

# Physics and Magic

Disenchanting Nature<sup>1</sup>

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## Introduction

A widespread view of the natural sciences holds that their historical development was accompanied by a constantly widening gap between them and magic. Originally closely bound up with magic, the sciences are supposed to have distanced themselves from it in a long-drawn-out process, until they attained their present magic-free form.<sup>2</sup> I would like, in this essay, to discuss some arguments in support of this plausible view. To this end, I shall begin with a definition of magical and scientific concepts of nature – a definition appropriate to the considerable length of time from the beginnings of science (which can plausibly be placed in Greek antiquity) to the present day.

One can define as 'magical' a concept of nature which asserts the possibility of gaining knowledge of secret natural forces, and the possibility of man's influencing some of them. These forces are 'secret' in several senses. Their presumed efficacy springs from a hidden, meaningful nexus that comprehends the whole of nature, and is often dependent upon the knowledge of this nexus. Also, one can know of these forces, and in some cases influence them, only in the context of actions not accessible to everybody.<sup>3</sup> This definition by no means covers the whole spectrum of concepts included in the idea of magic, but can be put forward to gain an initial orientation to the relationship between many of the varieties of magic and the sciences.<sup>4</sup> Natural science, in contrast to magic, denies the existence of secret forces. From the scientific standpoint, a force is 'secret' only as long as it remains unknown. Scientific statements about nature may not be founded on assumptions or practices that are restricted to only a small circle of the initiated. Scientific knowledge should be testable under conditions that can be repeated, and it claims unlimited inter-subjective validity.

However, the last century's historiography of science has taught us that the application of such a systematic distinction between magic and science can be very problematic. The magical and the scientific understanding of nature influenced one another so closely that it seems questionable whether a terminological differentiation between them can be sustained. This is, for example, the case with a good deal of physical and chemical research in the late Middle Ages and the Early Modern period. Thus alchemical notions, for example, classifiable as belonging to the sphere of magic, played an important role in the formation of modern scientific theories in these subjects.<sup>5</sup> However, the historically important areas of overlap between science and magic go only some way towards qualifying the thesis

of a steadily widening gap between the two modes of understanding of nature. The links between magic and natural science in medieval and modern alchemy – to stick with the example already mentioned – involved only some aspects of these two lines of research, and were already clearly different from the very close links that had subsisted between these two areas of knowledge in ancient Greece. Besides, they were of short duration.

To exemplify the gap which, over several epochs, widened between the magical and the scientific understanding of nature, I would like to examine two concepts in natural science, both assumed by physics, in historical sequence. My inquiry thereby restricts itself to concepts fundamental to the formation of theory in a scientific discipline, and selects only two themes illustrative of the separation of this science from magic. Physics is suitable for this purpose, because it has functioned as a leading discipline from the beginnings of natural science to the present day, dealing with matter in its various conditions of state and motion and its reciprocations.

The first concept I select is Aristotle's concept of *physis* (φύσις). It was fundamental to the emergence of physics, and set its mark on thought in this field right up to the beginning of the modern period. By means of this central concept of his physics Aristotle distanced himself from earlier magical notions of nature, though he was unable to prevent his concept being invoked by the magic both of the Middle Ages and of the Modern Period. The reason for the continuing ambivalence of the concept *physis* towards magic derives, in my view, essentially from the ambiguity of the contrast thought to subsist between it and art, i.e. *techne* (τέχνη) (section 2). *Physis* and *techne* are, in Aristotle, contrasting terms, and denote two mutually exclusive principles and spheres of reality. They still correspond closely enough to present-day modes of thought in everyday life to be translatable by the words 'nature' and 'art.'<sup>6</sup> (However, as they refer to only two of the meanings contained in the semantic complexes of both terms, they should actually be called 'Aristotelian nature' and 'Aristotelian art.')

To show the result, in history, of this opposition of *physis* to *techne*, I will show how, in the case of alchemy, both its defenders and its critics availed themselves of this opposition (section 3).

The distinctive characteristic of the second concept of nature is negative, consisting in the elimination of the Aristotelian distinction between *physis* and *techne*. The criticism was directed, though by no means exclusively, against arguments which have recourse to Aristotelian physics to support a magical view of nature. Champions of magic asserted that their *techne* of magic perfected *physis* for man's purposes. Against this, the champions of modern thought hold that all technical operations are subject to the laws of nature, and can therefore only modify nature within set limits. I consider Galileo Galilei to be a trail-blazer for this anti-magical position, as well as a co-founder of experimental science with his mechanical and astronomical works (section 4).

