year, the Boston Celtics, the dominant professional team of the late 1960s, wore Adidas to victory in the 1969 NBA championship and also the similarly successful UCLA Bruins switched from “All Star” to Adidas. Then, Adidas launched the “Superstar” model, and by 1970 Adidas legitimately claimed that the “Superstar” was worn by the best basketball players in the world. This was the moment in which the “Superstar” model became much more than a simple sport shoe. With countless players wearing three-striped shoes (the stripes were the logo of Adidas), television and magazine coverage worked as unofficial advertisement for the German brand. Among schoolboys the “Superstar” was immediately recognized as the state-of-the-art, modern sneaker and became desirable because of its association with top college and professional teams. Moreover, the shoes flat sole and strong construction made it well suited to everyday use in an urban environment. As a consequence, in the 1980s, nearly 50% of New York’s high schools students, including African-Americans, Asian-Americans and Latin-Americans wore these shoes. It was this ubiquity that led the shoe to become associated with Hip-Hop, a youth subculture that emerged in the late 1970s. in fact, sneakers were important within Hip-Hop style for several reasons: this style was created by teenagers,

who were already likely to wear sneakers as an everyday status symbol; it grew around informal dance parties in which comfort was important; sneakers were well-connected with an aesthetic tradition that reflected African-Americans' complex relationship with white society, and Hip-Hop was also closely associated with basketball. Thus, the Hip-Hop singers and rappers, who liked to wear the Adidas "Superstar", started a popular fashion and trend that is still lasting today (Turner, 2015).

One of the biggest sport mass markets is the one of biking. Every year over 130 million bikes are sold worldwide, 20 million only in Europe, with an average price of approximately 500 euros per bike (Wohlfeil, 2015).

Among the leading companies in this very competitive environment there's the company Trek, based in Wisconsin, which manufactured the carbon-fiber (an extra light and very resistant material that comes from the aerospace industry) bike frame of Lance Armstrong who won the Tour De France in 2005.

But the most famous in the field of sophisticated bike components is for sure the Japanese company Shimano, which makes shifters (to shift gears to make it easier to climb hills or to go faster on flat terrain), hubs (the center of the wheel, where the spokes connect), cranks (that allow the rider to transfer human energy through pedals), derailleurs (device that moves the chain across cogs).

By 2006 Shimano had grown from a family-based business founded in 1920 to a 1.6 billion dollar global company, with a net profit of 186 million.

Eighty percent of the company's sales come from high-end bike components, and it also owns 80 percent of the high-end component market, being often called "the Intel of the bike industry" (Chang & Saloner, 2006).

Nevertheless, Shimano's fine technology for cranks and derailleurs could soon be challenged by a new and promising German company, Pinion GmbH, which recently has entered the European market with a disrupting gearbox patent derived from automotive systems. It's a compact, totally enclosed and maintenance free gearbox solution, which is operated with a turning handle, weighs 3 kg and needs to be incorporated in the bicycle's frame. 40 different bicycle production companies have already introduced this innovative system in a part of their production (Wohlfeil, 2015).

Chapter 11: The role of sponsors in sport innovation

Besides companies that make products for the sport market, there are also national and multinational companies which are not involved in the production of sport goods but which are interested in promoting their brand through direct and indirect involvement in the world of sport as official sponsors of teams, of sport events or single athletes. Their goal is to get in touch with specific kinds of consumers, spectators or sport athletes. In some cases, the broadcasting companies themselves, take the role of sponsors, through the acquisition of exclusive rights on the sport event.

Considered that sport is usually associated with the concept of health and well-being many corporations which produce tobacco, alcoholics and junk food are interested to act as sponsors in order to increase their social legitimation and reduce the social opposition towards their products.

The coalescence of sport events, sport industries and sponsors has generated a whole specialized economy that, according to the 2016 KPMG report about Business of Sports, represents an actual market estimated to be worth between 600 and 700 billion US dollars, which accounts for approximately 1% of the global GDP (Skinner, et al., 2018).

The role of sponsors has become so relevant in this field, that it also has an influence on the decisional process related to single athletes, teams and events. If we consider the total amount of sponsorship investments made by companies worldwide in billion dollars, we can realize that between 1993 and 2003 the total amount grew from ten to twenty-seven billion dollars and two-third of this markets are connected to the sport world (Gratton, et al., 2012). It is also interesting to consider that among the list of the first ten companies there are also car makers, banks and financial services, telecommunications, beverages, logistic companies, insurance companies, tourism and travel companies.

Soccer is at the first place for the amount of sponsorship received, golf at the second and then Olympic games together with basketball and car racing events (Sports Marketing Surveys Ltd, 2012).

While the main amount of sponsorship is dedicated to sport teams, especially in soccer and basketball, the second level is occupied by the single athlete, as a proof that sport professionalism itself can generate a brand connected to the single name of the athlete and his position in the sport star system.

Howard and Crompton (Gratton, et al., 2012), outlined nine factors which increased the relevance of sponsors in sport:

1. the growing number of television channels and the consequent inflation of ordinary television ads has driven the big corporations towards alternative means of communication;
2. the growing costs of television ads in comparison with a very fragmented audience;
3. sport is less expensive in terms of television production if compared with other kinds of entertainment;
4. companies producing cigarettes and liquors have been banned from television ads, but are still free to appear as sport sponsors;
5. sport commercialization has been gradually accepted and appreciated also by national and international sport institutions;
6. the growing consciousness by enterprises of the benefits of sport sponsorship, which became evident after the Los Angeles Olympics in 1984;
7. the principle of fragmentation of the market, according to which each sponsor has been chasing niche markets for its products;
8. the need to improve the relationship with the product distribution channels;
9. the role of public agencies as sport event promoters, with the consequent search for sponsors to cover their additional costs.

