Sam Kean. The Violinist’s Thumb and Other Lost Tales of Love, War, and Genius, as Written by our Genetic Code. (New York: Little, Brown & Company 2012)

VISIONS REVIEWED DOI: 10.13135/2384-8677/1953

Sam Kean. The Violinist's Thumb and Other Lost Tales of Love, War, and Genius, as Written by our Genetic Code.

(New York: Little, Brown & Company 2012)

Enzo Ferrara [1,2]

1 Istituto Nazionale di Ricerca Metrologica – INRiM, Torino (Italy);
2 Interdisciplinary Research Institute on Sustainability – IRIS, Torino (Italy)

ISSN 2384-8677 **DOI:** http://dx.doi.org/10.13135/2384-8677/1953

Published online: December 15, 2016

Citation: Ferrara, E. (2016). Sam Kean. The Violinist's Thumb and Other Lost Tales of Love, War, and Genius, as Written by our Genetic Code. *Visions for Sustainability,* 6: 59-64.

Competing Interests: The author has declared that no competing interests exist.

Corresponding Author: Enzo Ferrara, Italy.

E.mail: e.ferrara@inrim.it

Dogma was just a catch phrase.

Francis Crick, 1988

When looking at the overall history of DNA studies and the investigations into its multiple functions, what is most striking is the recurrence of representations containing references to the laws of mechanics or informatics, identifying genetic information as the source of any biological alterations of living beings. On the other hand, DNA is not a biological mould able to totally determine the destiny of its possessor, even as far as the details of sexual, political, and cultural preferences, or the diseases that will affect health. Such still-dominant mechanistic perspectives concerning such a complex and multi-faceted phenomenon as DNA reveals what are the prevailing visions in science education and information.

Sam Kean, the American author of *The Violinist's Thumb: and Other Lost Tales of Love, War, and Genius, as Written by our Genetic Code* (New York, Little, Brown & Company, 2012), defines the Human Genome Project which aims to decode the entire DNA of *Homo sapiens* – widely acclaimed as a major scientific achievement – as "arguably the most reductionist biological project ever". Previously in *The Disappearing Spoon and the History of the World from the Periodic Table of the Elements* (New York, Little, Brown & Company 2010), Kean wrote stories dealing with chemical substances, in a fashion similar, although not exactly comparable, to the memorable autobiographic sketches by Primo Levi (*The periodic table*, 1975) and Oliver Sacks (*Uncle Tungsten*, 2001). In his latest book, *The Tale of the Duelling Neurosurgeons. The History of the Human Brain as Revealed by True Stories of Trauma, Madness, and Recovery* (New York, Little, Brown & Company 2014), Kean tackles the field of neurosciences, completing a best-seller trilogy built on systemic elements of science history: the periodic table of the elements, the genetic code and the nervous system.

In more than 400 pages, *The Violinist's Thumb* collects histories of scientists together with their research on the core issue of the DNA filament: the central element of biological reproduction. Kean has the ability to combine narration with scientific information. He provides plausible explanations of human misfortunes and bizarre lives, hypothesising relationships, for example, between the genetic code and a passion for cats, explaining why some people do not have digital fingerprints, and why some individuals have been able to survive the nuclear bombs of Hiroshima and Nagasaki. Indeed, in Chapter III (How Does Nature Read - and Misread - DNA?) we learn that at least 150 individuals, between 6 and 9 August 1945, had the misfortune to move from first of these towns to the other in Japan. Of all the reported double victims, the Japanese government has recognized only one official *nijyuu hibakusha* (double-exposure survivor), Tsutomu Yamaguchi, whose story is reconstructed by Kean, claiming that DNA had a major role in letting him survive both the explosions.

DNA combines genetics and environment.

People attribute to genes any biologic anomalies, from possessing tanned skin like John Kennedy to expressing genius like Albert Einstein. Certainly, genes provide some people with exceptional abilities. Sprinters are given a genic asset granting more elastic fibres and the Jamaican Usain Bolt, winner of all the sprint races at the Olympics in Beijing, London and Rio, combined this gift with that of height and longer legs, being on average 30 centimetres taller than is rivals. According to Kean, genes also have relationships with art, music and maths. For example, thanks to the flexibility of their joints, some people can become unique artists, like Niccolò Paganini – whose ability as a violinist is renowned and paid tribute to in the book's title. Scholars think that Paganini was affected by the Marfan syndrome, a genetic disorder of the connective tissues, making his hands much more flexible than the average person: "… he could unfurl and stretch his fingers

impossibly far, his skin seemingly about to rip apart. His finger joints themselves – Kean remarks – were also freakishly flexible: he could wrench his thumb across the back of his hand to touch his pinky (try this), and he could wriggle his middle finger joints *laterally,* like tiny metronomes. As a result, Paganini could dash off intricate riffs and arpeggios that other violinists didn't dare". The Italian musician had such a gift for producing extremely intricate arpeggios that people said he sold his soul to devil. Kean rather suggests a pact with DNA: a basic genetic anomaly could have bestowed him with such flexible fingers. The Marfan syndrome, however, also brought much pain and he was chronically weak and tired, unable to perform for long periods. The story of Paganini shows also how we are the result both of genetics and of our natural and social environment. A DNA fault enhanced his creativity, but equally important was the social *milieu* in which he grew up. If such a mutation had emerged in a different context, it would not have had such a positive outcome as giving birth to a virtuoso of the violin.