With Galileo's rejection of the distinction between *physis* and *techne* my in-

quiry is essentially at an end. As a conclusion I will say something of the relationship of magic to concepts of nature typical of the following period, both in physics and other natural sciences (section 5).

In as much as my investigation confines itself to questions concerning the understanding of nature, I exclude from consideration the contexts in which natural sciences and magic were actually practised. There are to date hardly any analyses dealing with a comparable period and focusing on the practical modification of nature.<sup>7</sup> However different practically oriented investigations may be in other respects from those undertaken from the perspective of the history of ideas, I believe the two kinds of inquiry would come to remarkably similar conclusions as regards the development of the relationship between natural science and magic. For, for one thing, the present-day marginalisation of magic as a means of investigating nature and its almost complete insignificance for natural science is obvious and a fact without historical precedent. For another, the disenchanting of nature that has led to this situation is to a large extent undisputed. It can be described by reference to various factors comprising conceptions and practices, three of which I wish to stress:

- The disenchanting of nature results from a historic process of rationalisation which affects the acquisition and processing of knowledge of nature, accumulates increasing social significance as it goes on, and assumes an understanding of rationality, which is conceived more and more instrumentally.

- It is also among the consequences of an increasing empiricisation of the bases of natural science, by which means the relevance of a universally accepted fund of empirical statements continues to grow.

- Finally, it has been furthered by a progressive mathematisation of the knowledge of nature, which changes the empirical basis into quantified and measurable data to render it calculable and therefore predictable in its future development.<sup>8</sup>

Interpretations of the term 'nature' constitute, to be sure, only one facet of these general tendencies. But their historical extent (over several epochs) allow such interpretations to offer the advantage of a criterion applicable over a long period. It is all the more surprising that in investigations of the relationship between magic and natural science in the history of ideas, a merely incidental importance was attributed to the concept of nature.<sup>9</sup>

### Aristotle's Contrasting of Nature and Art<sup>10</sup>

Aristotle's physics provided the natural sciences with a classical rational foundation that remained dominant until well into the nineteenth century. Aristotelian natural science is characterised by a systematic structure that claims to achieve completeness, general validity, truth.<sup>11</sup> Its object, *physis*, is characterised by the principle of self-movement, claimed, in physics, to be obvious to everybody.<sup>12</sup>

Self-movement means that all natural things have in themselves “a beginning of change and durability, in part related to space, in part to growth and decay, in part to change of condition.”<sup>13</sup>

In contrast to modern science, Aristotle has no concept of a law of nature. Natural processes on earth follow their structural principles only “with regularity.”<sup>14</sup> If, in the sublunary world, what is normally expected does not happen, then some “hindrance” has prevented it.<sup>15</sup> In the context of *physis* as teleologically conceived, hindrances occur either as mistakes or by chance. Mistakes differ from usually expected results, Aristotle argues, adducing freak-births and miraculous appearances as examples.<sup>16</sup> Accidental events differ from what normally happens not in the result, but in the lack of necessary cause. The accidental result has no inner relationship to what happened before.<sup>17</sup> It comes about spontaneously, remains inexplicable and unpredictable. Although Aristotle, in contrast to his predecessors (whom he also calls “magicians”<sup>18</sup>) undertakes a complete rationalisation of knowledge of nature, nevertheless the teleology of his nature leaves blank slots to be filled by accidents and mistakes.

In terms of Aristotle’s physics, human art also represents a divergence from the regularity of nature. In contrast to natural things, those that result from art are not moved by themselves but by something external to them: “On the contrary, a bed, or article of clothing, or whatever other classes of things there may be besides, (in so far as it meets this designation and is an object made by art) has no inner impulse towards alteration.”<sup>19</sup>

The operations of art are located in between the sciences characterised by generalised knowledge – physics being one of them – and experience, which is typified by particular knowledge about individual things.<sup>20</sup>

