

THE NATURAL AND THE ARTIFICIAL (An Attempt at Conceptual Clarification)

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Abstract

The paper aims at a conceptual analysis of the notions of 'natural' and 'artificial' resp. 'artefact'. In the first part a brief historical survey is given to highlight the formation process and the series of modifications these concepts have undergone in their past. The second part scrutinises into how these concepts are embedded into modern frames of scientific and technological reasoning. The author ends up with attempts at defining the two key notions, as well as at showing their importance and indispensability for contemporary philosophy of science, - technology and - ecology.

Keywords: history and philosophy of science, paradigm-change, methodological variance; philosophy of ecology.

For some time now I have been wondering whether an intelligent Martian or Andromedian (from somewhere in the Andromeda nebula), after its arrival on Earth, would be able to distinguish natural from artificial things, whether it would be able to discover an essential difference between a cow and a car. Would it, thereby be able to discover that there are intelligent beings living here and producing artefacts (if production of artificial things counts for the alien as a sign of intelligence at all). Or would its notes on terrestrial zoology contain, besides cats and cows, also such items as cars? Why not? And what about zedonks (the result of artificial crossbreeding of zebras and donkeys). Do cars and zedonks have more in common than cows and zedonks? Are present-day cows that live on a farm in, say, the Netherlands more natural than zedonks but less natural than, say, lions living on the savannah in Africa? Are there degrees of artificiality?

Or, to take a less science-fictional example, the Voyager programme: can we hope that intelligent beings somewhere outside the solar system will be able to find out that the spaceship itself or the metal plate (with engraved schematic drawings of human beings) are artefacts produced by intelligent beings and not by nature? Or again: did the Australian aborigines (those who became notorious for their having developed the so-called

'cargo-cult'), commit an epistemological fallacy by their not distinguishing an airplane from a huge bird, which excreted marvelous goods from its bowels? Was it simply lack of knowledge or a more fundamental problem, namely, lack of epistemological training what caused this result? Was it like not knowing how many moons the planet Saturn has, or not being able to draw the conclusion of an inference?

Let's further ask whether a bird's nest, a spider's web, and a human house would be for our Martian essentially different things, i.e., would count as members of two different meta-kinds, namely, of the natural and of the artificial. But do artefacts form a so-called 'natural kind'? Do they share a bunch of specific properties? Do they have features in common, over and above their being man-made? Answering these questions is especially important for the new field of inquiry concerning Artificial Intelligence.

The Historical Background of the Distinction: the Antique Dichotomy

Plato's contention was that all artefacts (including pieces of art) are imitations of something natural, of something genuine or original. To say that something is 'artificial', for Plato, is to say that the thing seems to be, but really is not, what it looks like. The artificial is the merely apparent; such a thing just shows how something else is.

Artificial flowers are only paper, not flowers at all. Anyone who takes them to be flowers is mistaken, deceived by a semblance, taken in by an illusion. And, being imitations or simulacra, or substitutes, they are less valuable than the genuine things and also have an air of the morally suspicious around them. (By the way, for Plato artefacts are, more precisely, not simply imitations, but imitations of imitations, since – according to the theory of Ideas or Forms – all worldly things are already imitations of their respective Ideas.)

For Aristotle the situation was different. He thought that nature and art (natural and artificial) have nothing in common; they form two different spheres of reality. In consequence of this, the *laws* governing these two kinds of entities differ essentially, and that is why their respective knowledges differ as well. Natural science does not include the know-how of instruments, tools and machines, nor are these latter illuminating or helpful concerning the cognition of natural entities. These are two different *types* of knowledge. Natural things have primary form, while artificial ones have secondary form forced upon them by human agents. According to Aristotle (W. CHARLTON, 1970), natural things 'have in themselves the source of their making', whereas for artificial things 'the source is in something else

and external'. For him the paradigm cases of the artificial are not – as for Plato – artificial flowers, dolls, decoys and statues but, e.g., the wheel, which is not given in nature as a means of transportation. Artefacts are not imitations of something previously given but true inventions; they represent something new, not just an imperfect copy of a prototype.

