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"The Ultimate Elixir of Sport"

In 1889, Dr Charles-Édouard Brown-Séquard, a world renowned physiologist and neurologist, who first described a syndrome that bears his name, published in *The Lancet*, a paper based on a number of experiments done on animals and humans (including himself) which involved injecting an elixir derived from blood from the testicular artery, semen and fluid extracted from freshly crushed animal testicles. He concluded "*...great dynamogenic power is possessed by some substance or substances which our blood owes to the testicles*." and "*I can assert that the ... given liquid is endowed with very great power*."

The inherent belief that human performance can be improved by the addition of an elixir can be traced to ancient Greece. Athletes and warriors ingested berries and herbal infusions to improve strength and skill. The intrinsic risk attached to these substances has always been appreciated. Scandinavian mythology mentions *Berserkers* (ancient Norse warriors) who would drink a mixture called "*butotens*", to increase their physical power at the risk of insanity. They would literally go berserk (where the modern meaning of the word arises) by biting into their shields and gnawing at their skin before launching into battle, killing anything in their path.

This desire to out-compete rivals at any cost seems to be branded into the human psyche. The willingness to partake of substances that may inevitably be detrimental even to the point of death has been repeatedly demonstrated. Thomas Hicks, an American-born athlete won the 1904 Olympic marathon having received multiple injections of strychnine by his trainer. Hicks survived his ordeal but never raced again.

An attempt at understanding the extent of this risk-taking behaviour was undertaken by physician Dr Bob Goldman. In his research involving elite athletes he presented a scenario where success in sport would be guaranteed by the ingestion of an undetectable substance, however, with death the inevitable outcome after five years. He concluded that approximately half the athletes would take the drug. This scenario has been dubbed the "*Goldman's dilemma*". A more recent repeat of this study yielded a lower correlation.

During World War II soldiers on both sides were given amphetamines to counteract fatigue, elevate mood and heighten endurance.8,9 Following the war these drugs – nicknamed "*La bomba*" and "*Atoom*" by Italian and Dutch cyclists – started to enter the sporting arena with intention of minimising fatigue.

In the 1950s, there was the perception in the USA that the success of the Russian weightlifting team was solely due to the use of performance-enhancing drugs. Dr John Ziegler, in collaboration with CIBA Pharmaceuticals and under FDA approval, developed the first oral anabolic steroid, methandrostenolone, which US Athletics gave its entire Olympic weightlifting team. Zeigler was later quoted when discovering that athletes were taking 20 times the recommended dose: "*I lost interest in fooling with IQs of that calibre. Now it's about as widespread among these idiots as marijuana*."

It came to a head at the 1960 Olympic Games where Danish cyclist, Knud Enemark Jensen, collapsed and died while competing in the 100km race. An autopsy revealed the presence of amphetamines and nicotinyl tartrate in his system. In the 1967 Tour de France, world renowned British cyclist Tommy Simpson died during the 13th stage after consuming excessive amounts of amphetamines and brandy. Simpson's motto was allegedly "*If it takes ten to kill you, take nine and win!*"

Simpson's death created pressure for sporting agencies to take action against doping. This ultimately led to the formation of The World Anti-Doping Agency (WADA) in 1999 as an international independent agency composed and funded equally by international sports associations and governments. Every year WADA publishes an updated list of banned drugs, which fall into three groups:

- M1. Manipulation of Blood and Blood Components
- M2. Chemical and Physical Manipulation
- M3. Gene Doping

Gene doping involves the use of gene transfer to alter gene expression and protein biosynthesis of a specific human protein. This is done by injecting the gene carrier into the athlete using a viral vector or by transfecting the cells outside the body and then reintroducing them. WADA has invested significant resources to detect this process. Currently there is no evidence that this is common practice.

In addition to the traditional incentives such as fame, honour and power, the past 60 years has brought with it the most potent of drivers – money. The financial incentives to both sporting institutions and athletes are profound with some authorities claiming almost a 250% increase in revenue with the introduction of industrial scale performance-enhancing drugs. The supplements industry has already exceeded a value of $60b a year.

The combination of primal ambition and ever improving designer performance-enhancing modalities makes the future of professional sport, I believe, the realm of the highest bidder.

References available on request.