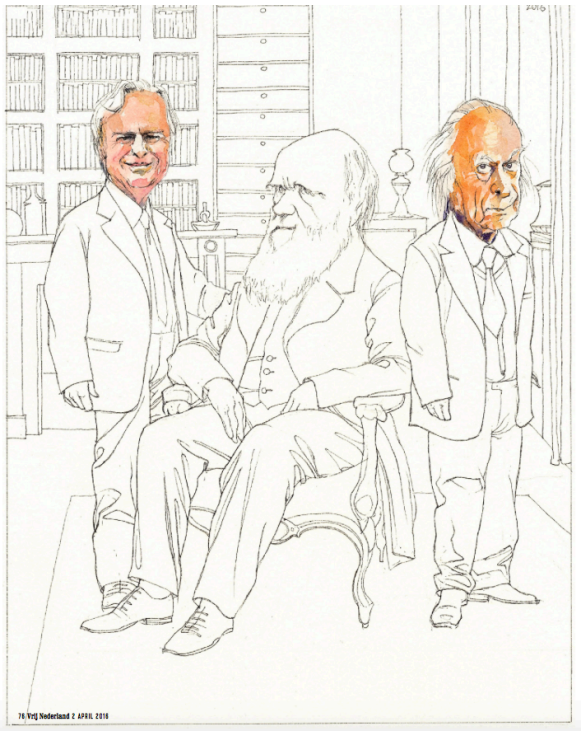
NOBLE versus **DAWKINS**



DNA IS NOT THE PROGRAM OF THE CONCERT OF LIFE

Forty years ago Richard Dawkins' book *The Selfish Gene* launched Neo-Darwinism to the general public. It is still as controversial as it was then. Philosopher Jos de Mul examines the case of Dawkins' biggest critic: Denis Noble.

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IT IS FORTY YEARS since the publication of Richard Dawkins' book *The Selfish Gene*, published in Dutch as *De zelfzuchtige genen. Over evolutie, agressie en eigenbelang*. This text of 'orthodox neo-Darwinism' (Dawkins' own words) sold 1 million copies in more than 25 languages. Probably since Darwin's *On the Origin of Species* (1859) no other biology book has had such a huge influence both on general public understanding of what it is to be human, and on scientific research, not only in the life sciences, but also in the social sciences and humanities. It is a particularly radical book which with its brilliantly worded message - that organisms are not much more than temporary vehicles for their immortal genes – expresses a reductionist, dramatically deterministic and ultimately nihilistic image of humanity.

GREED IS GOOD

Although much imitated, *The Selfish Gene* also evoked much resistance and today the book is still as controversial as it was at its appearance in 1976. While zoologist Matt Ridley in his review of the book in the authoritative journal *Nature* (28-1-2016) argues that Dawkins' gene-centric conception of evolution in the world of biology is now widely accepted and alternative explanations have now lost all importance, in the same journal *Nature* (10-9-2015) the historian of science Nathaniel Comfort argues that Dawkins' book has now been almost completely overtaken by recent developments in genetics. It bothers Comfort that revolutionary developments that have put the axe to Dawkins continue to be neglected by orthodox neo-Darwinism.

What makes the discussion surrounding *The Selfish Gene* fascinating and important is that it is much more than a controversy over competing biological theories. Dawkins' gene-centrism - the idea that the evolution turns exclusively on the reproduction of

selfish genes – also gave the critics of his book a questionable political charge. It would have served not only in the eighties as an ideological justification for 'greed is good Thatcherism', but also contributed to making race realism a socially respectable commonplace in the biological sciences, an idea that, after the horrific genetic experiments of the Nazis had been for many decades absolute taboo. Moreover, *The Selfish Gene* with its emphasis on the blind character of evolution produced fierce criticism from creationists, which Dawkins provoked in books like *The God Delusion* (2006) to implement an increasingly militant atheism. Moreover, that fight with the creationists made Dawkins allergic to criticism of his gene-centric approach by other biologists, which was quickly perceived like a stab in the back.

