2

Wonder, Magic, and Natural Philosophy

The Disenchantment Thesis Revisited

Koen Vermeir

> They say miracles are past, and we have our philosophical persons, to make modern and familiar, things supernatural and causeless. Hence is it that we make trifles of terrors, ensconcing ourselves into seeming knowledge, when we should submit ourselves to an unknown fear.
>
> —William Shakespeare, *All's Well That Ends Well*, II, iii, 1–6.

INTRODUCTION

Early modern magic might be characterized in a paradoxical way as *the science of the wondrous*. This article will be an exploration of this phrase and of its consequences. The central terms in it, such as "magic," "science," and "wonder," have changed considerably and in the early modern period they were understood very differently from today. We will have to look into what exactly these concepts meant and what place they took in the broader intellectual culture of the time.

Wonder is a very complex category, with an intricate history. There was a long, classical tradition of interest in the marvelous, and an increasingly rich vocabulary was developed to classify and describe it.[1] But

1. In Greek, the word for "wonder" was *thauma* and *to thaumaston*, from the word for "to see." The Latin used variations of *mirare* (such as *admiratio*, *admirabile*, *mirabilia*, *miracula*, or *ammiranda*), which had its roots also in the verb "to see." The German *Wunder* is from unknown origin. All of these linguistic roots have left their traces in the English language, and from the fifteenth century onwards, a renewed interest in wonder could be expressed in a subtle taxonomy, including words such as *wonder*, *marvel*,

it was especially the role of the wondrous in society and in intellectual culture that changed radically over time. In most of history, wonders were despised and dismissed as trivialities. In the early modern period, however, wonders suddenly took centre stage in various domains of culture, and they played a crucial role in epistemology and "science."

Until the early modern period, "science" [*scientia*] was about certain, contemplative, and abstract knowledge, and it meant something very different from the laboratory practices we associate it with today. Theology and mathematics were examples of "sciences," because their statements were derived from certain first principles. In natural inquiry, certainty was much more difficult to attain. Aristotelian natural philosophy claimed to be a science and aspired to demonstrate its conclusions deductively from certain premises. As a consequence, however, many more empirical and practical aspects of the study of the natural world could not be part of natural philosophy. It was only in the course of the early modern period that natural particulars, experimentation, and hands on knowledge became accepted as part of natural philosophy.

Before the seventeenth century, "science" was only concerned with universals and the general order of nature. Wonders and marvels were irrelevant in natural philosophy because they were anomalous, contingent phenomena of unknown cause. Therefore, the characterization of magic as the "science" of the wonderful is paradoxical from an Aristotelian perspective. First, a science of marvels is impossible because marvels are unique particulars while science deals with universals and regularities. Second, wonder stops where science and knowledge begin. Nevertheless, there was a general consensus in the early modern period that magic was the 'discipline' that studied and manipulated wonders.

At the time that magic started to disappear as a credible pursuit, the notion of "science" was revalued and it began to include wondrous and particular phenomena. This can make us wonder about the relation between magic, science, and the wondrous. Did science take the wondrous out of the world? Did science reject and replace magic, or did science revalue and incorporate aspects of magic? In this article, we will enquire whether the world was "disenchanted" by science, or whether science was "enchanted" by magic. During a relatively short but crucial time span in European history, roughly between 1600 and 1700, it seems

miracle, *admiration*, and *thaumaturgy* ("wonder making"), as well as *astonishment* ("to turn into a stone") and *bewilderment* ("to become wild").

that it would not be so preposterous or paradoxical to describe magic as "the science of the wondrous." This is the period when the notions of magic, science, and wonder were revalued, when they interacted and started to play new roles in intellectual culture. It is this period with which I will be dealing here.

WONDROUS PHENOMENA

Wonders are extraordinary phenomena. Throughout history, there was some ambiguity however as to whether their unusualness was objective or was only in the experience of the beholder. In the early thirteenth century, the English nobleman Gervase of Tilbury (c.1150–c.1228) outlined three categories of wonderful things: "We embrace things we consider unheard of, first on account of the variation in the course of nature, at which we marvel; then on account of our ignorance of the cause, which is inscrutable to us; and finally on account of our customary experience, which we know differs from others."[2] The first category describes really extraordinary phenomena, in the literal sense that they are outside the ordinary course of nature, such as monstrous births or strange apparitions in the sky. The second category may include more common phenomena that were incomprehensible at the time, because their cause was unknown or unknowable, i.e., the causes are "occult" or "hidden." The best example here is magnetic attraction, which did not really fit into the conceptual framework of Aristotelian natural philosophy and one did not know its cause. The third category is only uncommon in the eye of the beholder, and it signals ignorance or lack of experience. Examples might be exotic species that are unknown in the West, or better known objects that are only new to the ignorant beholder.[3]