The relationship between *techne* and *physis* is treated by Aristotle in his physics, where he describes it as imitation and completion. “In general terms, art sometimes completes what nature cannot bring to term, and sometimes emulates nature.”<sup>21</sup> *Techne* as the imitation of *physis* does not imply a reproduction of *physis*; rather, it means that art shares structural principles of processes with nature, *physis* being the source of these.<sup>22</sup> Both these spheres of reality can be investigated by means of the same fundamental conceptual categories (matter-form-deprivation, potentiality, actuality) and explained by the main kinds of causality (impulse to change/movement, matter, form, goal). In this sense therefore the products of art are rationally comprehensible.<sup>23</sup> *Techne* succeeds in completing *physis* when it closes gaps in the teleology of nature for the accomplishment of human intentions.<sup>24</sup> That is, *techne* not only repairs the flaws and coincidences of nature in cases where they run counter to human intentions – it also brings phenomena to pass which cannot be produced by nature. Water flows downhill by nature, but it is sometimes desirable for man that it should flow uphill. Art brings this about by the construction of wells.<sup>25</sup> As the extrapolation of what is already potentially present in *physis*, the completion shows a relationship with

imitation. Thus nature is primary, art is secondary and derived from the primary. But *techne* is also essentially alien to natural processes. This is already expounded in texts ascribed to Aristotle himself, albeit less clearly than in those that probably come from later authors. A good example of this is the *Mechanical Problems*, which shows that the artificial operations carried out against *physis* are unlimited in scope.<sup>26</sup> The completion of *physis* goes beyond *physis* to occupy a sphere of artifice to which *physis*, in its imperfection, is subordinate.

Although the concept of *techne* originating in Aristotle is ambiguous in its relation to *physis*, the post-Aristotelian interpretations of this relation generally take as their starting point a difference between *physis* and *techne* in a way that remained fundamental to medieval and early modern thinking.

### Medieval Alchemy as an Example of the Ambivalence of Aristotelian Physics and Magic

In order to discuss the ambivalent relationship between Aristotelian physics to magic exemplifying it by means of medieval alchemy, I must first clarify whether the magical, alchemical and Aristotelian concepts of nature current at that time are sufficiently related to one another thematically.

I characterised as ‘magical’ an understanding of nature that asserted the possibility of recognising hidden forces immanent in a meaningful nature, and the possibility that some of these might be influenced by man. Many of the thought processes in medieval alchemy meet this definition. Alchemists generally considered themselves as members of secret societies whose thinking was guided by a comprehensive symbolism of nature, and whose goal was the manufacture of the ‘philosopher’s stone.’ In so far as the procedures applied to this end were comparable to the crafts of the artisan, alchemy was considered, in the Middle Ages, to be an “*ars mechanicae*.”<sup>27</sup> In addition, it was often associated with magic by outsiders, as the reason alchemists could influence the hidden forces was thought to be their participation in supernatural forces. The alchemists themselves by no means always considered themselves to be magicians. In particular many of them rejected the classification of their art as demonic, or so-called ‘black magic.’ On the contrary several alchemists considered themselves committed to the contrasting ‘white’ or ‘natural’ magic whose goal was the improvement of human life through the understanding and modification of nature.<sup>28</sup>

Along with Plato’s philosophy of nature and Neo-Platonism, Aristotle’s physics can also be reckoned among the theoretical bases of medieval alchemy. Admittedly no unified and self-consistent alchemical system can be documented for any period.<sup>29</sup> But in the various conceptions, explicit references to Aristotle’s physics can be found nearly everywhere. They range from the individuation principles of matter and form to the doctrine of the elements and the teleological concept of the whole of nature right through to the opposition of *physis* to *techne*.<sup>30</sup>

But Aristotle's physics not only constituted an important point of reference for alchemical ideas. His work was also of decisive authority for those who criticised alchemy. This double function of Aristotle's physics – which played a role also in the divergent evaluations of the relation between *physis* and *techne* – is reflected in the ambivalence of Aristotelian physics to magic.

As a representative author, who, applying Aristotle's thought, rejected alchemy, I would like to name the Persian philosopher Avicenna (approx. 980-1037).<sup>31</sup> His argument, conducted in his work "On the congelation and coagulation of stones" (*"De congelatione et conglutinatione lapidum"*),<sup>32</sup> says that no human art can transform a naturally occurring baser metal into a more valuable and also naturally occurring metal, because, according to Aristotle, artificial and natural objects are essentially different. The reasons brought to bear against this view – and these also appeal to Aristotle – exalt the power of the art of alchemy above that of nature. Thus Albertus Magnus (about 1200-1280) explains the possibility of alchemical transformation of the properties of metals as being the exchange of forms which are compatible with a basic material common to all metals. The *techne* of alchemy is supposed to replace the impure by the purer form. Albertus compares the procedure of the alchemist with that of the art of medicine, which Aristotle, too, had classified as a *techne*. Just as doctors purified the body of a sick patient, so did alchemists purify material to put it into a better condition.<sup>33</sup> While Albertus's justification of alchemy restricts itself to its rather instrumental character, Roger Bacon (about 1214-1292), in his Aristotle-oriented philosophy of the *opus tertium* (1266), elevates that art to the status of a basic science because of its ability to lay bare and to alter nature, arguing that the whole science of medicine and of nature should spring from alchemy.<sup>34</sup>