Now abuses of such criticism by creationists, frequently implying that the theory of evolution as such is suspect, led to evolutionary biologists keeping their criticism of Dawkins' radical neo-Darwinism behind closed doors. In his book *The Music of Life. Biology beyond Genes*, the first edition of which appeared in 2006, almost simultaneously with the thirty-year anniversary edition of *The Selfish Gene*, Noble presents a full frontal attack on Dawkins. His boldness is probably associated with the fact that Noble is a relatively external bystander in the field of genetics and evolutionary theory. Noble is (emeritus) professor of cardiovascular physiology at Oxford University and has gained great fame with computer simulations of the heart. He is considered one of the founders of Systems Biology. A spicy aspect of his work is that the target of his attack was a former student and colleague at Oxford. Dawkins studied biology in the sixties at Balliol College, where five years earlier Noble, whose candidature had already made him a name with publications in *Nature*, was appointed in 1963 to lecturer. Until his retirement in 2008, Dawkins, was professor of Public Understanding of Science also at Oxford University.

EVOLUTION: Lamarck explained the long giraffe neck as a consequence of it being constantly extended.

SIMPLISTIC EXPERIMENT

To understand the purport of the struggle between Noble and Dawkins, we need to place it against the background of the development of modern evolutionary theory. While, under the influence of Christianity until well into the eighteenth century, thinking about nature assumed that biological species have remained unchanged from the time of their creation, the world in the nineteenth century underwent a

fundamental historicizing. While eighteenth-century Linnaeus, to whom we owe the classification of biological species still used today, continued to represent a predominantly static view of the order of nature, the French philosopher Lamarck developed in his *Philosophie Zoologique* the first consistent theory of evolution. The starting point was the idea that all organisms have a life-force that encourages them to increasingly complex organization. Thereby Lamarck assumed that organisms must continually adapt to the circumstances. Organs could be strengthened or disappear and acquired characteristics are transmitted to the next generations. He said the long neck of the giraffe arose from its continually extension to reach the highest leaves. According to Lamarck evolution proceeded by such learning: fast, jerky and targeted. Darwin took the idea of Lamarck, but also developed in his book *On the Origin of Species* a complementary theory of the evolution of life: the theory of natural selection. This theory states that the number of offspring is always larger in nature than the number that mature and reproduce themselves. Reproduction always makes small differences, and Darwinian nature selects the individuals that are best adapted to the changing circumstances. Unlike Lamarckian evolution, Darwinian evolution is very slow, gradual and unfocused.

The popularity of Lamarck's theory was brought to an abrupt end by an equally crude and simplistic experiment by the German biologist August Weismann. For six generations he cut the tails on a large number of mice to test whether this "acquired property" would be passed on to the progeny and when that did not happen he concluded that Lamarck's theory was incorrect. According to him this proved that changes in the body's cells do not exert any influence on the germ cells. This so-called Weisman barrier would become an important source of inspiration for neo-Darwinism.

COPY FLAWS

Neo-Darwinism resulted from the combination of Darwin's theory of natural selection and Mendel's laws of heredity. Although Darwin had observed that offspring always exhibit differences, he could not explain why. Through experiments with growing peas Mendel came out with the theory that there exist hereditary characteristics from discrete units – baptized in 1909 by the Danish botanist Johannsen as 'genes' - the inheritance of which obeys mathematical laws. Population genetics was based on that understanding and provided a mathematical basis for Darwinism during the first half of the twentieth century.

The ideas of the 'modern synthesis', designated as the melding of evolution and genetics, were crowned in 1953 in the discovery of DNA, a macromolecule that is located in each cell nucleus and that in humans consists of no less than three billion nucleotides in four variants as the common building blocks. Each gene consists of specific sequences of these building blocks - as the discoverers thought - were the recipe or program for the genetic characteristics of the organism. When reproducing, the DNA is transmitted to the offspring (which in the case of sexual reproduction creates in each offspring a unique blend of the parental characteristics). The emergence of new properties occurs by occasional copying errors in the reproduction of the genetic material. These mutations play a crucial role in the evolution of life on Earth according to the neo-Darwinists.

