What is our Real Knowledge about the Human Being
Pontifical Academy of Sciences, *Scripta Varia* 109, Vatican City 2007
www.pas.va/content/dam/accademia/pdf/sv109/sv109-berti.pdf

IS THE DNA SEQUENCE A SUFFICIENT DEFINITION OF HUMAN NATURE? A COMPARISON BETWEEN ARISTOTLE, THOMAS AQUINAS AND JACQUES MARITAIN

ENRICO BERTI

In order to answer this question it might be useful to examine how Aristotle and Thomas Aquinas – i.e. the ancient and medieval philosophers more often associated with the concept of human nature – would have answered it, had they been aware of DNA, and how their most recent interpreters have indeed done so.

As we all know, DNA was discovered in the 1950s by James Watson and Francis Crick, who, also thanks to research carried out by other scientists, managed to describe the structure of deoxyribonucleic acid, one of the two acids which make up the nucleus of the cells. Watson and Crick discovered that DNA molecules are formed of two chains of nucleotides resembling an entwined double helix: when the cell divides, the two helixes separate and two more helixes form attaching to them, in order to rebuild their primitive structure. DNA can thus reproduce without changing its structure, except for occasional errors or mutations. For their discovery, Watson and Crick obtained the Nobel Prize for Medicine in 1962.

The philosophical relevance of this discovery was highlighted a few years later, by Jacques Monod, in his famous book *Chance and Necessity*,[1] but also by an American biologist of German origin, Max Delbrück (1906-1981), who, in turn, won the Nobel Prize for Medicine in 1969 for his research on bacteriophage viruses, with an article about Aristotle ironically entitled 'Aristotle-totle-totle', a play on a well-known German song, which continuously repeats the name Mariandle.[2]

[1] J. Monod, *Le hasard et la nécessité*, Paris 1970.

[2] M. Delbrück, Aristotle-totle-totle, in J. Monod and E. Borek (eds.), *Of microbes and life*, New York-London, Columbia University, 1971, pp. 50-55.

In his article, Delbrück argued that, if a Nobel Prize to the memory of someone existed, it should be awarded to Aristotle for the discovery of the implicit principle of DNA. Indeed, in his biological works, Aristotle maintained that the germ from which the embryo developed, which for him was only the male seed (Aristotle did not have a microscope to see the female ovum), was not a mini-man, as Hippocrates thought, but a formal principle, that is, a 'development plan', a 'programme', containing a certain amount of information (this is Delbrück's translation of the Aristotelic terms *eidos* and *morphê*). This principle acts as a motive cause, transmitting a series of mechanical impulses to the matter, constituted by the menstrual blood provided by the mother, which cause the matter to organise and, in turn, form the various organs, beginning with the heart and ending with the complete individual who appears at the moment of birth.[3]

According to Delbrück, Aristotle's thought in general had been completely misunderstood due to the way in which it re-entered Western culture through the theology of the Christian scholastics (and, earlier still, I add, through the Muslim theology), which created a total barrier of misunderstandings between theologians and scientists, from Thomas Aquinas to today's mystical movements, Catholic, Protestant and linked to LSD (quoting the American scientist). A new look at Aristotle the biologist – concludes Delbrück – can lead to a clearer understanding of the concepts of purpose, truth and revelation, and maybe to something better than the mere coexistence between us, scholars of the natural sciences, and our colleagues of the other faculties.

A significant example of this misunderstanding is the Thomistic doctrine of generation, which was adopted for a long period of time by the Catholic Church and summoned up in recent times by a philosopher, Jacques Maritain, who was not at all ignorant of biological studies, and by a theologian who at the same time was a geneticist, Father Norman Ford. Indeed, in *De generatione animalium*, Aristotle writes that the embryos of animals have, first of all, a vegetative soul, one that also belongs to plants, and then a sensitive one, which makes them animals, because 'It doesn't become in fact simultaneously animal and man, neither animal and horse'.[4] Taking this sentence as a starting point, Thomas Aquinas maintained that the vegetative soul was in potency to the sensitive soul and that

[3] Aristotle, *De generatione animalium*, I 18 and 21-22.
[4] *Ib*., II 3, 736 a 35-b 2.

the latter was in potency to the intellectual soul, 'as it appears in human generation, in which the fetus lives first by plant life, then by animal life, and finally by human life'.[5] And, since Aristotle in a subsequent passage affirmed that 'It remains, then, for the intellect alone so to enter from outside (*thurathen*, literally through the door) and alone to be divine',[6] Thomas immediately thought, as a Christian creationist, of God's creation of the intellectual soul and of its infusion in the embryo only when a matter proportionate to it has been formed, that is, 'that multitude of organs that is necessary for the exercise of his many capabilities' (today we would say the nervous system),[7] and concluded authoritatively: '*Haereticum est dicere quod anima intellectiva traducatur cum semine*'.[8] The heresy in question is the so-called 'traducianism', professed in antiquity by Tertullian arguing against the excessive spiritualism of the gnostics.