Further examples of the argument over alchemy could be cited until well into the sixteenth century.<sup>35</sup> Arguments both for and against magical concepts avail themselves of the conceptual ambiguity of the relations between the contrasting notions of *physis* and *techne*. While the idea of *physis* permits the appearance of phenomena which contradict the general run of natural occurrences, the idea of *techne* conceives all technical operations together as a non-natural procedure recognising no natural limits to its ability to change reality. On the other hand, both *physis* and *techne* are subordinated to shared rational principles which explain phenomena – principles that can be adduced against magical concepts.

### Galileo's Elimination of the Aristotelian Opposition of *Techne* to *Physis*

As the opposition of *physis* to *techne* was such a fundamental determinant in medieval and early modern thought, so the process of dealing with and criticising it in physics was correspondingly prolonged. This process can be traced back to the medieval theory of impetus,<sup>36</sup> it determines the foundation of modern mechanics, and does not near its end until the early nineteenth century with the

formulation of the principle of the conservation of energy. The whole process is an argument about basic physical concepts and theories, an argument so important as to provide us with a criterion to distinguish one epoch from another in the history of science. The elimination of the opposition between *physis* and *techne* allowed nature to be investigated by means of technical constructions, without restriction. Technology as an object of natural science first opened the door to the development of the experimental method which led to where science is now. By this method the laws of nature were discovered and/or tested under artificial, repeatable laboratory conditions. Conversely, it became possible to think of nature not only as a model of human art, but to think of nature as actually being a technical construct. Nature became a mechanism, and mechanics was promoted to the status of the leading science. Compared to these innovations, which determined the further development of the natural sciences, the devastating consequences for magic of the elimination of the categorical difference between *physis* and *techne* seem merely an incidental matter. In a world in which man's ability to modify nature is subordinated to generally comprehensible laws, there is no longer any place for secret magical knowledge.

In Galileo, whose work I shall use to exemplify the critique of the Aristotelian opposition of *physis* to *techne* a lack of interest in magical inquiries is already to be seen – inquiries which still dominated the minds of his contemporaries. Alexandre Koyré, the science historian, aptly if with some exaggeration typified the culture of the time as one in which "gloomy superstition was dominant, magic and witchcraft [...] were far more widespread than in the Middle Ages," and "astrology [...] played a far greater role than astronomy."<sup>37</sup> Yet we find Galileo living in this time and free of all enthusiasm for magic. In his work he deals with themes belonging to the wider field of magical concepts only incidentally, and in the context of the mechanical and astronomical topics that interested him.<sup>38</sup> In some places he mentions astrology positively, sometimes using arguments which can be matched in the writings of Johannes Kepler.<sup>39</sup> But his astronomical discoveries and theories do not derive their claim to validity from the assumption of hidden influences emanating from the stars, but from phenomena in the sky that anybody with a telescope can observe. In other sections of his work he distances himself strictly from alchemical interpretations of nature. To discredit the Aristotelian critics of his discoveries and theories, he scorns (in, for example, the "Dialogue Concerning the two Chief World Systems") the search for the 'philosopher's stone' that enjoyed among them such high repute. How ridiculous is their belief that they can find in texts from bygone epochs the secret of making gold. "Nothing is funnier," he writes, than to hear the alchemists' commentaries "on ancient poets."<sup>40</sup>

Galileo wrote no elaborated critique of alchemy or any other related form of magic. His most important contribution to the dispelling of the concepts basic to these procedures was of a practical nature. He practised and propagated technical-experimental research into nature and mathematical models for the results

thus gained. Accordingly, in the discussion of mechanical instruments and their potential for modifying nature, he came to terms with the concepts of *techne* that went back to Aristotle. In the introduction to his early treatise “Mechanics,” 1593, he criticised the belief of the “Mechanici,” that they “can move and raise the heaviest weights with little effort, intending thereby, with their machines, to cheat nature, to some degree.”<sup>41</sup> They deceived themselves concerning the “immutable characteristics” of nature which is such “that no resistance can be overcome by a force weaker than itself is.”<sup>42</sup>

Using simple mechanical devices he showed that the work expended on them did not depend on the procedures used each time, but only on the results attained. Looking back on these investigations, he wrote in a letter to Ciampoli (1625) that through many experiments he had convinced himself that “nature cannot be conquered or deceived by art.”<sup>43</sup>

Galileo had recourse to experiments with technical apparatus and thought experiments relating to these, to help him formulate invariably valid laws of nature which all arts obey as well. His orderly nature knew of no hidden forces whose efficacy revealed itself to initiates alone. The comprehensibility of his physics, achievable for anybody, corresponds to the epistemological status of the technical constructions by means of which natural laws are discovered and/or tested – for the constructions are fully understandable. By becoming part of a generally available technology, natural research parts company with the notion of secret knowledge, which includes magic.