Discovering the DNA structure.

Kean tells the 150 years of DNA history by focusing on characters who are generally less well-known, but are equally important for the scientific basis of genetics. His writing also captures the reader's attention, despite the complexity of the topics dealt with. At school, we all learn that Gregor Mendel (1822-84) demonstrated the existence of what we now call genes making experiments with peas in the garden of his monastery. Kean summarizes Mendel's history and the importance of his research, but he also gives ample space to a less known contemporary scholar, the Swiss physiologist Johannes Friedrich Miescher (1844-95), who was the true discoverer of DNA, having extracted for the first time in 1869 the genetic filament from cells' nuclei. In fact, although it is not commonly understood, Francis Crick, James Watson, and Maurice Wilkins won the Nobel Prize in Medicine in 1962 for their findings concerning the molecular structure of nucleic acids, but they were not the actual discoverers of DNA. Almost a century before Crick, Watson, and Wilkins, Miescher had already identified in the leucocytes of blood a substance he called *nucleon*, later identified as *nucleic acid*, and later on as *deoxyribonucleic* acid or DNA. At the same time, he did not intend to isolate this substance, the existence of which he didn't even imagine, since he was searching for the protein components of leucocytes. To achieve this goal, he set out to recover used bandages – at times, Kean exploits macabre histories to sustain his storytelling – from a near surgery, collect the serum that remained on the patches, filter leucocytes, and from these finally extract the proteins. However, eventually he isolated in the cellular nuclei of leucocytes a new substance showing a major phosphorous content and resistance to proteolysis, i.e. the chemical digestion of proteins. "With experiments using other tissues, – Miescher wrote – it seems probable to me that a whole family of such slightly varying phosphorous-containing substances will appear, as a group of nucleons, equivalent to the proteins". In the following decades, renowned scientists such as Phoebus Levene and Erwin Chargaff carried out a series of research projects that unveiled further details on DNA molecules, including information about the primary chemical constituents and the ways these connect with each other. Without the scientific basis provided by all these pioneers of molecular genetics, Watson and Crick would never have been able to discover at Cambridge in 1953 the tridimensional double helix of the DNA molecule.

Dogma was just a catch phrase.

We owe the idea of DNA as the expression of a "scientific dogma" – an oxymoron – to one of the best-known discoverers of its structure, Francis Crick. He coined this unhappy idea to describe the flow of genetic information in a

lecture on protein synthesis given at University College London in September 1957. According to some scholars (R. Olby, Francis Crick, DNA, and the Central dogma, *Daedalus*, 99, 1970, 938-987; B. J. Strasser, A World in One Dimension: Linus Pauling, Francis Crick and the Central Dogma of Molecular Biology, *Hist. Phil. Life Sci.,* 28, 2006, 491-512), most of Crick's claims were unoriginal. Using a quantity of experimental facts recently published, he interpreted the work of others and, unfortunately, he tried to render explicit assumptions that in his view colleagues had left undeveloped in their own work. At the same time, as of 1956 the so-called *Central Dogma of Molecular Biology* at least formally defines the modalities ruling, one amino acid after another in the duplication mechanism of DNA.

Genetic information does not transfer from a protein to another – as previously hypothesized – nor from proteins to nucleic acid. The sequential hypothesis of Crick identifies a unique directionality for information transmission: "DNA originates ribonucleic acid (RNA) and RNA assembles proteins". This is an extreme simplification, which in the intentions of its authors did not preclude the possibility of an inversion of the information flow, from RNA to DNA for example. However, Crick reused the very same words for a paper on Nature in 1970 (F. Crick, Central Dogma of Molecular Biology, *Nature* 227, 561-563, 8 August 1970) and the use of dogma hindered for a long time any other possible hypothesis.

Eventually, this physicist-turned-biologist Nobel Prize winner changed his mind. He claimed in his autobiography (*What Mad Pursuit. A Personal View of Scientific Discovery,* New York, Basic Books*,* 1988**)** that he did not know the meaning of *dogma* exactly, but that he liked it because it seemed erudite.