As a consequence of all these new driving factors, sponsorship has been extended also to fields which were not considered in the past, such as the right to assign the name of the sponsor's brand even to a whole stadium or to a full sport event.

As an example, Mercedes Benz has recently made an agreement with the soccer team of the city of Stuttgart, where the company is based, to call the city stadium Mercedes-Benz Arena, for a cost of 31 billion dollars in 30 years.

The sponsorship process involves also international institutions like FIFA or CIO.

Since 1982 FIFA, the organizer of the soccer world championship, granted sponsorship rights: in 2006, 15 different sponsors paid each 35 million dollars to be part of the event, then only 8 main sponsors have been selected for the timeframe 2007-2014, among which Adidas with a contribution of 350 million dollars, Sony with 305 million dollars, Coca Cola with 500 million dollars (with an extension to 2020) and Emirates airlines which paid 195 million dollars.

Even CIO, the organizer of the Olympic games, had some sponsors since 1976, but with the Los Angeles games in 1984 the acceleration became impressive: 34 sponsors, 64 companies with exclusive supply rights, and 65 companies providing officially licensed services (Lo Verde, 2014).

Chapter 12:

The influence of media innovation on modern sport

As we could see, sport has become a social trend for the mass, especially as a consequence of its spectacularity and not only as a consequence of its diffusion as leisure time practice.

The most popular kinds of sport events have attracted plenty of fans from their beginning, but this was also possible because during these events, there was always somebody reporting the sport fact to a wide public. Newspapers were the first media to tell the sport achievement of teams and champions and the time measured by the chronometer will become the symbol of the speed of the nineteenth century (Coakley & Pike, 2009).

In the modern world, the sport reality that media reinterpret is built also through the information produced by the people involved, like producers, editors, program managers, television operators, writers, journalists, commentators, bloggers, including fans who use social media and whose influence through the new technology can be equal to the one of a news professional. All these people are engaged in the following aims: generate profits, influence values, provide a public service and build reputation. As a consequence, sport competitions will be selected by media on the base of the interest for the audience, be it readers, spectators or radio and television auditors. In the same way, also the kinds of image and of comment that can increase the audience will be selected (Lo Verde, 2014).

According to Jarvie and Thornton (Jarvie & Thornton, 2012), the kind of sport media contents become so relevant that the interpretation given by spectators is certainly influenced also by the interpretation given by the commentator himself, who provides a vision on the event which is certainly important for spectators.

Television and media tend to describe the sport event making a dramatic event out of it and an epical conflict, generating an “esthetic” of the sport event production and an “esthetic” of the sport event fruition.

Between the end of the nineteenth century and the beginning of the twentieth, sport events became interesting for newspapers.

The growth of interest for sports by newspapers was also fuelled by the diffusion of the telegraph lines. From its invention in 1844, the electric telegraph rapidly assumed a significant role in the dissemination of news. During the pioneer years, a telegraph message was both costly and brief, and sport events were reported on a limited scale. The expansion of sporting news in the following years was directly related to the more general usage of telegraphy, which made possible instantaneous reporting of ball games, horse races, boxing matches, yachting regattas and other events. In USA for example, when the Associated Press sent its representative in 1889 to the Sullivan-Kilrain boxing match in New Orleans, reporters appeared from every prominent journal in the Union, and the Western Union Telegraph Company was said to have employed fifty operators to handle 208,000 words of special reports about the fight.

International sporting news between USA and Europe were empowered by the "Atlantic cable", which overcame the mid-century handicap of reporting two or three weeks old English sporting news to the States. When the Harvard crew rowed against Oxford in a highly publicized race in 1869, the result was flashed through the "Atlantic Cable" as to reach New York about 01:15 a.m., enabling many of the San Francisco habitants to discuss the subject at their breakfast table and swallow the defeat with their coffee (Betts, 1953).

At the beginning newspapers dedicated a single page to sport with the information on competitions and results and some stories concerning single champions. In Germany, the first sport page was published in 1886, when the "Muenchener Neueste Nachrichten" reported a strange challenge between a runner and charioteer, but in Great Britain in 1890 there were already three sport newspapers, among which "Sporting Life", "Sporting Chronicle" and "Bell's Life in London".

In the States, Americans depended on daily newspapers for their sporting news. In a nation of 75 million people in 1899, the average daily newspaper circulation was 15 million. In the 1920s sporting news comprised already 40% of local news in the New York newspaper "World", and 60% in the New York Tribune. Subsequent inventions further speeded mass production of newspapers and cut costs. Improved presses printed on a continuous roll of cheap papers, cut it into sheets, and folded it, while the Mergenthaler linotype machine (1886) mechanized type setting. This invention facilitated a boom in the "penny press" that resulted in huge circulation (Riess, 2013).

In the second half of the nineteenth century also the invention of the camera came to the aid of sport. Professional photography had developed rapidly and the introduction of the Eastman Kodak found a mass market that started to put it to personal and commercial use. Sporting magazines started to publish pictures taken from photograph and in the early 1890s photographic prints of athletes and outdoor sportsmen came into common usage.

In 1872 Eadweard Muybridge made the first successful attempt “to secure an illusion of motion by photography”. By establishing a battery of cameras the movements of racing horses were successively photographed, and then he extended this technique to describe movements also to baseball and other sports. His pictures had presented possibly the best illusion of motion prior to the development of flexible celluloid film (Betts, 1953).