Galileo is only one of the founders of modern science. Others, like Johannes Kepler or Giordano Bruno before him or Isaac Newton after him, attach more importance to magical concepts. The initial restriction of the revolution in physics to research into astronomy and mechanics left room, on the one hand, for various concepts in the philosophy of nature among which the magical systems were to persist. On the other hand the narrower definition of the research areas and methods proper to physics resulted in a specialisation which, in its subsequent development, totally excluded every function of comprehensive world-pictures from the forming of scientific theories.

## Conclusion

Galileo formulated neither an elaborated critique of magical interpretations of nature, nor any alternative to Aristotle’s concept of nature. New and fundamental definitions of nature were not worked out until later, by philosophers like René Descartes, Baruch Spinoza and Gottfried Wilhelm Leibniz, to name only a few important thinkers. Among these, Descartes with his distinction between nature and mind achieved an importance that has remained relevant to discussions of natural philosophy to the present day. Descartes integrates into his concept of nature the whole field of Aristotle’s *techne*, and of his *physis*, too, except for that

part of the human mind which he sees as the mind of a thinking ‘I,’ and which he sets up as an opposite principle to nature. In contrast to mind, nature is, as simply extended substance, completely predictable, mathematically describable, and belongs entirely in the subject-area of mechanics.

A discussion of Descartes’s dualism and the natural philosophies that came after him could show that these, not only in their original substance-theoretical form, but also in tempered-down but still dualistic variants, leave room for magical thought. Within the realm of mind – thought of as completely independent of nature – the belief in the possible existence of extra-sensory forces able also to influence physical things, remains irrefutable. Such magic-related conceptions play, however, no role in Descartes’s scientific reflections, which are not able to include the human mind, opposed as it is to the realm of nature. In Cartesian thought, magic has already been fully excluded from the realm of natural science.

The footholds still left for magical thinking as a result of the opposition between nature and mind do not disappear until the advent of a concept of nature which interprets all manifestations of consciousness and action as natural phenomena. This naturalistic concept, characteristic of present-day research, has gained influence in physics as well. I would like merely to mention here that in the last hundred years physics has lost its role of leading discipline that it had enjoyed ever since antiquity. The completely novel ways of discussing magic scientifically which follow from the naturalistic concept are more important for the relationship between scientific and magical interpretations of nature. These two interpretations no longer oppose one another as two different modes of knowing which relate to one another reciprocally. Rather, the occurrence of magical beliefs becomes a phenomenon to be investigated by science. Thus the relationship between scientific and magical interpretations of nature is turned upside down. The question is no longer whether magic can possibly influence nature, but rather, what sort of natural phenomenon is the belief in magic. What scientific explanation can be found for the fact that people believe in the efficacy of forces – and in the possibility of influencing these – when these forces are, from a scientific point of view, non-existent? The legitimacy of such questions opens a further – and presumably not the last – chapter in the history of the relationship between magical and scientific interpretations of nature.

## Notes

<sup>1</sup> Translated from the German original by John Fowler, Universität Stuttgart.

<sup>2</sup> Examples of this interpretation are, among others, James Frazer and Lynn Thorndike. Also, Jean-Jacques Rousseau: “Indeed, one may consult the annals of the world [...], but one will never find the origins of the sciences to be as one would wish them. Astronomy took its rise from superstition, [...] and natural sciences form idle curiosity” (*Discours sur les sciences et les arts* 45). Friedrich Wilhelm Joseph Schelling: “Mankind’s first relationship with nature was in fact magical” (*Sämtliche Werke*, 2. Abteilung,

vol. 3, 363), and Norbert Elias: "The liberation from the double bind [Doppelbinder] that had held mankind so long on the magical-mythic level of life in the state of nature, could hardly have happened as a short-term event" (*Der Fischer im Mahlstrom* 116). All English versions here by John Fowler.

<sup>3</sup> The qualifications are intended to enable astrology to be included in the concept of magic. The influence of the stars is neither dependent upon the knowledge of their constellations, nor can it be influenced.