Epigenetics, hereditariness, environment and education about DNA

In a passage dedicated to epigenetics *(Easy Come, Easy Go? How Come Identical Twins Aren't Identical,* Chapter XV), Kean explains how DNA mutations could influence the future of our species. DNA and above all RNA do not limit themselves to codifying proteins. In fact tens of RNA types exist, that act as regulators, while only three types are sufficient for genetic duplication: messenger, transfer, and ribosomal RNA. The hypothesis of biologic reductionism, according which we are expression only of our DNA, continuously loses ground and support. The principle stating that each gene corresponds to a unique protein is no longer valid and most of the actual degenerative diseases, among these diabetes and tumors, are polygenic. Studies on regulation and modulation of the genetic expression, and not merely on its sequence, gains larger relevance as concern grows for the possible interaction between RNA forms with regulating functions and the varieties of toxic substances ubiquitously distributed in the environment.

An important message emerging from the narrative approach of Kean offers good support to science education. The author repeatedly emphasizes that in the majority of cases scientific protagonists were for a long time convinced supporters of wrong hypothesis, before moving to more sustainable conclusions. Kean highlights, for example, how at the beginning of the nineteenth century, just before Mendel's genetics and Darwin's natural selection were unified within the so-called *new synthesis*, most scientists thought that each chromosome carried only one genetic character, while some believed that chromosomes had nothing to do with hereditariness. Thomas Hunt Morgan – another USA scientist rediscovered by Kean, winner of the Nobel Prize for his studies on the fruit fly, *Drosophila melanogaster* – was convinced that the theory of the relentless pace of evolution was an error of Darwin, until the moment when his own results made him change his mind. Even when the four nucleotide bases (Adenine, Guanine, Thymine, Cytosine) were discovered as

constituting the fundaments of the information codified in DNA, it appeared impossible that these could transmit all the traits from generation to generation. The theory of hereditariness on a protein basis still appeared more probable, because proteins are constructed on the combination of twenty amino acids, i.e. five times the number of nucleotide bases.

Another issue recurring in Kean's book is the inability of the scientific community to appreciate the important discoveries in genetics in the moment when they were made. Mendel was rediscovered long after his death. Barbara McClintock (1902-92), who discovered the transposable elements of DNA — fragments of gene that can move around a chromosome making insertions, suppressions or localized exchanges – gave up printing her results in the 1950s, frustrated by the criticisms of colleagues who refused to publish her works. Thirty years later, in 1983, she received the Nobel Prize for those very same observations. Even the director of the journal that published Miescher's first paper on DNA, eventually praised the contribution as important scientific progress, while considering it in terms of the study of empathic serum accumulating in the wounds.

The general significance of DNA has been of public domain since the middle of the last century and it is still a key concept for the historical awareness of our time. Nevertheless, while our society is based more and more on how techno-science plays a major role in public decisions, a truly comprehensive understanding of DNA functions has made only small steps in within the public audience and remains anchored to anachronistic dogmas. A wider diffusion of scientific information that could condition our choices and influence on our lives would be desirable. Moreover, studies of genetics have found applications that go well beyond biology. The analysis of mitochondrial DNA demonstrates for example that Neanderthal and humans coexisted for thousands of years, until much more recently than previously believed. Applications in archaeology, history and semiology provided fundamental results for human sciences too, as in the work of Alberto Piazza, Luca Cavalli-Sforza, and Paolo Menozzi, *History and Geography of Human Genes* (Milano, Adelphi, 1997). Based on genetic diversification among populations, these authors traced the map of human migration in the last 150 thousand years, confuting any possible justifications of racism on the basis of DNA studies. Therefore, genetics can contribute also to neutralizing atavistic prejudices and discriminations, as it shows that differences among individuals are only superficial and do not go beyond the color of skin or other irrelevant details. For the most part, among ourselves as human beings and together with animals, we are much more genetically similar than we usually suppose.

It is possible to question the way Kean chooses to present his arguments. During seminars he proposes himself as a speaker of *scientific cabaret*, and he places the accent on the extravagant aspects of science history capable of catching attention to make science more accessible, without staying too long on technical issues. "No equations, I promise!" he writes on his website for those inviting him to make speeches. At times, his stories are in danger of resulting much more interesting than the scientific ideas they serve to illustrate, but, as any teacher knows, students often find it easier to learn secondary and anecdotal particulars, rather than the boring, although crucial, parts of lessons. Telling stories is an effective means of illustrating science because the human mind is accustomed to memorizing information in narrative form, while the use of data and formulae makes their understanding more complex. It is probable that instead of remembering Miescher for having been the first at isolating DNA and showing it was not a protein molecule, the mind recalls how the cells he studied were extracted from the serum remained on bandages of patients suffering from chronic plagues. While science

education cannot only use narration, it is indeed true that once attention is caught it is much easier to go deeper into the issues dealt with.

The Violinist's Thumb is a book useful for spreading knowledge about genetics by moving questions concerning DNA from a merely technical perspective to a more accessible ground, thereby opening space for more widespread understanding and participation in debates.

All the books of Sam Kean are appropriate for those desiring to approach science with colorful notes and narrations. Moreover, teachers and specialists should appreciate an approach to science that is important in highlighting the nature of the experiments that underpin it and connecting the history of scientific research to what actually happens around us, beyond the laboratory, thereby making a contribution to the sustainability of science for all.