Also Frank B. Gilbreth is considered a “father of motion studies” for using motion pictures to chart the swing of early twentieth century golf champion and the movements of other sportsmen. Using photographic technology, he developed what were called chronocyclegraphs, which isolated the elements that composed a complete cycle of motion, created by attaching small electric lights to the limbs of the sportsmen. By analyzing the “light track” recorded on photographic films, Gilbreth was able to determine the precise path of the motions, as well as calculate the time occupied in each separate movement. Thus, Gilbreth used the motion picture camera to break down and reconstruct work processes “for the sake of economic advantage”. According to Gilbreth: “to become a champion yourself you must learn from a champion. But very few champions are good teachers in the sense that they can tell what to do and how to do it. Often, they have entirely wrong theories about their own procedures”. As Gilbreth cyclegraph revealed, very often: “a champion does not know why he is a champion”. It was Gilbreth’s theory that “all manual works, whether it is a surgeon, a bricklayer or a tennis player, is alike in this: it possesses a fundamental rhythm” (Bedeian, 2012).

Radio became popular in the first decade of the 20s and the first transmission will broadcast the live report of boxing and baseball matches. In Great Britain, the first radio programs will broadcast the rowing competition between Oxford and Cambridge, the horse races and the final games of the Football Association.

Today, in the whole world, there are more than fifty-thousand radio companies which depend on sponsorship for their survival and which are still successfully broadcasting millions of hours of sport events, especially because radios are easy to transport and don't require a visual attention by the audience (Lo Verde, 2014).

However, according to Collins (Collins, 2013), the real revolution in commercial sport began in the 50s when it landed to television. The direct television broadcast of sport events was a real revolution for this kind of show, in fact the British Boxing Board of Control, between the 40s and 50s, outlined that in the United States, because of television, boxing matches lost 80 percent of physical spectators. In fact, the growth television control of sport events was parallel to its capacity of sponsoring the sport event buying their broadcasting rights.

For example, in the US in 1962, the National Football League was able to sell its rights to CBS for 4.65 million dollar, but in 2012 they were able to sell the same rights to CBS, Fox, NBC and ESPN, for a time frame of eight years, for 17.6 billion dollar. This is the proof that when a sport becomes interesting for television its level of commercialization grows dramatically; as a consequence, many sports have less spectators because they don't fit on television, which means that they are not very spectacular if shown on television.

What's more, through television, teams which had a local or national relevance and audience have become globally visible and famous, internationalizing their audience. As a consequence, the migration of sport fans to different locations has created opportunities for sport teams to develop new markets. This is reflected in NFL (American National Football League), playing games in Europe to capture more audiences in this geographic area. Alternatively, soccer clubs such as Manchester City have had a successful internationalization strategy by creating overseas partnership clubs like the one with Melbourne City in Australia (Ratten, 2018).

The negotiation of broadcasting rights between sport leagues and television broadcasting companies had an influence also on the timing of the events in order to ease the international coverage of the broadcasting activity from the point of view of the timing frame of the event, which has to be visible by the highest possible amount of spectators.

Moreover, according to Horne (Horne, et al., 2013), television does much more than simply broadcasting an event. It selects, puts in a frame, advertises, personalizes, dramatizing the event. In this process, space and time are put together in order to enhance the value of the entertainment.

To better evaluate the role of television in sport, we also have to consider the speed of the internet worldwide diffusion, which has increased the importance of the visual broadcasting of sport events. UNESCO's recent report on internet broadband confirms that the use of the new communication technology is more and more characterized by a mobile fruition. The number of users between 2000 and 2012 has grown by 480 percent, and sport events are among the contents in which the new online users are more interested.

This kind of mobile and immediate online broadcasting is changing the sense of sport and of competition, enhancing its dramatic and spectacular characteristic. On the other hand, this kind of tool is also considered a threat by traditional media operators, because it is a mean of very quick circulation around the world of video clips, which can be produced and broadcasted at very low cost, by passing even the professional video production.

According to Hutchins and Rowe (Hutchins & Rowe, 2012), what is happening is the generation of a new sport media network in which the challenges that a sport federation has to face are becoming more complicated; the problem of the copyright of sport broadcasting that was easily solved before through a direct negotiation with operators that use the same broadcasting platform, has become more difficult. And this depends on the fact that the value of the rights for online distribution is becoming higher. At the same time, also online piracy of media products has become difficult to control together with the relationship with companies that produce sport videogames.

In conclusion, as consumers shift from cable to digital media, we can expect a fast evolution in sport media. In fact, in October 2016 some of the US and Europe most important broadcasters saw their viewing figures dropping drastically as their viewers were courted by online-only streaming services, both illegal and legal. Providers like Ituned, Vimeo Ondemand and Amazon Instant Video, allow customers to pay for individual pieces of contents, and many are suggesting that sport streaming follows this route, with packages specific to a user-preferred team.

Many leagues are getting creative with their digital rights, tailoring their deals toward non-linear viewing and multi-screens usage, which opens the market to social networks and specialized websites. For example, the NFL's deal with DirecTV includes the red zone channel which switches automatically viewers to games where big plays are about to occur. When selling television rights, leagues can develop allotment strategies that optimize the value of both television and alternative platforms. The NFL, MLB and NBA have created their own internet streaming services for customers (Skinner, et al., 2018).

What's more, Amazon, through its video streaming platform, Amazon Prime Video, succeeded recently in acquiring the general broadcasting rights of the Italian football Champions League top-pick Wednesday matches 2021-2024, overwhelming all the other traditional broadcasting companies with an offer of 93.8 million dollars per year. Furthermore, the digital social network company Facebook has signed in 2017 a deal with Univision Communications to broadcast 46 Liga MX games from Mexico's top football league; Facebook will also be showing in 2017 LaLiga Spanish football events for free (Ratten, 2018).

Although Facebook may have failed with its 600 million dollar bid to stream Indian cricket, this is only the beginning and may result in other over-the-top (OTT) platforms seeking similar live rights packages (Skinner, et al., 2018).