2. Gervase of Tilbury, *Otia imperialia*, in *Scriptores rerum Brunsvicensium,* ed. Gottfried Wilhelm Leibniz (Hanover: Nicolaus Foerster, 1707) 960; quoted in Lorraine Daston and Katherine Park, *Wonders and the Order of Nature, 1150–1750* (New York: Zone, 1998) 23.

3. On the history of wonder, see especially Daston and Park, *Wonders and the Order of Nature*; Stuart Clark, *Thinking with Demons: The Idea of Witchcraft in Early Modern Europe* (Oxford: Clarendon, 1997); William E. Burns, *An Age of Wonders: Prodigies, Politics and Providence in England 1657–1727* (Manchester: Manchester University Press, 2002); Mary Baine Campbell, *Wonder & Science: Imagining Worlds in Early Modern Europe* (Ithaca: Cornell University Press, 1999); Charles T. Wolfe, , ed., *Monsters and Philosophy* (Texts in Philosophy 3; London: College Publications, 2005); Zakiva Hanafi, *The Monster in the Machine: Magic, Medicine, and the Marvelous in the Time of the Scientific Revolution* (Durham: Duke University Press, 2000).

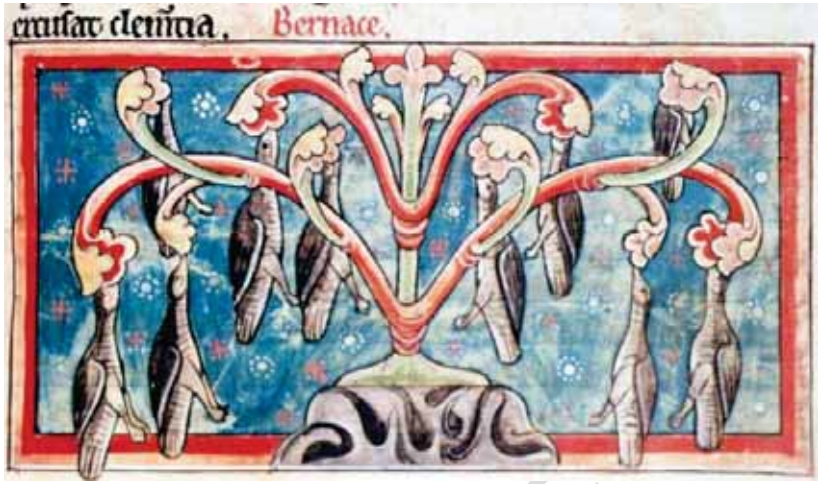
There are many kinds of wondrous phenomena, and what was considered wondrous changed throughout the centuries. There was a canon of wonders, however, which remained relatively stable. One example is monstrous births, which had always been marvels and took pride of place. Especially human monstrous births were poignant and unsettling, because they put into question the nature and limits of humanity. They are uncommon, the causes that generated them are unknown, and they violate the ordinary course of natural generation and reproduction. A second example is the loadstone, which was not yet well known. Although regular and orderly, its mysterious attractions were a continuous cause for wonder, because of their incomprehensible nature.

It was in general not difficult to identify curious phenomena, but the debate evolved around the causes of these phenomena, and the same possibilities were always restated.[4] Of course, many wonders were considered to be of divine origin in one way or another. In the early modern period, marvels such as monsters, comets and strange meteorological phenomena were often still interpreted as portents, for instance, as divine signs that had to be interpreted. Portents were distinct from miracles, however. Portents were uncommon but natural phenomena, which had nevertheless a sign function. They could signify that God was unhappy with the current events, such as with political changes or with the moral degeneration of the people. In contrast, miracles were not natural phenomena but direct supernatural interventions from God. They were not related to worldly events but had an exclusively religious and theological meaning.