What Aristotle accentuates is the manmadeness of artefacts as their common distinctive feature. He also lays emphasis upon the distinctness of the two spheres: the natural and the artificial. They are not only ontologically different (primary vs secondary forms) but epistemologically as well (theoretical vs productive knowledge; epistem vs techn), 'he distinguished between 'know-how' (the sort of knowledge which the craftsman and the engineer possess) and what we might call 'know-why' or demonstrative understanding (which the scientist alone possesses). A shipuilder, for instance, knows how to form pieces of wood together so as to make a seaworthy vessel; but he does not have and has no need for, a syllogistic, causal demonstration based on the primary principles of first causes of things. Thus he needs to know that wood, when properly sealed, floats; but he need not be able to show by virtue of what principles and causes wood has this property of buoyancy. By contrast, the scientist is concerned with what Aristotle calls the 'reasoned fact'; until he can show why a thing behaves as it does by tracing its causes back to first principles, he has no scientific knowledge of the thing. (L. LAUDAN, 1983).

The basic dichotomy separating the natural and the artificial for Aristotle runs, essentially, along the line dividing the spontaneous and the intentional. The sphere of human interference, i.e., that of artefacts, is thus sharply separated from that of nature by its being the product of human agency. The two spheres, however, are similar in their being teleologically structured. In contrast to modern conception, it is not the case that natural processes were causal (effected by efficient causes) while artificial ones were teleological (governed by final causes). As is well known, all four Aristotelian causes work in both spheres.

Thus, while there can be no true inventions for Plato, for Aristotle the world of art and craftsmanship is the territory of human ingenuity. The creations of *homo faber* are, however, considered to be much inferior to the workings and products of nature. It is well known how ancient Greek philosophers deprecated the crafts and their products. 'In the *Leges* (Laws) Plato forbids the citizen to exercise a mechanical trade and when he has pointed out to Gorgias how great an interest the state has in the work of the engineer, he does not omit to emphasize that in spite of this the latter does not count in social respects. Nor is Aristotle prepared to admit the artisan as a citizen into the ideal state; and in the *Nichomachian Ethics*

he holds a contemplative life superior to the highest forms of practical activity.' (DIJKSTERHUIS, 1986).

Thus the predicates 'natural' and 'artificial' were value-laden terms for the ancient Greek philosophers. A higher value was ascribed to what was natural, i.e. produced by nature, than to what was artificial, i.e. fabricated by men. Moreover, the term 'natural' had another connotation. It meant something organic, vivid, autonomous and spontaneous, while 'artificial' meant something dead, soulless and, in general, inferior to natural things.

With the advent of Christianity this ancient deprecation is for a long while retained. Some time around the 11th century, however, a formerly neglected characteristic of the Christian God gains emphasis (in contrast to the earlier neo-Platonic conception), namely, that He is the *Creator* of this world, who devised and brought into existence everything in the universe, and who even cares for the maintenance of the world-order. (This idea appears also in one of the famous proofs of God's existence, the 'Quinque Viae' of Thomas Aquinas.) As a result of the Cluny reform, physical labour and craftsmanship regain moral value but their products, the artefacts, seem even further to lack any epistemological value. They are completely uninteresting as objects of knowledge for the Schoolmen, who in other respects prove to be true disciples of Aristotle, namely, in rejecting the method of experimentation (i.e. the deliberate intervention into the natural course of events) as a legitimate means of cognition. The official standpoint of the Church was that experimentation is an illicit activity, an interfering with God's ways, i.e. crossing and perhaps even opposing them. But this, so it was presumed, could be performed only with the help of evil powers. This kind of reasoning can be seen in operation in the famous case of Roger Bacon though, it should be added, his 'scientia experimentalis' lies somewhere in the twilight zone between experimentation proper and 'ars magica', the magic art of producing awesome appearances. (Here is a mixture of the Platonic and the Aristotelian conceptions of producing artefacts.)