One additional very relevant aspect of the connection between sports and media is the one related to gambling. Modern sport was arguably "gamblified" long ago, in fact the first newspapers entirely dedicated to sport in the UK in the nineteenth century were focused on making forecasts and giving tips for readers that were horse-racing bettors. In some cases sport events were created for the sole purpose of betting, like personal bets over walking a specific distance, or track and field races. A more recent example is the creation of the Intertoto Cup in 1961 (which later became a UEFA Cup), which was a summer soccer tournament conceived to allow national football "pools" (gambling organizations similar to national lotteries) to continue their business activity during the off-season. Gambling has taken more and more advantage of the fact that the arrival and popularization of television by mid-twentieth century has transformed sport into a high value commodity capable of grabbing the attention of spectators more than any other television show. This has generated an ever growing involvement of gambling activities

in sport, and it is now estimated that the sport betting industry worldwide will be worth 155 billion US dollar by 2024, and the report commissioned by the American Gaming Association has predicted that in US the new online sport betting regulation will add a combined increase of 4.23 billion dollar per year to the current revenue of the four major professional sport leagues of the country.

In the UK, online and land based sport betting represent today 33.4% of the gambling industry gross yield. A similar proportion, 31.5% has been reported in the Spanish gambling market. In Australia in 2018, sports and racing betting were the 19.2% of the total gambling expenditure in the country, but sport betting is the highest growing gambling form, increasing at least twice as much as any other form (Lopez-Gonzalez, et al., 2021).

In fact, gambling companies are heavily investing in the sport branch. The American National Football League, NFL, has been making lately enormous sponsorship agreements with sport gambling companies, casinos, and lotteries like DraftKings, FanDuel and Caesars which made a five-year pacts worth nearly one billion dollar. NFL also made secondary deals with BetMGM, WynnBET, Fox Bet and PointsBet (Young, 2022).

In particular, online sport betting, thanks to the newest digital technologies, is becoming pervasive and is changing the market. From the ever present mobile phone, bettors can increase their emotional and financial engagement with any game or match, and are inundated with promotional messages for “risk-free” and “no-brainer” betting opportunities on online sport books. In 2021, 23 million Americans reported plans to bet around 4.3 billion dollar on the Superbowl. A record 7.6 million people said that they would bet online with an increase of 63% from the previous year. Sport’s gambling grows explosively at the same time that mobile and online technologies evolve to created unlimited types of wagering opportunities.

According to some social analysts, this fast trend could generate problems in future, because sport bettors have higher rates of gambling problems than other gamblers (twice as high), 45% of sports betting now take place online at any time, aggressive marketing promotions make it more difficult for bettors who are trying to reduce their gambling, young people have higher rates of gambling problems than adults and 75% of students do gambling (Bell, 2021).

Sports betting products can be especially invasive as they exploit a process which psychologists define as “Meaning Transfer Model” (MTM). According to the MTM, cultural meaning is drawn from a culturally constituted world and transferred to a consumer good. Then the meaning is drawn from the object and transferred to an individual consumer. According to this scheme, sport is a culturally constituted world, sports betting is a consumer good and sport bettors the consumers. Marketing and advertising strategies reflect rituals in which sports betting products and sports bettors become associated with positive attribute of sport, the result being the improvement of the general perception of sports betting. As a consequence, many famous athletes are employed to serve as brand ambassadors for various gambling firms (for example Neymar, Bolt and Cristiano Ronaldo).

Therefore, the symbolic association between sport and gambling reinforces specific cognition about sports betting, normalizing it and lowering the awareness about its risks, especially among youngsters. The actual strong connection between new sport media and the gambling industry can be considered as an application of the most advanced psychological techniques to the market of sport spectators (Lopez-Gonzalez, et al., 2021).

Chapter 13:

The influence of innovation on the new “extreme” sports

Some of the sports that have become part today of the outdoor leisure time like rafting, kite-surfing, paragliding or mountain-biking, even if they have entered in some cases the list of Olympic sports, began as “extreme sports” or physical activities for individuals in which, instead of challenging somebody, the athletes challenge themselves or their own limits. These individual limits can be physical resistance, the time during which a single athlete is able to preserve his balance, the distance that can be reached on a difficult track and so on.

In most cases, the results of these activities are risky and unpredictable, based on experiences and emotions that can be hardly replicated, like the launch from space made by Felix Baumgartner from 39.000 meters of height.

These activities start, develop and disappear with a certain regularity also because of the process of institutionalization that every sport practice has to make before it is formally accepted by official sport institutions. They usually start in non-organized situations, most of the times in open-air or in a natural environment. on the initiative of singles or spontaneous groups.

Their main characteristic is the interest in risk, according to a process based on experimentation and betting, in which the athlete undergoes a training path in order to keep the risk “under control”. If all these practices can be considered sport might be questionable, but on the other hand, many of the extreme sports have been accepted among the Olympic disciplines (like skateboard, motocross etc.) (Lo Verde, 2014).

According to Robinson (Robinson, 2013), these sports are also mentioned in sociological literature as “Californian sports”, lifestyle sport, wiz-sport or edgework, with the meaning of limit situations in which the absence of rules or their transgression becomes the typical characteristic. For example, in the practice of surfing what appears to be central is a lifestyle that is more focus on the permanent research of technical skills than a search for adrenaline and risk.

In general, athletes of extreme sports are the expression of a sport subculture in which the authenticity of the practice is paramount, in terms of knowledge of self and of the own psycho-physical limits and in terms of being able to face the pain and suffering that these practices can generate.

From a certain point of view many of these practices can be interpreted as a kind of resistance against globalization of organized sports, a sort of resistance in general, to a system of social rules against which the athlete tries to oppose. A typical example of this kind of opposition, very popular among youngsters, is “parkour”, a discipline started in France in the eighties with the name of “art du déplacement”. Its name derives from “parcour du combatant”, a war-training developed by George Hebert, a military officer of the end of the nineteenth century who was well-known for revolutionizing the training methodologies in “efficientist” terms, aiming the training to the exploitation of all psycho-physical resources of each soldier in relation to the challenges of a given environmental situation.