<sup>4</sup> For the concept of magic, cf. Kurt Goldammer, *Magie*, Bert Hansen, *Science and the Magic* 484ff., Bronislaw Malinowski, *Magie, Wissenschaft und Religion* 71, Kurt Goldammer, *Der Göttliche Magier und die Magierin: Natur, Religion, Naturmagie und die Anfänge der Naturwissenschaft vom Spätmittelalter bis zur Renaissance* 14ff., Claus Priesner, "Magie."

<sup>5</sup> This insight derives in large measure from Lynn Thorndike, *The History of Magic and Experimental Science* and Frances A. Yates, "The Hermetic Tradition in Renaissance Science." For a criticism, cf. Brian Vickers, "Introduction" 3ff.

<sup>6</sup> Gregor Schiemann, *Natur, Technik, Geist: Kontexte der Natur nach Aristoteles und Descartes in lebensweltlicher und subjektiver Erfahrung*.

<sup>7</sup> The secondary literature on the relationship of natural science to magic is predominantly oriented towards the history of ideas. Cf. Lynn Thorndike, *The History of Magic and Experimental Science*, Bert Hansen, "Science and the Magic," Bronislaw Malinowski, *Magie, Wissenschaft und Religion*, Brian Vickers, *Occult and Scientific Mentalities in the Renaissance*, Jean-François Bergier, *Zwischen Wahn, Glaube und Wissenschaft: Magie, Astrologie und Wissenschaftsgeschichte*, Wayne Shumaker, *Natural Magic and Modern Science*, Richard Kieckhefer, *Magic in the Middle Ages*.

<sup>8</sup> On the process of mathematisation, cf. Eduard Jan Dijksterhuis, *Die Mechanisierung des Weltbildes*. On the concept of quantification and measurement, cf. Gernot Böhme, "Quantifizierung – Metrisierung."

<sup>9</sup> Cf. footnote 7. The importance of the concept "nature" for medieval magic is pointed out by Hansen, *Science and the Magic* 484ff., Goldammer, *Der Göttliche Magier und die Magierin: Natur, Religion, Naturmagie und die Anfänge der Naturwissenschaft vom Spätmittelalter bis zur Renaissance* 8ff., Christa Habiger-Tuczay, *Magie und Magier im Mittelalter* 176. The last two do not deal with the conceptual relation between nature and art or skill, which Newman discusses for alchemy. In Vickers, *Occult and Scientific Mentalities in the Renaissance*, Wayne Shumaker, *Natural Magic and Modern Science* and Richard Kieckhefer, *Magic in the Middle Ages*, the concept is not part of the theme.

<sup>10</sup> 'Art' (*technē*) as in 'art of medicine,' 'art of house-building,' etc.

<sup>11</sup> On the difference between the classical and modern concept of science, cf., in general, Alwin Diemer, *Der Wissenschaftsbegriff in historischem und systematischem Zusammenhang*, and on physics, Gregor Schiemann, "Was heißt moderne Physik?"

<sup>12</sup> "ὡς δ' ἔστιν ἡ φύσις, περιῶσθαι δεικνύναι γελοῖον· φανερόν γάρ οὐ τοιαῦτα τῶν ὄντων ἔστιν πολλά·" "It would be ridiculous to try to prove that there is such a thing as a natural condition. It is obvious that many of the things that exist are of this nature" (Aristotle, *Physics* II 1 193 a 3f.). Quotations from Aristotle are indicated by book, chapter and paragraph according to Bekker's edition.

<sup>13</sup> "τούτων μὲν γὰρ ἕκαστον ἐν ἑαυτῷ ἀρχὴν ἔχει κινήσεως καὶ στάσεως, τὰ μὲν κατὰ τόπον, τὰ δὲ κατ' αὐτοῦ καὶ φύσιν. τὰ δὲ κατ' ἀλλοιωσιν" (Aristotle, *Physics* II 1 192 b 13ff.), cf. corresponding passage in III 1 200 b 12, also VIII 3f., 253 b 5, and 254 b 17. Cf. for what follows, Schiemann, *Natur, Technik, Geist: Kontexte der Natur nach Aristoteles und Descartes in lebensweltlicher und subjektiver Erfahrung*, chapter 1.1.1.

<sup>14</sup> Aristotle, *Physics* II 8 198 b 35f.

<sup>15</sup> *Ibid.* II 8 199 a 10f. and b 17f., IV 8 215 a 23f.