The Turn-over of the Hierarchy: The Vision of 'Man the Magus'

Hermeticists, however, who distinguished black magic from white or natural magic (the 'magia naturalis'), did not think that the latter stands in need of any devilish help in order to be performed. They rather took man to be endowed with a divine creative power akin to God's (which was denied to man by orthodoxy). This, then, gives rise to the idea of Man the Magus, who is able to gain insight into the course of nature and thus has the power

to interfere with it in order to generate new things or reorganize old ones. In his desire to anticipate and influence the future, or to 'be Gods Counsell' as Henry Briggs (a 16th c. hermetist mathematician) expressed it, the magus considered his art as creating a universe within, and not inferior to, the one created by God. The main purpose of the magic was to produce tools: mental (symbols, like John Dee's 'monas hieroglyphica' or numerology) as well as physical (like the instruments in the laboratory of the alchemist) in order to achieve further human goals, or in general, to gain command over nature (in Shakespeare's words: 'to husband Nature's riches' - Sonnet XCIV).

The idea of productive knowledge, in contrast to Aristotelian contemplative knowledge, gained ascendancy with the Hermeticists well before Francis Bacon and Descartes. And while a new emphasis was put on man's active intervention into the course of nature, a new vision emerged concerning the relationship of the two spheres: the natural and the artificial. Formerly, in antiquity and scholasticism, they were taken to be merely distinct but not subordinated to each other; the hermeticist, however, saw nature as dominated by and subjected to man the magus and his instruments. The value-hierarchy is thus reversed. Nature becomes inferior to artefacts, the products of the magical arts.

In the concept of magic, however, one can locate the origins of two modern concepts: that of experimentation and that of technology. For the hermeticists they are intertwined and mixed with occult elements as well. Both are forms of human intervention into the natural (i.e. spontaneous) course of things, and both mean an intentional and deliberate rearrangement of events and things. But while for us the goal of technology is just to produce artefacts, that of experimentation is to preserve as much of the natural (though maybe not spontaneous) course of events as possible. Transuran elements, vector bosons, or zedonks, for that matter, are not artefacts in the same sense as motor cars are. The former are merely artificially produced, the end results of experimental processes; they are non-spontaneously generated but otherwise natural things. Modern experimenters do not like, however, the so-called artefacts of experiment (artefacts in the Platonic sense of the term), i.e. the unintended and unpredictable appearances, or side-effects, produced by the experimental situations and measuring instruments themselves. The modern problem is just this: how to avoid mistaking experimental artefacts for natural phenomena predicted by the theory and intended to be observed in the experiment. Think for example, of the notorious cold fusion experiment and its alleged replications - provided they were not merely hoaxes; or of Joseph Weber's highly controversial claim in the early '70s that he had detected gravitational waves by an apparatus he constructed. The problem was that,

as Collins pointed out, 'It was not clear at the outset whether a properly designed experiment should detect gravity waves because their detectability was the very subject of the dispute.' (COLLINS, 1989). The question was in other words, whether what the apparatus allegedly detected were gravitational waves existing independently but detectable only by means of the experimental setup, or some phenomenon, a so-called experimental artefact, produced by the apparatus itself (and its environment). The question is, then: how to demarcate genuine results from spurious claims?

Ian Hacking's counsel, given in his *Representing and Intervening* (HACKING, 1983), is that we can take those results as genuine (as he says: real) and not as experimental artefacts which appear to be invariant under changes of the experimental setup. (This definition, however, is problematic when applied to quantum-mechanical measurements where, it is known, the type of measurable magnitudes varies with the kind of measuring instrument). Notice that invariance serves here as the definitive trait. And experimental manipulability itself serves for Hacking as a means to distinguish theoretical or instrumental artefacts (i.e., non-existent referents of theoretical terms or semblances produced by the apparatus) from natural (in this case: real) things. Hacking originally meant this definition to be of some help in the scientific realism debate.