Not all wonders came from God. In the Middle Ages and early modern period, nature was not understood as acting according to inviolable laws. Nature, therefore, was not completely regular. Nature was active and ingenious and there was place for plays and sports of nature. Fossils, for instance, were interpreted as just such jokes.[5] It was thought that nature imitated animals in rocks, sometimes changing them into unrecognizable species, just for the sport of it. Occasionally, nature even

4. Koen Vermeir, "The 'Physical Prophet' and the Powers of the Imagination. Part I. A Case-Study on Prophecy, Vapours and the Imagination (1685–1710)," *Studies in History and Philosophy of Science* 35C (2004) 561–91.

5. Paula Findlen, "Jokes of Nature and Jokes of Knowledge: The Playfulness of Scientific Discourse in Early Modern Europe," *Renaissance Quarterly* 43 (1990) 292–331.



Medieval Bestiary—According to medieval bestiaries, barnacle geese, a marvelous species of geese, come from trees that grow over water, straddling the boundary between plant and animal. British Library, Harley MS 4751, Folio 36r.

depicted a religious scene in a stone or in a curious landscape. Nature created her own wonders.

More often, however, wondrous phenomena were the result of demonic action. Demons and devils could not act beyond the laws of nature. Only God could do supernatural deeds. Demons were considered to be like powerful natural magicians who knew all about nature and could manipulate it. Therefore, demons were often held responsible when nature did not act according to its ordinary course. They could change the circumstances, bring in obstacles and manipulate nature in many other ways in order to bring about monsters, strange apparitions and other marvels. If cause and effect were held to be disproportionate—something that could almost serve as a definition of a wondrous phenomenon—people suspected that a demon was involved. People who could do wonderful things were often identified as witches and evil magicians, who were accused for dealing with demons and making contracts with the devil.

The fourth possible origin of wonders was human. Nature herself sometimes acted as a master artist when she played with and transgressed her own rules. On the other hand, artists and artisans tried explicitly

to imitate and enhance nature in their work. This already indicates the flexibility between the natural and the artificial in early modern reflection about wonders. Mankind had always manipulated nature, sometimes to wondrous effect. Artists and craftsmen began to construct objects that went beyond what could be imagined before. Sixteenth- and seventeenth-century cabinets of curiosity or *wunderkammern* were filled with marvels and wonders both natural and artificial. Early modern pleasure gardens were equipped with elaborate fountains in which moving statues spouted water at unsuspecting spectators. Speaking statues gave passersby a fright and, totally confounded, they sometimes interpreted the message as if it were an oracle. Often, artificial wonders would trick the spectator in an illusion, confounding the credible and the incredible.[6]

An excellent example is Athanasius Kircher's (1602–1680) museum at the *Collegio Romano* in Rome, which was filled with such artificial wonders.[7] Kircher describes, for instance, how the ingenious setup of mirrors in his museum can transform spectators in the most unexpected ways. The unwary visitor sees the color of his face changed in that of a liver patient. He suddenly sees a horn growing on his head, or sees his neck craning, making him similar to a real crane. In one of Kircher's instruments, the body of the spectator was reflected with his head substituted by an animal head. In this way, Kircher held a mirror with a moral message to the courtier, who could not discern his mask from his real face anymore. Kircher's museum was a real catoptrical theatre, in which the spectator doubts his own identity and is disguised for himself.[8]

6. On collecting and cabinets of curiosity, see Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Studies in the History of Society and Culture 20; Berkeley: University of California Press, 1994); Barbara M. Benedict, *Curiosity: A Cultural History of Early Modern Inquiry* (Chicago: University of Chicago Press, 2001); Krzysztof Pomian, *Der Ursprung des Museums: Vom Sammeln* (Wagenbach Taschenbuc 227; Berlin: Wagenbach, 1988).

7. On Kircher's museum, see Giorgio de Sepibus, *Romanii Collegii Musaeum Celeberrimum* (Amsterdam, 1678); Gaspar Schott, *Magia Universalis* (Würzburg, 1657); Johannes S. Kestlerus, *Physiologia Kircheriana experimentalis* (Amsterdam, 1680); Filippo Buonanni, *Musæum Kircherianum* (Rome, 1709); see also Michael J. Gorman, "Between the Demonic and the Miraculous: Athanasius Kircher and the Baroque Culture of Machines," in *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher,* ed. Daniel Stolzenberg (Stanford: Stanford University Libraries, 2001) 59–70; and Koen Vermeir, "Athanasius Kircher's Magical Instruments: An Essay on Science, Religion and Applied Metaphysics," *Studies in History and Philosophy of Science* 38 (2007) 363–400.