<sup>16</sup> *Ibid.* II 7 197 b 32ff.

<sup>17</sup> *Ibid.* II 8 197 b 19f. and b 36f.

<sup>18</sup> Aristotle, *Metaphysics* XIV 4 1091 b 10.

<sup>19</sup> "κλίνη δὲ καὶ ἰμάτιον, καὶ εἴ τι τοιοῦτον ἄλλο γένος ἐστίν, ἢ μὲν τετύχηκε τῆς κατηγορίας ἐκάστης καὶ ἀδύνατον ἐστὶν ἀπὸ τέχνης, οὐδεμίαν ὁρμὴν ἔχει μεταβολῆς ἔμφυτον" (Aristotle, *Physics* II 2 192 b 16ff.). On Aristotle's opposition of Nature and Art cf. in addition to Schiemann, *Natur, Technik, Geist: Kontexte der Natur nach Aristoteles und Descartes in lebensweltlicher und subjektiver Erfahrung*, also Hans Blumenberg, "Das Verhältnis von Natur und Technik als philosophisches Problem," and Joachim Schummer, "Aristotle on Technology and Nature."

<sup>20</sup> "γίγνεται δὲ τέχνη, ὅταν ἐκ πολλῶν τῆς ἐμπειρίας ἐννοημάτων μία καθόλου γένηται περὶ τῶν ὁμοίων ὑπόληψις." "Art arises when, on the basis of many observations made from experience, a general concept of similar instances develops" (Aristotle, *Metaphysics* I 981 a 5ff.).

<sup>21</sup> "ὄλως δὲ ἡ τέχνη τὰ μὲν ἐπιτελεῖ ἃ ἡ φύσις ἀδύναται ἀπεργάσασθαι, τὰ δὲ μιμεῖται" (Aristotle, *Physics* II 8 199 a 15ff.).

<sup>22</sup> *Ibid.* 2 194 a 21f.

<sup>23</sup> On this view of the standard interpretation of Aristotle, e.g. Michael J. Moravcsik, *What Makes Reality Intelligible?*

<sup>24</sup> Robin Smith, "Filling in Nature's Deficiencies."

<sup>25</sup> Aristotle, *Meteorology* II 1 353 b 27ff.

<sup>26</sup> Cf. Fritz Krafft, *Dynamische und statische Betrachtungsweise in der antiken Mechanik*.

<sup>27</sup> Bernhard Dietrich Haage, *Alchemie im Mittelalter. Ideen und Bilder: Von Zosimos bis Paracelsus* 44ff. Mircea Eliade deals with the medieval and later association of craftsmanship and alchemy in *Schmiede und Alchimisten*. Magic (as distinct from alchemy), along with prophesying the future, was included among the 'forbidden arts.' Cf. also Habiger-Tuczay, *Magie und Magier im Mittelalter* 177, and Goldammer, *Der Göttliche Magier und die Magierin: Natur, Religion, Naturmagie und die Anfänge der Naturwissenschaft vom Spätmittelalter bis zur Renaissance* 14. The closeness of medieval magic to technique has been stressed in Hansen, *Science and the Magic* 495ff. and William Eamon, *Technology as Magic in the Late Middle Ages and the Renaissance* 171-212, and is documented and exemplified by Joachim Schummer in "Aristotle on Technology and Nature" and Habiger-Tuczay in *Magie und Magier im Mittelalter* 184ff.

<sup>28</sup> Claus Priesner, *Magie* 227ff.

<sup>29</sup> Claus Priesner and Karin Figala, *Alchemie: Lexikon einer hermetischen Wissenschaft* 8.

<sup>30</sup> Haage, *Alchemie im Mittelalter. Ideen und Bilder: Von Zosimos bis Paracelsus* 18ff.

<sup>31</sup> In what follows I am indebted to William Newman, "Technology and Alchemical Debate in the late Middle Ages," note 59.

<sup>32</sup> Avicenna, "*De congelatione et conglutinatione lapidum*," Being Sections of the Kitāb al-Shifā," in William Newman, "Technology and Alchemical Debate in the late Middle Ages" 427ff.

<sup>33</sup> Newman, "Technology and Alchemical Debate in the late Middle Ages" 431f., Martha Baldwin, "Albertus Magnus" 21f. and Karl-Heinz Göttert, *Magie: Zur Geschichte des Streits um die magischen Künste unter Philosophen, Theologen, Medizinern, Juristen und Naturwissenschaftlern von der Antike bis zur*

Aufklärung 114f.