The Emergence of the Clockwork Universe: Unification of Natural & Artificial

The Aristotelian natural/artificial dichotomy was then finally destroyed and replaced by the real/non-real dichotomy in the 17th c., mainly by F. Bacon and Descartes. Whereas the Aristotelians kept the two respective spheres of cognition (theoretical and practical) separate, taking the latter as having no bearing upon the former, Bacon declared technical know-how a possible source of genuine knowledge claims. Technology – according to Bacon – will be able to promote natural science, because one learns more about nature when it is 'subjected to the trials and vexations the mechanical arts impose upon it than when it is allowed to run its own course' (Bacon, F. quoted: DIJKSTERHUIS, 1986). This is a fundamental change indeed! As Bacon urges, scholars should no longer feel above the mechanical arts and should be open to the knowledge they are apt to provide. It is especially those arts in which natural materials are transformed which are of importance: chemistry, dyeing, brewing, the manufacturing of glass, sugar, gunpowder, etc., or those which presuppose the use of mechanical tools: carpentry, architecture and the manufacture of clocks and mills. This then gave rise to the so-called Baconian sciences, which were

completely alien to the mentality of an Aristotelian, as was pointed out by KUHN (1976).

In this connexion Bacon advocates the compilation of a History of Arts which could form a pendant to, and would stand on a par with, the History of Creatures, i.e. ordinary Natural History. This means that arts and crafts, as well as their material and spiritual products, the artefacts and the know-how, are no longer considered inferior to the natural sciences.

The Aristotelian natural/artificial dichotomy is thus destroyed in the 17th century by Bacon and Descartes. This runs parallel to the process whereby the four Aristotelian types of causes were reduced to only one: the efficient cause. Paolo ROSSI (1982), has convincingly shown how the basic analogy had been reversed by early modern science. Whereas formerly the source of analogy was nature and its target the artefacts, from the seventeenth century it is the artificial sphere which serves as a model for understanding nature. According to Descartes (*Principia Philosophiae*) there is no difference in principle between natural and artificial bodies (machines), only their sizes and proportions differ; while those tubes, springs and wheels which are made by an artisan are big, those produced by nature are tiny and mostly invisible or hard to perceive. The difference is then merely quantitative. Descartes' methodological advice to the scientist is, accordingly, to model natural processes on the analogy of the more easily observable artificial ones (like, e.g., the workings of machines), and to explain the former in terms of the latter. For the Cartesians it began to be conceptually impossible to draw a theoretical line between the natural and the artificial. Hence the abundance of such books as La Mettrie's 'L'homme machine'. God the Creator was likened to a supreme watchmaker and the universe to a huge clockwork full of smaller and bigger wheels, springs and tubes.

Both the natural and the artificial were considered as created (respectively, by a divine and by a human agent), and both seemed to work according to strict laws. Bacon and Descartes laid frequent emphasis on how inseparable truth and utility were. With the conversion of the basic analogy a new ideal of scientific knowledge emerged: that of constructive knowledge as opposed to Aristotelian contemplative knowledge whose goal is intelligibility. According to the Cartesians, only that which can be used for constructing machines is worthy of the name 'knowledge'. Knowledge claims can therefore be justified in general by their experimental and technical import. (Recall that the most important technical term of our epistemology, 'fact', is etymologically derived from the Latin 'Factum', a past participle, meaning something that is made, done or effected.)