8. Kircher, *Ars Magna Lucis et Umbrae* (Amsterdam, 1671), 775, 783, 786; Koen

This short discussion of the four kinds of wonders already suggests that the reception of an uncommon phenomenon was always seen from a specific framework. A wondrous phenomenon could be interpreted as a divine intervention, as the result of a playful nature, as the effect of demonic involvement or as human artifice. Sometimes, extra conditions and circumstances could clarify the situation, but usually the same phenomena stood open for widely divergent interpretations. Many wondrous phenomena were therefore highly contested and the subject of fierce controversies. For instance, when on the third of February 1688 a young woman suddenly started to prophesy, convulsed and spoke various languages as if in a trance, she could be interpreted as being a holy prophet, a deluded hypochondriac or the victim of demonic possession. A fourth possibility was also open, that her prophecies and convulsions were artificial and brought about by a certain trick. Which of those four possibilities was the right one was open to vigorous debate, often with strong moral, political or religious consequences. In this case, these prophecies sparked a Huguenot revolution that would rage in the South of France for years.[9]

Contemporaries used categories which had informed similar debates about unusual events for centuries. Godly miracles, the cunning of the devil, hidden natural principles and human artifice were persistently evoked as causes of wondrous phenomena. One could make a further distinction between the *effects*, as real and imaginary. Each of these two could be caused by God, nature, demons (good or evil) or man. If the perceived effect was only *imaginary*, this could be caused by God or his messengers (mystical visions, real prophecy, when the imagination is pure and perfected), nature (the disturbed imagination of an ill person) or demons (which delude the imagination). The last possibility was the involvement of human art (mostly seen as fraud, or as artificial magic), which did not really delude the imagination, but which deceived the spectators with an *apparent* effect.

One kind of imaginary wonders was created in the literary imagination. A work of Francesco Patrizi (1529–1597), *La deca ammirabile* (1587), was an important one for Renaissance literary theory, breaking

Vermeir, "Mirror, Mirror, on the wall . . . On the Aesthetics and Metaphysics of 17th Century Scientific/Artistic Spectacles," in *Kritische Berichte, Zeitschrift für Kunst- und Kulturwissenschaften* 32:2 (2004b) 27–38.

9. Vermeir, "The 'Physical Prophet' and the Powers of the Imagination. Part I."

with Aristotelian tradition. Patrizi argued strongly in favor of creating wonder as the task of literature. In an expanded taxonomy of wonder, he introduced twelve sources of wonder available to the poet: ignorance, fable, novelty, paradox, augmentation, departure from the usual, the extranatural, the divine, great utility, the very precise, the unexpected, and the sudden. In particular, Patrizi argued against verisimilitude and the imitation of nature, and stated that the maker of the marvelous had a duty to refashion reality. This was in contrast to the Aristotelian stress on credibility, verisimilitude, possibility, necessity and truth.[10]

Patrizi's literary theory attests to the new prominence of wonder in early modernity. Similar ideas were advanced in the other arts, but here not only imagined literary wonders were constructed but also *real* marvels were built. The best known manifestation of early modern wonder is probably the vogue of *wunderkammern*, in which these real artificial wonders were collected. The *wunderkammer* is a sign of the times, and attests to the prominence of wonder, but it also reflected distinctions present in the broader cultural setting. Kircher's museum, for instance, was like a big show, similar to illusionist paintings or baroque theatres excelling in stage machinery, devised to baffle courtiers and dignitaries. I have already related that Athanasius Kircher's artificial marvels sometimes had a moral significance, but more often it represented religious and political messages. It was a museum of wonders for the elite, where the latest techniques and inventions found a place in a Catholic framework, and Kircher played with hidden messages that served to reinforce his religious position. The common man, it was supposed, was prone to superstition. Only the educated gentry were able to enjoy the play and read the hidden messages. Marvellous devices referred to the incapacity of the vulgar and helped constitute a distinct elite epistemic culture.