In addition to the transfer of genetic traits in the progeny DNA also plays a crucial role in the production of the approximately one hundred thousand different types of proteins that, as building materials, fuel, enzymes, hormones and antibodies, are indispensable for human life. The idea was that each gene encodes one specific protein and a trait. Francis Crick, one of the inventors of the structure of DNA, formulated 'the central dogma' of the neo-Darwinism: that genetic information can be transferred exclusively from DNA to proteins (via an intermediate stage in the form of the substance RNA), but never the other way around. This rule was seen by neo-Darwinists as much under the influence of Weismann and was interpreted as meaning that the characteristics of the organism may be inherited only through the genes, and that the organism or the environment may not themselves make changes to the genome.

This interpretation of Crick's central dogma paved the way for the gene-centric approach of evolution, which, thanks to Dawkins' bestseller *The Selfish Gene* then took enormous flight. Gene-centrism also formed an important source of inspiration for the Human Genome Project (1990-2003). This mapping of all of the genes would not only lead to the prediction of diseases which would be cured, it would mean no less than the deciphering of "the book of life."

NATURE AND NURTURE

The speed with which the human genome was mapped by global collaborative geneticists, is certainly impressive, but the result was disappointing in some ways. That the human genome contains not one hundred thousand genes (as predicted on the basis of the number of different proteins), but rather not much more than twenty thousand, meant not only an affront to the ego of the human species (there are protozoa that have three times as many genes as man!), but also the end of the one gene, one function paradigm. Most genes are involved in networks, often with hundreds or thousands together in these complex networks. The number of possible combinations is so hyper-astronomically large (many times larger than the number of elementary particles in the universe), that the realization took hold that Human Genome Project is not so much the end as marking a very humble beginning of genetic research. What also became clear was that genes are not naturally expressed. They can be switched on and off. The 98.5 percent of DNA that does not consist of genes, which was dismissed rather as evolutionary garbage (junk DNA), also plays a crucial role.

'Post-genomic' research also proved various different assumptions of neo-Darwinism to be untenable. Mutations turn out to be less random than previously assumed. The speed, quantity and location show strong fluctuations. Such forms of 'natural genetic engineering' have been found, for example in the immune system, which can therefore adapt quickly to the constant mutations of viruses that threaten the organism. Such studies also show that genetic change often does not proceed gradually. For example, Barbara McClintock discovered already in 1951 that large pieces of DNA, which often comprise more genes, can be transposed from one location to another on the genome. For the discovery of these 'jumping genes', which had been neglected for a long time under the influence of the neo-Darwinian

paradigm, she was awarded the Nobel Prize in 1983. These discoveries drew attention back to what Lamarck noted as self-organization of the organism. If possible, even more spectacular was the rehabilitation of Lamarck's idea of the inheritance of acquired characteristics in epigenetics (the branch of genetics that studies the impact of inheritance processes originating outside the nucleus). Heredity does not limit itself to DNA, since also behaviours and substances outside the cell nucleus appear to be capable of being fully inheritable. For example, the Chinese research group of Sun in Wuhan showed that when the DNA of a carp is placed in the fertilized but enucleated (DNA removed) egg cell of a goldfish, the result shows hybrid properties of both the carp and the gold fish. And the research of Feig showed that mice that then grew up in a stimulus rich environment a control group performed better on memory tasks than a control group, and the learning effect also persisted in the subsequent generations, even if they do not grow up in a stimulus rich environment. Experiments also showed such Lamarckian learning effects in the little worm *C elegans*, which may persist for a hundred generations.

What these experiments teach us is that the whole distinction between *nature* and *nurture* effects is problematic. It is not so much a question of having 'both a bit', the experiments show that acquired properties (such as Lamarck surmised) can themselves be inherited.