Hence, in 1967, apparently ignoring the discovery of DNA, Maritain derived the thesis that St Thomas was an evolutionist too, because he admitted some substantial mutations, though in the development of the embryo and not yet in the evolution of the species, i.e. true forms of generation and corruption, in the sense that, at a certain point, the embryo apparently loses the form that animated it, be it the vegetative soul first or the sensitive soul later, to make room for a higher form, the intellectual soul.[9] And Father Ford, who, on the contrary, surely knew about the discovery of DNA, in his successful book *When did I begin?* (1988), relies on Thomas and Aristotle to defend the thesis supported by the 'Warnock Report', according to which, until the 14th day, the moment in which the 'primitive streak', i.e. the first element of the nervous system, forms within the embryo, the embryo does not yet possess an individuality, because it is made up of totipotent cells and thus can still divide.[10]

In actual fact, Thomas, in his reading of Aristotle, here as elsewhere, was totally conditioned by the Neoplatonic and Augustinian culture that dominated the Middle Ages, to the point of forgetting that, for Aristotle,

[5] Thom. Aq., *Summa Contra Gentiles*, III, 22.

[6] Aristotle, *De gen. an.*, II 3, 736 b 28-29.

[7] Thom. Aq., *Summa Contra Gentiles*, II, 75.

[8] Thom. Aq., *Summa Theol.*, I, q. 118, a 2, c.

[9] J. Maritain, Verso un'idea tomista dell'evoluzione, in Id., *Approches sans entraves*. Scritti di filosofia cristiana, Roma, Città Nuova, 1977, vol. I, pp. 87-153.

[10] N.M. Ford, *When did I begin? Conception of the Human Individual in History, Philosophy and Science*, Cambridge, 1988.

a substance could not have more than one form, not even at a subsequent time, and man possessed a single soul, the intellectual one, which contained within it potentially both the vegetative and the sensitive soul, as a polygon contains within it the square and the triangle, in the sense that, in man, the vegetative faculties develop first (eating and growing), followed by the sensitive ones (perceiving and moving) and finally the intellectual ones (thinking, wanting, etc.), but his soul always remains the same, i.e. the intellectual one.

Indeed Aristotle writes in *De anima*: 'The cases of figure and soul are exactly parallel; for the particulars subsumed under the common name in both cases – figures and living beings – constitute a series, each successive term of which potentially contains its predecessor, e.g. the square the triangle, the sensory power the self-nutritive. Hence we must ask in the case of each order of living things, What is its soul, i.e. What is the soul of plant, animal, man?'.[11] As this passage makes clear, each living being possesses the soul that is proper of its kind and of its species (plant, animal or man), and possesses a single one, because the higher one, although appearing last, contains in potency the inferior ones, that is, it is also the principle of the inferior faculties, which appear first. In the abovementioned passage of *De generatione animalium* Aristotle explicitly makes reference to *De anima*, thus that passage must be interpreted in the light of the latter work, signifying not a succession of different souls within the same being but a successive manifestation of the functions all contained in potency in the higher soul, starting from the inferior ones.

Again in *De generatione animalium* Aristotle says that human embryos have in potency all three souls, vegetative, sensitive and intellectual,[12] which, in the light of the abovementioned passage of *De anima*, cannot be interpreted if not in the sense that they have the intellectual soul, which contains in potency the sensitive and the vegetative ones, and that 'sperm carries the animation principle which, in all intelligent animals, is separate',[13] that is, it can also carry out immaterial functions, such as thought.