The third category of wonders discussed by Gervase of Tilbury referred to the ignorance or lack of experience of the beholder. This category of wonder reflects some intellectual elitism, because knowledge of wonders distinguished cognoscenti from the vulgar. Knowledge and wonder went hand in hand. Therefore, collecting marvels and wonders became a sign of social elevation and prestige. This tradition of collecting exploded in the early modern period into a craze of wonders and *wunderkammern*, providing some social standards and distinctions in a

10. Peter Platt, "'Not Before Either Known or Dreamt of': Francesco Patrizi and the Power of Wonder in Renaissance Poetics," *Review of English Studies* 43 (1992) 387–94.

time of social, political and religious instability. The rare and extraordinary was valuable, because it fascinated, but also because it was scarce. Marvels therefore played an important role in a gift culture. Scholars and courtiers aspired for the patronage of the mighty and tried to lure them with gifts: the attribution of a book, a marvelous natural rarity or an exceptional work of art. Galileo even named his new discovery which was one of the greatest wonders of the time, the four moons revolving around Jupiter, after Cosimo II De Medici, as a gift in order to win the Grand Duke's patronage. In order to smoothen international relations, diplomats often exchanged wonders, which attests to the value attributed to them.

The excited activities of collecting and creating wonders had many goals. Besides aiming at the emotion of wonder, combined with pleasure, curiosity or fear, they had important social functions in an early modern court society. Wonders, once presented as gifts to a King or Prince, often ended up in a cathedral or cloister, to evoke awe at the wondrous variety of God's creation. They had also an epistemic significance in that they could hint at new understandings of nature. It was not always clear, however, whether a wondrous effect was natural or whether it was caused by God, the devil, or human artifice.

MAGIC AND WONDER

Magic is a term almost impossible to define, but among early modern writers, there was a broad consensus that magic was the enquiry into the wonderful. The Protestant philosopher and encyclopaedist Johann Heinrich Alsted (1588–1638) wrote, "magic is the art which is concerned with wondrous effects [*apotelesmas*], commonly known as incredible."[11] The Jesuit scholar Gaspar Schott (1608–1666) for his part defined magic as "whatever is marvellous and goes beyond the sense and comprehension of the common man."[12] Of course, such a 'definition' cannot be taken as comprising necessary and sufficient conditions. Some of the alternative descriptions of magic were more specific, or singled out one

11. Johann H. Alsted, *Encyclopaedia*, 7 vols. in 4 bks. (Stuttgart: Frommann-Holzboog, 1989; reprint of original edition of 1630) 4:2267: "Magia est ars occupata circa apotelesmata mirabilia, & vulgo incredibilia."

12. Gaspar Schott, *Magia universalis naturae et artis* (Würzburg: 1657–1659) 1:18. See also Norbert Henrichs, "Scientia Magica," in *Der Wissenshaftsbegriff: Historische und Systematische Untersuchungen*, edited by Alwin Diemer (Meisenheim: Hain, 1970) 30–46, for various early modern and Enlightenment definitions of *magic*.

specific aspect. Francis Bacon (1561–1626), the English statesman and philosopher, favors the operative character of magic, for instance, when he writes that he understands magic "as the science which applies the knowledge of hidden forms to the production of wonderful operations; and by uniting (as they say) actives with passives, displays the wonderful works of nature."[13] This operativeness is not an essential characteristic, however, and the occult philosopher Agrippa von Nettesheim (1486–1535) also stresses the contemplative potentials of magic, making it akin to mysticism: "Magick is a faculty of wonderfull vertue, full of most high mysteries, containing the most profound Contemplation of most secret things."[14] What binds these different definitions of magic together is the stress on the wonderful, and it has preserved these connotations until the present day, together with related words like magical, fascination, enchanted, and bewitched.

In early modern Europe, scholars and intellectuals relegated magic to the domain outside science and outside religion, which dealt with the ordinary course of nature and with supernatural events respectively. Magic belonged to the realm of the *preternatural*, i.e., of the wonderful but not supernatural. This was one of the early modern epistemic categories that guided the understanding of phenomena. According to traditional scholasticism, magic comprised what was excluded by supernatural and "regular" phenomena. The supernatural was a strictly defined category that described God and God's actions in the world (like miracles), but excluded the actions of demons and spirits, since these could not do anything beyond the course of nature. The sciences, on the other hand, conceptualized the regular workings of nature along Aristotelian lines by means of manifest qualities. Everything that was inexplicable in this way,

13. See Francis Bacon, *De augmentis scientiarum*, in *The Works*, 14 vols., edited by James Spedding et al. (London: Longman, 1857–1874), 4:366–67.