The Present Tense of the Problem: Tentative Answers and Further Questions

But now we are back in the 20th century. As far as the natural/artificial distinction is concerned, we are true heirs of the Baconian–Cartesian conception. No wonder, then, that the very possibility of such a conceptual distinction, to the best of my knowledge, has been left unreflected upon by philosophers of science. This problem is a white spot on our epistemological map, not dealt with either positively or negatively in the vast philosophy of science literature. I think, however, that it deserves scrutiny and is worth our philosophical attention. The natural/artificial distinction, affects the problem of natural kinds (recall the question put at the beginning of this paper, i.e. whether ‘artefact’ is a genus, a natural kind-term, like ‘animal’). And if this problem remains unsolved then the distinction between the natural and technical sciences might be blurred. The solution is also badly needed for laying down the theoretical fundamentals for environmental studies and for artificial intelligence research. It is no wonder, however, that the very possibility of such a distinction seems to have disappeared from the field of philosophical inquiry. It seems to be almost or truly a pseudo-question, one which can be put only within the framework of pre-scientific, everyday reasoning but has no theoretical relevance or bearing on matters scientific or technological. The reason for this, I think, is the pervasive reliance on that basic analogy (I mentioned earlier) which is so determinative of our scientific paradigm. Within the Cartesian–Newtonian ideal of science we know how the world is, or the state of affairs within the world, only insofar as we can manipulate them, insofar as we can model them on the analogy of artefacts and instruments already constructed and working. That is, we know nature insofar as it is machine-like, we know that aspect of it which is like our artefacts. Through our paradigmatic glasses we see an artificial nature – however paradoxical that might sound.

What is left for us, under these conditions, to use for a tentative definition of ‘artificial’? With the elaboration of thermodynamics a quasi-definition seems to emerge: those structures are artificial the probability of whose spontaneous coming into being (under their given conditions, in their environment) is extremely low and runs counter to, though is not excluded by, the law of entropy. They, therefore, come into being by the intervention of an intelligent being (a being who is able to think teleologically and has a predictive capacity).

To sum up our historical survey: the only invariant characteristic in the definition of the ‘artificial’ seems to be ‘man-made-ness’. The value attributed to this feature and its ontological as well as epistemological implications varied greatly through the centuries. Thus, it seems, that

'artefact' is not a generic term (not a natural kind term) but rather a 'genetic'-term: in order to apply it correctly, one has to know the genesis of the potential referent of the term, i.e. the history or the antecedent process leading up to its coming into being. It seems that a great deal more complicated problem is to give a non-parochial a definition (i.e. a set of necessary and sufficient criteria) for a distinction between natural and artificial in general, that is, where 'artificial' means: made/produced by any intelligent being whatever provided it is made intentionally. Intentionality, namely, occurs here essentially. Therefore, I think, we can tell whether a given thing is natural or not, insofar as we are able to scrutinize the ways of reasoning of its producer/creator. In other words, insofar as we can recognize it as an intelligent being (able to have intentions). A pretty vicious circle appears here: one can tell whether a thing is artificial once one knows that it was produced by an intelligent being and one can tell whether it was produced by an intelligent being once one knows that it is an artefact produced intentionally. Recall, Stanislaw Lem's science fiction novel the 'His Master's Voice' where the whole plot turns around this point in a really circular way, called 'caroussel' or merry-go-round reasoning by Lem. The question is, as you recall, whether the 'letter' is a natural or artificial thing, i.e. whether there exists a sender or not.

To finish, let me set up a list of different classes of artificiality.

There are two main headings in my classification: under the first I put items which are artificial products and items which are artificially produced but eventually natural. I would put cars under the first heading, while say, domestic cats or farm cows under the second.

The formerly mentioned zedonks and mules, for that matter, belong to a mixed category, along with trimmed trees. In this category both the procedure leading up to the product and the end-result itself are artificial. This is the case with the end-results of the genetic-engineering processes. Let me add a post script. A corollary of the above mentioned modern definition (made with reference to the second law of thermodynamics) is that producing artefacts means a local decrease of entropy (i.e. in a local subsystem of the global terrestrial system). This can be done at the cost of a larger entropy increase somewhere else in the environment of the given subsystem, so that the sum-total of entropy in the end of the productive process be greater than zero.

Would this mean that by mankind's producing more and more complicated artefacts, i.e. highly complex structures, thereby locally decreasing entropy and disorder, by extending the technical sphere, we necessarily produce disorder at the same time in our terrestrial environment? Does technical development inescapably lead to the destruction of the natural order upon the Earth?

I do not claim to have found the answer to this question. My guess is, however, that the answer is a gloomy yes.

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