A GROUP OF JAZZ MUSICIANS

What these developments teach us, says Denis Noble in *The Music of Life. Biology Beyond Genes*, is that the gene-centric picture of heredity and evolution that Dawkins outlines with his metaphor of the selfish gene, is at best one-sided. Noble counters his argument with the metaphor of 'the music of life'. Just as you cannot reduce music to the notes on paper, you cannot reduce life to the code of DNA. Music is only possible through a combination of composer, score, musicians, their instruments and the conductor. Similarly, life is only possible through a combination of genes, proteins, tissues, organs and the environment.

Metaphors are not merely ornamental. They focus on specific aspects of reality and so direct the research. In addition, they provide rhetorical ammunition. The music metaphor used by Noble not only allows us to explain the context of the said elements of life, but also to show why Dawkins' reductionist determinism fails.

The whole idea that genes contain the recipe or the program of life is absurd, according to Noble. DNA cannot do anything by itself. We should understand it not so much as a recipe or a program, but rather as a database that is used by the tissues and organs in order to make the proteins which they need. We are not the temporary vehicles of the genes, the genes are rather the forced labourers of the organism.

In addition, Noble sets against Dawkins' reductionism the notion of 'downward causation'. Where Dawkins' arrow of causality proves to have only one direction (from genes via proteins, cells, tissues and organs in the body as a whole), Noble's metaphor focuses on the many feedback mechanisms, including from higher to lower levels in the organism, where the higher levels represent controlling levels of organization. The conductor of the music of life is thereby incidentally, not a specific

body within the organism, but rather the network as a whole. In that respect, an organism is more like a group of jazz musicians playing without a conductor to produce melodious music.

In his discussion of the composer Noble is careful not to end up in creationist waters. The role of the composer is not a creator standing outside or above nature, but the process of evolution itself, noting that the evolution is even “blinder than Beethoven was deaf”. Noble’s metaphor of the music of life may, however, provide an alternative to the deterministic implications of *The Selfish Gene*. As individuals, we are not merely a plaything of the processes occurring in a deep place inside our cells. Thanks to the mechanism of downward causation, we can live our lives as legally competent individuals. Again, there is no all-determining conductor (the autonomous, self-conscious subject which modern philosophers such as Descartes and Kant imagined), but we depend on the interplay of all elements of the network. With broken instruments or organs the music of life will get out of tune or even comes to a stop. But before that, life fortunately also has times when it 'swings from the pan' and fills us with vitality.

Noble offers a powerful antidote to the nihilism of Dawkins. Although Dawkins writes on the last pages of *The Selfish Gene* that man is the only creature to rebel against the selfish genes, how that would be possible in the light of the reductionist determinism which permeates the preceding two hundred pages of his book remains completely unresolved.

That reassuring incantation is not always received by Dawkins' readers. I had to think about it when I read the interview that the well-known Dutch author Joost Zwagerman gave to *HP/De Tijd* four days before his self-chosen death. Referring to a statement by Nietzsche, he says that the thought of suicide for a long time gave him consolation during bad times in his life. But that comforting character completely disappeared when his father undertook an attempt to take his own life. From that moment his life was dominated by the fear that he and his children and future grandchildren would be genetically predisposed to commit suicide. Of course I do not claim that the neo-Darwinian view of man alone drove Zwagerman to suicide. The failure of his marriage, the incurable very discomforting and pain-causing ankylosing spondylitis and recurrent depression will undoubtedly have also played an important role. Again, it is always a combination of elements in life. But the genetic predestination found in books like *The Selfish Gene* seem to me very likely to have played a role.

For those who love life, the aubade that Noble sings in the music of life, offers at least a lot more grip.

Professor of philosophical anthropology Jos de Mul focuses on the impact of new technologies in robotics, neuroscience, visual culture, science and art and their interaction in us as humans.
He wrote the introduction and commentary to the Dutch translation of *De muziek van het leven. Biologie voorbij de genen* by Denis Noble, Amsterdam University Press, 238 pp., € 19.95.
The translator was Tijmen Roozenboom