14. See Heinrich C. Agrippa, *Three Books of Occult Philosophy,* edited by Donald Tyson, translated by James Freake (St. Paul, MN: Llewellyn, 1998/15311) I, 2. The quotation continues: "together with the nature, power, quality, substance, and vertues thereof, as also the knowledge of whole nature, and it doth instruct us concerning the differing, and agreement of things amongst themselves, whence it produceth its wonderfull effects, by uniting the vertues of things through the application of them one to the other, and to their inferior sutable subjects, joyning and knitting them together thoroughly by the powers, and vertues of the superior Bodies." Operativeness is often part of magic, but is not a necessary condition. Other traditions stressing the contemplative and mystical nature of magic are Hermeticism and Lullism. See also chapter 1 above, by Elisabeth Blum and Paul Richard Blum.

The magician Zoroaster performing demonic magic, in a manuscript from 1425. Add. MS 39844, f.51.

like magnetism and all kinds of particular virtues of plants and metals, was explained by reference to "*occult*" or "hidden" qualities. Such qualities could not be generalized, and this is why, according to Aristotle and the scholastic philosophy, they could not be part of a real *scientia*. These occult virtues, often specific to a particular substance, were studied in "magic" instead. (This professed lack of generalization already explains the strong empirical tendencies in magic.) The traditional scholarly canon thus "defined" magic in opposition to science and religion, which proved to be crucial for the history of magic in the West.[15]

15. On the preternatural, see Daston and Park, *Wonders and the Order of Nature*; Clark, *Thinking with Demons*; Daston, "Preternatural Philosophy," in *Biographies of Scientific Objects*, edited by Lorraine Daston (Chicago: University of Chicago Press. 2000) 15–41.

The four different ways of explaining wondrous phenomena were reflected in a common classification of magic into four kinds. It was widely agreed that God (directly or by means of the angels), demons, nature or humans were the possible causes of any marvel.[16] Different groups of people, theologians, natural philosophers, legal experts, physicians, gentlemen, and others, had specific preferences as regards these explanatory categories. Nevertheless, this distinction in four categories was a standard cognitive tool for all of them, and taken together these categories exhausted the possible causes that contemporaries could conceive of. Except for a direct intervention by God, which would be a supernatural event, contemporaries considered and negotiated the possible distinct kinds of magic related to these causal categories, i.e., angelic magic, demonic magic, artificial magic, and natural magic respectively.

I should add the caveat that the four explanatory categories that could be invoked, i.e., good spiritual entities (God and angels), demons, nature or humans, were usually underdetermined by the specific phenomena. The example of the young woman prophet already showed that the difference between divine, demonic, natural and artificial marvelous phenomena was often very hard to make in practice. Most characteristics of such phenomena could be interpreted in various ways. Different factions (physicians, theologians, magicians) had other ideas about what criteria were relevant for interpreting them. Marvelous phenomena assumed a different shape—e.g., as prophecy, madness, possession or politically inspired fraud—depending on who is looking. Therefore, the different kinds of magic are impossible to relate to specific practices or phenomena.

Angelic magic or 'theurgy,' propounded and practiced by Giovanni Pico della Mirandola, Agrippa von Nettesheim, and John Dee amongst others,[17] verged on religion, and often involved an ascetic spirituality that aimed at a mystical union with God. This kind of magic was very contentious indeed, especially for orthodox religion, which feared new heresies or even an alternative religion. Yet even the magicians admitted

16. See also, e.g., Alsted, *Encyclopaedia*, 4:2267, who classifies miracles "in the broad sense" in these four categories. (Miracles in the broad sense are wonders. In the strict sense, miracles are strictly divine interventions.)

17. For Pico and Agrippa, see the previous chapter by Elisabeth Blum and Paul Richard Blum; for John Dee, see Stephen Clucas, "Enthusiasm and 'Damnable Curiosity': Meric Casaubon and John Dee," in R. J. W. Evans and Alexander Marr, eds., *Curiosity and Wonder from the Renaissance to the Enlightenment* (Aldershot: Ashgate, 2006) 131–48.

that it was very difficult to make sure that only angels instead of demons were involved, and some contemporaries rejected the possibility of angelic magic. That is why the Jesuit demonologist Del Rio (1551–1608), when he classifies magic "under the heading *efficient cause*," only distinguishes between "Natural, Artificial, and Diabolic [magic] because all its effects are to be ascribed to the innate nature of things, or to human agency, or to the malice of an evil spirit."[18]

Artificial magic includes all techniques used to create wondrous effects, and comprises the more spectacular aspects of technology (as opposed to the usual crafts). Also, instruments that created illusions like the magic lantern or stage machinery were part of this tradition. Jugglery and legerdemain (and "fraud") are part of magic caused by human skill, but scholars usually did not include them in the more prestigious category of "artificial magic." Some contemporaries used "mathematical magic" as a synonym for artificial magic, but the former is a more ambiguous term and was sometimes taken to include any kind of magic that involved numbers, such as parts of astrology, parlor games and the Kabbalah. Since human ingenuity works by means of natural objects, many practitioners considered artificial magic to be part of natural magic. Therefore, when we do not consider angelic magic and when artificial magic is seen as part of natural magic, the basic distinction in magic can be reduced to the opposition between the natural and the demonic.