The name “parkour” was given to the discipline to the first two athletes, David Bell and Hubert Kounde, in 1998, who specialized in overcoming with the maximum possible efficiency all the obstacles on a given urban track (Lo Verde, 2014).

In spite of their origin, even extreme sports have become subjected to heavy global commercialization due to the global interest they have awakened in television and media in general. They have also become targeted by the sport industry, which has intercepted the demand of the athletes offering new equipment, technologies, clothing, but also events and exhibition opportunities

A company that has given a relevant contribution to the growth of extreme sports, exploiting at the same time their success to achieve big profits on the global market, is GoPro.

The idea of miniaturizing portable video cameras in order to connect them to the athletes body and report in the most immediate and exciting way his performance became quickly the most effective way to involve any kind of spectators in unbelievable experiences related to extreme and risky sport activities.

GoPro has really changed the action sport market with its affordable and portable camera. They launched their first product, the “Hero” camera, in 2004, allowing

sportsmen to record themselves when playing sport. GoPro has since expanded the product range to drones and Virtual Reality (VR), making Nick Woodman, its founder, a billionaire. The GoPro “Karma” is their most recent product innovation, a portable drone that lets users take also aerial videos (Ratten, 2018).

Another company that has given a relevant contribution to extreme sports, especially in the outdoor field, is Patagonia. The founder of Patagonia, Yvon Chouinard, being passionate of alpinism and nature, started developing and producing clothing and equipment tailored for people interested in enjoying mountain sports in isolated and harsh locations. His respect for nature led him to innovate wetsuit materials by using natural sustainable tree rubber, which is organic and it is produced in an environmentally friendly manner (Ratten, 2018). His contribution to mountain trekking and climbing was the development of a new “cube” technology, which avoids the use of nails for climbing, using small alloy dices instead of tools which tend to break and consume the rocky surface.

When Chouinard started to climb the Yosemite mountains, where one single excursion could last for days, only single-use nails were available on the market. The climbers used to leave the spikes on the rock for the next climber. However, very often the heads of the used spikes tended to break. For this reason Chouinard started to manufacture the spikes on his own, in order to have more resistant ones which could be extracted after climbing.

He had to manufacture best quality products, as he was the first to try and the quality of the climbing equipment was not good enough, he could have put his own life at risk. His customers began to be very satisfied with the high quality of his equipment and started asking for more assorted tools for climbing. In 1970 the company Chouinard equipment was the main supplier of climbing tools in USA.

Climbing was becoming more and more popular in US and the market of buyers of Chouinard equipment increased. However, Chouinard and his friends were disgusted of the situation they found on their favourite US mountains: there were plenty of holes in the rocks, and all the people climbing always in the same few zones were spoiling the mountains. Even though the sales of nails were growing exponentially, they decided to shift to climbing dices (that British climbers used for climbing steep cliff), improving their shape as they were not safe enough. In 1972 he had the courage to print a new

catalogue that started with an article on the negative impact of the nails on mountain ecosystem.

In the same years he had the idea to start producing special clothing for climbing: during an excursion in England, he discovered the last active factory in the world with a machine that still produced very resistant and super-heavy corduroy, which during the industrial revolution was made for the workers' clothes, in order to make them last longer. The thick ridding protected workers from scrapings and cuts, which was perfect for climbing. Moreover, while climbing in Scotland, he discovered some rugby jerseys which were perfect to attenuate traction and friction and had a collar that prevented scratches on the neck.

The next step, after some years, was to focus on technical multifunctional wearing. The first innovation was a raincoat made of Foamback (an predecessor Gore-tex), which prevented sweat condensation inside the cloth, because the inner nylon surface was covered with a thin layer of foam rubber and gauze. Then Patagonia started searching for a clothing material that could substitute cotton or wool clothes: synthetic pile (made of polyester fiber) was the new material that worked very well, because it guaranteed a perfect thermic isolation without absorbing humidity. This was the kind of choice and evolution that later led the company in developing the most successful clothing made with the artificial fibers called Synchronilla and Capilene, which dramatically increased the comfort of athletic climbers providing very dry and perspiration-fitted underwear (Chouinard, 2016).

The fashion of extreme sports has generated the global success of several new equipment and apparel brands. Havaianas, for example, the Brazilian shoe company, originally sold cheap shoes to workers. Surfers then started wearing different coloured havaianas and this created a global fashion trend.

Even Ugg boots, a very basic kind of shoe, have become internationally successful because originally they were worn by surfers after being in the water, as these boots were warm and very easy to put on. Ugg boots became popular also with non-surfers due to their connection to the lifestyle of surfers (Ratten, 2018).

Another brand which took advantage of the surfing environment is the company Rip Curl, which understood that the cold ocean currents created a need for special, highly-insulated wetsuit. Its "Elastomax" and Slickskin" technologies set international

standards for wetsuit design, allowing Rip Curl to gain an international reputation (Skinner, et al., 2018).

A similar case happened with Vans shoes, which were the favourite skateboarding shoes in Los Angeles and then received broader market attention from other types of consumers.

Some extreme sport equipment brands achieved international recognition binding their brand to famous sportsmen. One of the typical cases is the surfing company Quiksilver, which originally started in the 1960s in Torquay, Australia, which is the traditional sponsor of the great American surfer Kelly Slater, who won a total of eleven world surfing titles. He is considered one of the most influential surfers in history, for his ability to connect surfing to a worldwide global audience and his promotion of surfing as a sport. Quiksilver originally sponsored Kelly because of his future surfing potential but also for his linkages to the American surfing market and his international appeal. Kelly Slater's sponsorship for Quiksilver involved the fact that he wears its clothing line but also owns 3% of the company in stock. The connection between Kelly Slater and Quiksilver has been mutually beneficial for both, as Quiksilver has grown more than thousand percent since the first signing of Kelly Slater as a major surfing star (Ratten, 2018).