The statement 'for the intellect alone so to enter', as proven some time ago by Paul Moraux, a great scholar of Aristotle and of his doctrine of the

[11] Aristotle, *De anima*, II 3, 414 b 28-33.
[12] Aristotle, *De generatione animalium*, II 3, 736 b 8 ss.
[13] *Ib.*, 737 a 5-15.

intellect, does not mirror Aristotle's thought but is part of a dialectic discussion in which Aristotle presents the point of view of the Platonics.[14]

This means, in terms of modern science, that human DNA is present since the beginning in the nucleus of the cells that form the zygote (a cell resulting from the union of the two gametes, male and female), then the morula (composed of four cells), then the blastocyst (a structure made up of more cells) and finally the embryo itself. And the human genome, the group of approximately 25,000 genes that form the chromosomes contained in the zygote, which were entirely mapped at the end of the 1990s, is formed of human DNA, which is different, although minimally (less than 5%), from that of the other animals (for example the chimpanzee, which was mapped even more recently), that is, it already contains the programme of the adult individual who will develop the sensitive and the intellectual faculties, as well as the vegetative ones.

Returning to Aristotle, we can state that biological individuality is determined by form, i.e. by the soul (it is well known that, for Aristotle, the soul is not an independent substance, but is the form, the capacity to live and to carry out a whole series of functions proper of a living organism), which is absolutely individual. This comes not so much from the passage of *De anima* affirming that 'each body seems to have a form of its own',[15] which might also allude to a form that is proper to the entire species, a universal one, but from a famous passage of *Metaphysics* which says that: 'the causes of things in the same species are different, not in species, but in the sense that the causes of different individuals are different, your matter [i.e. your body] and form [i.e. your soul] and moving cause [i.e. your father] being different from mine, while in their universal definition they are the same'.[16] The age-old problem of whether the form for Aristotle is universal, as the

[14] P. Moraux, A propos du "nous thurathen" chez Aristote, in AA.VV., *Autour d'Aristote. Récueil d'études de philosophie ancienne et médiévale offert à Monseigneur A. Mansion*, Louvain, Publications Universitaires de Louvain, 1955, pp. 255-295. To this end I must correct what I wrote in an article on Father Ford's book, that is, Quando esiste l'uomo in potenza? La tesi di Aristotele, in M. Mori (ed.), *Quale statuto per l'embrione umano? Problemi e prospettive*, Milano, Politeia, 1992, pp. 52-58. Ford replied to it in the Italian edition of his book, pp. 309-322, while I returned to the topic in La generazione dell'uomo secondo Aristotele, *Bioetica*, 4, 1999, pp. 590-595. Both articles of mine have now been reprinted in my *Nuovi studi aristotelici, II – Fisica, antropologia e metafisica*, Brescia, Morcelliana, 2005, pp. 143-150 e 151-156.

[15] Aristotle, *De anima*, I 3, 408 a 23-24.

[16] Aristotle, *Metaphysics*, XII 5, 1071 a 27-29.

definition requires, or individual, is solved. As a recent article also stated very well, it is universal in potency, in the sense that, in its essential characteristics, for example the human soul's capability of thinking or speaking, it can exist in all the individuals of the same species, but it is individual in act, in the sense that it always exists in a single individual and could exist even if it were unique in all its species.[17]

In terms of modern science I think we can say that human DNA is the same in all individuals of the human species and different from that of all of the animals, but also that the DNA of each single human individual is different from that of all the others (like fingerprints, for instance). Indeed, DNA analysis is also used today for paternity tests, or to identify the author of a crime or of an action, if he or she has left traces containing DNA cells. This is neither 'biologism' nor an over-emphasization of the biological aspect, an accusation that is addressed to the notion that makes individuality depend on biological identity from sources often involuntarily spiritualistic,[18] because the human being is fundamentally a biological reality, a living being, albeit one that lives a human life. If we should want to reconcile Aristotle with a creationist vision of the soul, we could admit that the intellectual soul was created directly by God and infused in the human zygote at the same time as its conception, because the DNA contained in the nucleus of the zygote (ignored by Aristotle and Thomas) already contains all the information necessary for the development of the nervous system, i.e. of matter, by means of which the intellectual soul operates. Besides, even the supporters of the discontinuity of the embryo's development, that is, of subsequent stages of its development, separated for example by the 'decision' of forming a single individual or two twins, by the formation of the primitive streak or by the activation of the chromosome which determines the gender of the baby, must recognise that these mutations do not take place through an external intervention, therefore they are all already planned or envisaged by the DNA of the zygote. Thus it would appear that the question of whether the DNA sequence is a sufficient definition of human nature should be answered affirmatively.

[17] R.W. Sharples, Some Thoughts on Aristotelian Form: With Special Reference to Metaphysics Z 8, *Science in Context*, 18, 2005, pp. 93-109.