<sup>34</sup> Newman, "Technology and Alchemical Debate in the late Middle Ages" 432f.

<sup>35</sup> Cf. the references provided *ibid.*, note 59.

<sup>36</sup> Hans Blumenberg, *Die Genesis der kopernikanischen Welt* 174ff.

<sup>37</sup> Alexandre Koyré, *Galilei: Die Anfänge der neuzeitlichen Wissenschaft* 84 and 82.

<sup>38</sup> One of the texts that deal with a theme belonging to the broader field of magical concepts considers the possible astral influence of the moons of Jupiter (Letter to Biero Dini 1611, in Galileo Galilei, *Le Opere* XI 105-116). Galileo there counters the objection that the moons of Jupiter discovered by him cannot exist, as they don't appear anywhere in astrological practice, and this takes everything into account. Galileo does not contest the basic astrological claim that the stars exert a manifold influence upon earthly affairs. Instead, he adopts the position that all such influences are conveyed by means of light. But the light of Jupiter's moons is so weak that they need not be taken into account in astrological practices – yet could none the less exist (cf. Volker R. Remmert, *Ariadnefäden im Wissenschaftslabyrinth: Studien zu Galilei: Historiographie – Mathematik – Wirkung* 207-209; I follow the account there given.). Galileo's openness *vis à vis* astrology does not contradict his critique of the Aristotelian opposition (of *physis* to *techné*) as that only contested any effective instrumental influencing of nature, which is not claimed by astrology.

<sup>39</sup> Darrel Rutkin, "Celestial Offerings: Astrological Motifs in the Dedicatory Letters of Kepler's *Astronomia Nova* and Galileo's *Sidereus Nuncius*."

<sup>40</sup> Galileo Galilei, *Schriften, Briefe, Dokumente* I 209.

<sup>41</sup> *Ibid.* 68.

<sup>42</sup> *Ibid.*

<sup>43</sup> Letter to Ciampoli of 1625 in Galileo Galilei, *Le Opere* VIII 571 ff., cit. in Stillman Drake, *Galileo at Work* 297ff.

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## The Techno-Magician

A Fascination Around 1900

Robert Stockhammer

I

"Magick," Aleister Crowley decrees, "includes all acts soever. Anything may serve as a Magical weapon; [...] a Magical Operation [...] may be defined as any event in Nature which is brought to pass by Will. We must not exclude potato-growing or banking from our definition." At around 1900 *magic* becomes attractive to the degree that it was impossible to define it by way of a *definitio e contrario*, i.e. by indicating what it was not. Ill-defined or somewhat arbitrarily redefined again and again, the signifier *magic* is less than a *concept*. It is, however, more than simply a *metaphor*, since magical notions of language precisely state the impossibility of distinguishing between metaphorical and literal usages of language. It is more than simply a word since it appears in well-ordered syntactical co-texts and pragmatic con-texts whose rules can be analyzed, and in which it can even be substituted by other words: in many contexts, for instance, it works almost synonymously with 'energy.' Rather than searching for a common denominator of its conflicting definitions, I will therefore point out several conditions for its attractivity and its omnipresence around 1900, addressing *magic* (somewhat arbitrarily in my turn) as a *figure* in a specific *configuration*.

Even a superficial first look reveals that, from 1880 onwards, *magic* begins to play a crucial role in various disciplines. Master disciplines for the study of magic are, of course, the history of religion and anthropology, and one nucleus of its career is formed when these disciplines meet in an analysis of 'primitive religions' – as is the case with Sir Edward Burnett Tylor or Sir James George Frazer. One of the earliest (and certainly one of the most interesting) *Outlines of a General Theory of Magic*, the *Esquisse d'une Théorie générale de la Magie* (1902/03), is the product of a collaboration between a classicist, Henri Hubert, and an anthropologist, Marcel Mauss. Since these studies point out the involvement of our 'own' European tradition with what is called *magic*, they nourish a wide-spread interest in anthropology, as, for instance, in the works of Bronislaw Malinowski, whose Trobriand tetralogy is one life-long effort to come to terms with *magic*. Cultural philosophy and the philosophy of history, from Ernst Cassirer's *Philosophy of Symbolic Forms* to Max Horkheimer and Theodor W. Adorno's *Dialectic of Enlightenment*, will continue to rely on tripartite models of historical evolutions as conceptualised by Frazer, with *magic* as a first stage. The Melanesian word *mana* – introduced into European languages by Max Müller as a synonym for magical power and discussed in detail by Hubert/Mauss – plays a crucial role for all of the

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