Together with traditional and professional sports, also extreme sports, which need during their most difficult phases and performances a boost of additional energy, gave their contribution to the increase in sport drinks or energy bars that enable athletes to replenish resources quickly (Ratten, 2019).

For example, the company RedBull has built its global success developing an energy drink, conceived for extreme sport athletes, in order to increase cognitive performance, such as increased attention and reaction speed, together with increased endurance and power. Several test showed the capacity of this kind of drink, based on caffeine, taurine and vitamins B (B2,B3,B5,B6,B12) to increase upper body muscle endurance during repeated Wingate tests in young healthy adults (Forbes, et al., 2007).

Case Study: Gelindo Bordin and Diadora

In order to better understand the achievements of the track and field sport branch, we had an interview with the famous marathon athlete and Olympic champion Gelindo Bordin, who became marketing manager at the sport shoes company Diadora at the end of his sport career.

Gelindo Bordin was born in 1959 in Vicenza and was the first Italian athlete to win a marathon gold medal at the Olympics, in Seoul in 1988. Before this great victory, he also won a bronze medal at the World Championship in 1987 and two gold medals at the European Championships in 1986 and 1990.

According to Gelindo Bordin, the scientific progress in the field of physiology had an important influence on his sport career. The most important innovation he took advantage of was the measurement of the aerobic level on the basis of the evaluation of the lactic acid. Together with his medical assistance he developed a kind of test which consisted in covering five times the distance of two thousand meters according to a progression in speed. At the end of each test the level of lactic acid was measured in millimoles to evaluate which was the best speed to be maintained in the marathon competition. Just a few drops of blood were taken from the lower part of the ear to make the measurement in real time. Test after test the speed on the two thousand meters range was increased until reaching two millimoles of lactic acid production. Two millimoles were the limit to set the proper competition speed. This limit in fact, allowed his organism to avoid the accumulation of the acid at muscular level. This deep knowledge of the importance of the lactic acid production during his performance had a very relevant impact on his sport career.

But also the new training discipline developed during his career had a very relevant influence on his achievements. The physiologists understood during the seventies that a long range run needs a constant availability of aerobic energy, and the avoidance of using energy coming from anaerobic sources. According to modern science, the contribution of the several body energy sources to form ATP (Adenosine Triphosphate, a high energy phosphate stored within skeletal muscle) during a marathon is divided as follows: 75% aerobic glycogen, 5% hematic glucose, 20% triacylglycerol (fat acids). Therefore, the main energy sources required during a marathon are: glycogen stored in the muscles, liver and fats. The sugar reserves in a body are limited but not the ones of

fats: thus, one of the most important adaptation to the resistance training is a lower use of carbohydrates as fuel and an increase of the use of fat acids during the standard exercises. this involves the combined effect of diminishing the use of muscular glycogen and to reduce the production of glucose coming from glycogenolysis and hepatic gluconeogenesis.

In fact, the lipidic power is the capacity of an organism to consume fat, which means using fat as energetic fuel. Only with a good lipidic power it is possible to run a marathon at a steady and rapid speed. If the consumption of fat per minute is too low, the athlete will burn mostly sugars (glycogen) and will find himself inevitably exhausted in energetic terms before the end of the competition. Nowadays the calculation of the lipidic power is normally made in a laboratory on the base of the breathing ratio, which means calculating the percentage of CO₂ eliminated and consumed oxygen. If the ratio is equal to one, this means that we are only consuming carbohydrates, which if this ratio is lower, it means that there is a certain contribution by the consumption of fat to the consumption of energy. More oxygen in fact is needed in relation to the eliminated CO₂ to produce the same quantity of energy starting from fat acids. The level of 0.7 would mean that the energy is produced only by fats, but this is not a proper evaluation because the consumption of fat for energy production has necessarily to be made together with the consumption of a certain amount of sugar. This kind of fuel has to be used at a low-medium intensity, so that the reserves of glycogen can be spared.

In conclusion, during a marathon, the fuel that is utilized is a mixture of sugar plus fats and this has to be achieved through specific training. The elite athletes have to make a series of specific works to activate the metabolic system with the target of optimizing the mixture of sugar and fats during the competition. The kind of training that can optimize this kind of mechanism is the following:

- Aerobic training with energy coming from fats plus sugar to empty the reserves of glycogenes coming from muscles and liver: medium or long interval training with marathon rhythm;
- Anaerobic glicolitic training: it is the short term energetic system based on the use of lactic acid with energetic purpose; it is based on short races of 3.000 and 5.000 meters;
- Aerobic training with prevailing energy coming from fats: it is based on resistance training to overcharge all the components of the cardiovascular system; it is based on

slow running with a duration from 50 to 90 minutes and a heart pace between 120 and 130 per minute;

- Aerobic training with prevailing energy coming from fats and sugars in final phase: long progressive running between 90 to 180 minutes and heart pace between 130 and 160 per minute;
- Aerobic training with a mixture of energy coming from fats plus sugars: long range between 10 and 18 km, heart pace 160 and 170 per minute;
- Aerobic training with energy coming mainly from sugars and less from fats: long range run, with a progression and speed on a distance between 15 to 25 km and a heart pace between 140 and 160 per minute;
- Aerobic plus anaerobic glycolytic training with energy coming from fats and lactic acid: fast run, distance between 5 and 10 km, heart pace 170 and 180 per minute;
- Aerobic training with energy coming from fats plus sugars on a steep field: slow run on hills with a heart pace between 110 and 150 per minute;
- Aerobic training with some anaerobic phases with energy coming from fats, sugars and lactic acid: hill field with a distance between 10 and 20 km and heart pace between 140 and 180 per minute;
- Aerobic/Anaerobic interval training with energy coming mainly from fats plus sugars, and little accumulation of lactic acid: distance from 8 to 12 km with speed variation, heart pace between 140 and 180 per minute;
- Anaerobic training with energy coming from sugar and lactic acid: short runs with distance between 200 and 500 meters and heart pace between 170 and 180 per minute;
- Aerobic training with energy coming from sugars, fats and lactic acid accumulation: repeated long run with distance between 1.000 and 7.000 meters and heart pace between 150 and 170 per minute;
- Anaerobic training with energy coming from lactic acid and sugars: repeated runs on a steep field with a distance between 80 and 300 meters and heart pace between 170 and 180 per minute;
- Aerobic/Anaerobic glycolytic training with energy coming from sugars plus lactic acid: repeated long runs on a steep field with distance between 300 and 1.000 meters and heart pace between 160 and 180 per minute;