[18] I am referring to the article by C.A. Viano, L'embrione è arrivato tra noi, *Iride*, 9, 1996, pp. 541-553, to which I replied in Sostanza e individuazione, Seconda navigazione. *Annuario di filosofia*, 1998, pp. 143-160.

However, 'human nature' does not yet mean 'human life', because nature is capacity, which Aristotle calls the first act, while life is activity, that is, the second act, the exercise of capacity.

What does 'human' life mean? Aristotle would reply that it means a life lived by means of an intellectual soul, which is specifically identical in all human individuals and specifically different from that of all the other living beings, and is already contained in the embryo, even though only in potency. But this does not mean that human life is determined only by biological identity, i.e. the genome. Again Aristotle theorized the existence of 'character/disposition' (*êthos*), which forms through habit (*ethos*), i.e. the repeated exercise of 'actions' (*praxeis*), which are the fruit of 'choice' (*prohairesis*).[19] The 'good life', living well, the happiness of each human individual, requires first of all forming a good character, a character which is virtuous, which means excellent, perfect ('virtue' in Greek is *aretê*, which means excellence, perfection), throught the exercise of 'ethical virtues', so called because they are proper of character. The 'dianoetic' virtues are thus added to this, such as wisdom (*phronêsis*) and knowledge (*sophia*), which however presuppose a fair society, one founded on justice (ethical virtue) and the possession of friends with which to philosophise, i.e. to make friends (another ethical virtue).

Finally, we should not forget Aristotle's well-known affirmation contained in *Politics*, according to which man (all human beings, be they male and female, free or enslaved) is 'by nature' – today we would say genetically – a political animal, that is to say, made to live in the *polis*, who can reach his fulfilment and 'live well' only in the *polis*.[20] Therefore, human nature is fulfilled in the *polis*, which today we would call 'civilisation' (the Latin word *civilitas* derives from *civilis*, that is belonging to the *civis*, to the citizen), 'culture' (the Greeks would have said *paideia*, which is possible only in the *polis*). Indeed, it is not by chance that, precisely in the Politica, Aristotle declares that 'the nature (*phusis*) of a thing is its end (*telos*). For what each thing is when fully developed, we call its nature, whether we are speaking of a man, a horse, or a family'.[21]

Therefore, how can one reconcile the Aristotelic thesis according to which the soul, which, in the case of living beings is the intellectual soul,

[19] Aristotle, *Nicomachean Etics*, III 4, 1111 b 6.
[20] Aristotle, *Politics*, I 2, 1253 a 2-3.
[21] *Ib.*, 1252 b 32-34.

is transmitted by the father through his sperm, and thus is already present in the embryo from the start, with this other thesis, equally Aristotelic, according to which human nature is only fulfilled in the *polis*? This is possible by recalling the famous Aristotelic doctrine of potency and act. Indeed, Aristotle answers the question 'when is a being a man in potency?' with 'the seed is not yet potentially a man; for it must be deposited in something other than itself and undergo a change. But when through its own motive principle it has already got such and such attributes, in this state it is already potentially a man; while in the former state it needs another motive principle, just as earth is not yet potentially a statue (for it must first change in order to become brass)'.[22] Here the difference is evident between the sperm, which is not yet a man in potency, because in itself it is not yet capable of becoming a man, and the embryo, the seed deposited in the uterus and transformed into an embryo following union with matter (today we would say with the ovum), which instead is explicitly said to be already a man in potency, because, if no external impediments intervene, it is already capable of becoming a man in itself, by its own virtue. But if the embryo is already a man in potency, it must already possess in acto, as 'first act', a form, a set of capabilities, i.e. the intellectual soul, which is proper of the human species, even though it does not yet exercise all its capabilities (which would be, in the language of scholasticism, the 'second act'), but exercises only the vegetative ones.

On the contrary, 'fulfilment' as Martha Nussbaum says a propos of the Aristotelic notion of happiness (*eudaimonia*), is reached by a man who is learned and, why not, happy, a man who has achieved full development and who will thus be able to lead a *flourishing life*.[23]

[22] Aristotle, *Metaphysics*, IX 7, 1049 a 14-18.

[23] M.C. Nussbaum, Nature, Function and Capability: Aristotle on Political Distribution, in G. Patzig (ed.), *Aristoteles' "Politik"*, Göttingen, Vandenhoek & Ruprecht, 19.