- Aerobic/Anaerobic training with energy coming from sugars plus fats plus lactic acid: time-measured run on a steep field with distance between 4 and 6 km and heart pace between 170 and 180 per minute;
- This kind of training has to be made according to a careful periodization with three weeks of hard work and one week of rest, or two weeks of work and one of rest;

According to Bordin, also food science played a relevant role in high performance athletics since the 80's. Nowadays, the so-called "periodized nutrition" (a strategic combination of nutrition, type of training and training cycles) is one of the strategies chosen by trainers with the aim of improving the adaptation to the training and improve the performance during the competition. For example, a training that has the goal to improve the capacity of burning oxygen has to be accompanied by a diet with low percentage of carbohydrates. Different strategies are adopted in pre-competition, competition, and post competition time.

In the pre-competition phase the recommended diet is made of 10-12 kg of hydrocarbons during 36-48 hours, and a low amount of fibers. Immediately before the competition the meal should have a low content of fats, fibers and proteins in order to avoid gastric disorder during the competition.

During the competition only fluids should be ingested for hydration and to provide additional energy, but just 30 to 60 grams/ hour every 5 km.

After the competition it is paramount to recover from de-hydration drinking 450/675 milliliters of liquid for every 500 grams of weight that has been lost during the competition. The liquids should contain electrolytics, especially sodium, because most of the liquids are lost during the competition through sweat which contains mainly sodium. A simple way to compensate the loss is drinking salt-added water, with a content of 3 grams of salt per liter.

The amount of hydrocarbons required to replace normal amount of glycogen in muscles and liver is around 1.0/1.5 in the first 30 minutes after the competition, and the same quantity every 2 hours for 4-6 hours. The meal that follows the competition should contain also some proteins, which will provide the aminoacids that are necessary to repair the muscular structure.

Bordin thinks that also modern psychology has become a precious tool to improve athletic performance. He's been working on his sport career in close cooperation with a psychologist, focusing in particular on the "principle of happiness", according to which a condition of happiness can significantly improve athletic performances.

This kind of condition has been well described in Shawn Achor's book "the advantage of happiness". According to this author: "you're not happy because you are successful, but you're successful because you're happy", in the sense that when we have a positive mental attitude, we become more committed, creative, motivated, energetic, resilient and productive in our work.

According to this kind of approach, helping an athlete to focus for a 70 percent on his best qualities and only for a 30 percent on his worst ones, we would obtain a double benefit for his performance: on one side the athlete would have a positive opinion of himself, avoiding a persistent and negative concern about his points of weakness, and on the other hand we would help him to nurture the qualities which can make the difference in the competition strategy.

According to Bordin, the application of the above mentioned principles led him to make very original choices in his career, like the decision he took at the Seoul Olympics in 1988, when he went to a disco just the evening before the competition that gave him the marathon gold medal.

His team mates and federal technicians were disappointed, but that evening gave him, in his opinion, the kind of "mental freshness" he needed to obtain his best performance ever, after months of hard professional training.

In Bordin's opinion, science and psychology will lead the human beings to overcome their athletic limits more and more often in future. He bases this assumption on the sport records statistics, which show that anytime a record is set that is considered unbreakable many athletes succeed in overcoming it.

An example of this trend is given by the British runner Roger Bannister. In the early 50's, after deep analysis and mathematic calculation on the characteristics of our anatomy, experts said that the human body would never be able to cover the distance of a mile in less than 4 minutes, but in 1954 broke this assumption covering that distance in 3 minutes, 59 seconds and 4. After this achievement a mile has been covered by many athletes in less than 4 minutes.

Also the technical innovations concerning track-and -field shoes had a relevant influence on Bordin's performance.

He reminds that the most important innovations in this kind of shoes started in the early 80's, with the aim of reducing the accidents.

Since 1736 some explorers noticed that the Amazonian indios used to protect their feet with the resin they extracted from the gum tree, which became harder when they dried it up with some fire. After a century, in 1832, Wait Webster patented the first rubber sole, and in 1839 Charles Goodyear increased dramatically the resistance of rubber with the "vulcanisation" process. The Brits, in 1850, were then the first to make a sport shoe as we mean it today, with a rubber sole and an upper part made of textile. This first sport shoe was called " Plimsoll" because it had a stripe of white rubber on the sides, which reminded the load line painted on the ships, which was invented by Samuel Plimsoll in order to show the safety limits of the ship load. When this shoe landed in the States it became what we nowadays call a " sneaker".

But according to Bordin, for runners the most important innovation was the introduction between rubber sole and foot of the " EVA" (Ethilene-Vinil-acetate) intermediate printed sole, a solution that has increased the elasticity of the shoe and its capacity to absorb the impact with the soil.

This kind of intermediate sole is usually thinner in the front and thicker in the back, and this difference is usually called " drop".

The measure of the " drop" had a revolution in the 80's, because of the American boom of jogging. American statistics tell that in the 80's nearly 30 million of US citizens were regular jogging practitioners, and that the accidents related to training were a relevant number.

Thus, several sport apparel companies started investing more in research to improve the shoe quality, both in terms of safety and comfort. This also led to a frequent difference in the "drop", which varied from 0 to 12 millimeters.

The higher the drop, the bigger the modification in the runner's race posture, because this little difference in the intermediate sole has an influence on the lower leg muscle: if the drop is high, the muscle is pushed in the upper direction and becomes " shorter", and this makes a difference, encouraging the athlete in touching ground with the heel (and a better amortization provided by the intermediate sole in the back) and not with the front part of the foot.

To make the consequences of the drop easier to be understood, Bordin mentions an article written by Sergio Migliorino for Runner's World Italia. He considers that most of the runners nowadays start running at the age of 30, and their motion is slow (well over 5 minutes per km), and this kind of users takes advantage of a lower impact on muscles, bones and nerves.

Simon Bartold, of the Melbourne university, has studied the impact of a 12 mm drop on the Achilles tendon on male athletes running on treadmills, and the outcome was that a higher drop provides more protection.

In the 90's an additional innovation was based on the introduction of a plastic "bridge" to divide the rubber sole in two different parts, and separate the heel from the front part of the foot. This has reduced the contact area of the sole with the ground to provide a more dynamic reaction of the shoe structure. The shoe makers have also increased the amortisation through patented solutions based on new structures, like the "air" coucisin in Nike, the gel bubble in Asics, Adiprene in Adidas, "double action" in Diadora, "Wave" in Mizuno, "Grid" in Saucony etc.

When Bordin became a manager of the sport shoes and apparel company Diadora, in the area of Treviso, Italy, he was able to use his precious experience to develop a revolutionary innovation: the Diadora "blue shield" technology.

It's a foot amortization system which was introduced in the market in 2017 and is based on the intuition that feet don't touch the ground in a symmetric way.

Bordin understood, together with the Diadora technicians, that 80 percent of the runners suffer from an excessive rotation of the foot towards its inner side, which is often caused by a reduction of the foot arc. This problem can cause damage to the Achilles tendon or to the knees, as they are stressed by thousands of micro side-movements out of the axis of the runner's trajectory.

The solution came from the observation of the feet from the point of view of their bottom, where it is evident that in normal conditions each foot has 3 main points of contact with the ground. But when feet are pressed heavily on the ground, the 3 points of contact are flattened and the contact surface loses its symmetry. What was noticed is that walking on sand, like men did when they started marching on two legs, feet avoid excessive deformation, because the sand fills naturally some gaps in the foot arc.

Diadora's idea was to use a filling material in the shoe that could act similarly to the sand, with 2 different layers over the shoe sole, the first called " equalizer", and the second " zero deformation level", laid on a sole that is carved according to the natural shape of the foot.

Conclusion

As we could see, in modern sports the athletic performance is not only based on human action and skills, but is empowered by a wide system of scientific and technological research and experimentation, supported by the industry, by governments and sport federations, and driven by the modern quest for records, speed and super-human achievements.

Team victories and individual athletic records are based on extended assistance by physiologists, nutritionists, biochemical scientists, engineers, now even IT experts, and steadily improved by an impressive mass production of innovative tools provided by a global sports industry that supplies more and more affordable and sophisticated sport goods.

Athletes and industry are thus bound in a common effort in exploring the limits of the human body, but also in spreading globally a culture of wellness and physical fitness that didn't belong to all the world's cultures in the past, but has become globally dominant, step by step, through the internationalization of the "codified sports" ,which took the move from the industrial revolution started by Anglo-Saxon countries, and the overwhelming growth of global sport events inflated by the ever increasing media power.

There's no doubt, if we consider this successful evolution of the branch, that this combined effort of all the parties involved has given a remarkable boost to the global levels of lifestyle quality and social health, and that the principles of healthy growth for human beings and better social organization preached by the founders of the modern sport disciplines has generated a universe of activities, events, services, infrastructure, tools and inventions that have largely benefited both male and female lovers of outdoor and health. The ancient roman principle of "mens sana in corpore sano" has found the highest level of expression in modern times.

The global sport revolution brought by "organized sports" has influenced the people's ordinary life. This can be perceived in the growing gender equality, in the street-wear trends, where sport apparel has replaced the former "bourgeois" etiquette, in the nutrition trend, where diets based on sport physiology have modified the concept of well-being, and even in politics, considering that the Olympic Games enhanced cooperation and friendship among nations for a more peaceful and unified world.

On the other hand, some experts are questioning what will happen of modern sports once many athletic performances will face their natural physical limits, and the steady capacity of modern technology combined with modern training science to set new records will be exhausted. In our opinion, team sports will keep on being extremely successful for their capacity of attracting and entertaining masses of spectators, also through a progressive adjournment of the rules of the game, while "extreme sports", as individual "freestyle" performances, might continue to attract that part of sport fans,

which has lowered its interest for the standardized records of track and field activities. This trend is also proven by the late inclusion of some extreme sports like skateboarding among the Olympic disciplines.

In future, the interest of the global mass market for athletic performances will keep on growing, increasing its actual weight of 1% of the global GDP, while the need for physical activity in post-industrial societies, where intellectual work and “smart-working” (as a consequence of robotization and employment of artificial intelligence in production processes) are becoming dominant, will keep on boosting the global sport equipment industry.

All these trends are clearly predictable on the base of the steady growth of the global middle class and on the base of the growing number of Olympic medals conquered by emerging countries.

In fact, by 1975 the world’s middle-class had reached one billion people, it could surpass four billion by 2021 (Kharas, 2016), and at the Tokyo Olympics in 2021, 88 different Olympic National Committees have earned a podium, which was the largest list of medal winning countries in history (Mercer, 2021).

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