Giambattista Della Porta (1535–1615) writes: "There are two sorts of Magick; the one is infamous, and unhappy, because it has to do with foul Spirits, and consists of incantations and wicked curiosity; and this is called Sorcery; an art which all learned and good men detest . . . The other Magick is natural; which all excellent wise men do admit and embrace, and worship with great applause; neither is there any thing more highly esteemed, or better thought of, by men of learning."[19] Demonic magic works by means of demons. These demons were not "supernatural," but

18. Martin A. Del Rio, *Disquisitionum magicarum libri sex* (Louvain, 1599–1600) I, 2. Apart from his distinction as regards efficient causes, Del Rio also classifies magic in terms of final causes: "It may be divided into (a) 'good magic', provided this be done with good intention and uses lawful methods, something which applies only to Artificial and Natural Magic; and (b) 'evil magic', whose methods and ultimate aim are both depraved. This refers particularly to forbidden magic which is tacit idolatry and a type of superstition." We see here the typical divide between natural and demonic magic as good versus bad.

19. Giambattista Della Porta, *Natural Magick* (London, 1658) bk. 1, ch. 2.

they were considered to know how to manipulate the subtlest aspects of nature. Magicians and witches communicated with the demons by means of strange symbols, incantations or magical objects such as talismans. This kind of magic was known as the black art and was often called necromancy.

In contrast, natural magicians only worked with natural means. No demons, angels or other spiritual beings were involved. They studied nature and made experiments in order to be able to manipulate nature and to create wonderful effects. The different chapters in Porta's book give a nice sample of the diversity of subjects in which natural magic was involved. Porta discusses the generation of animals and plants (showing how living creatures of diverse kinds may be mingled and coupled together, that from them, new and yet profitable kinds of living creatures may be generated), the changing of metals, counterfeiting gems, the wonders of the loadstone, ways to beautify women, distillation, perfuming, artificial fires, cookery, fishing, fowling, hunting, invisible writing, optical experiments, static experiments and pneumatic experiments. Porta himself was the most famous proponent of natural magic, and after rejecting other definitions of magic (such as "the practical part of natural Philosophy" or the "science whereby inferior things are made subject to superiors, and earthly subdued to heavenly"), he concludes: "I think Magick is nothing else but the survey of the whole course of Nature."

ENCHANTMENT OR DISENCHANTMENT?

There is a general perception that our culture has changed from the magical worldview of the Middle Ages into a modern world characterized by rationalism and empiricism. The driving force behind this transformation is usually identified as the scientific revolution, which took place in Europe in the seventeenth century. Somewhere on the way, because of the instauration of a scientific worldview, magic and wonder were eliminated from the world. One strong expression of this view is the catchphrase 'the disenchantment of the world,' made famous by Max Weber (1864–1920) in his text, *Wissenschaft als Beruf* (1918).

As it turns out, Weber did not write so much about disenchantment, and he focused especially on the disenchanting effects of the protestant reformation and the increasing importance of calculability. But together with his thesis that the rise of Protestantism was crucial for the origin of

science, a thesis later adapted by Robert Merton (1910–2003), the disenchantment thesis came to represent the idea that the rejection of magic interlocked with the origin of science. The impact of this idea has been enormous, and later commentators have cashed in on this expression in different ways. The oldest versions of the disenchantment thesis coincide with triumphant accounts of the scientific revolution. They recount a story of secularization and naturalization. Nature became divested of spiritual qualities and science and religion were separated.[20]

The historical record, however, shows us a different picture. Important natural philosophers tried to find experimental evidence for spirits, for instance. Robert Boyle (1627–1691), founding father of the Royal Society and one of the most prominent natural philosophers of the seventeenth century was very interested in expanding his natural philosophy to the spirit world. Furthermore, for almost all early modern natural philosophers, natural inquiry and religion went together. For some of them, natural philosophy was even a form of religion. In the recent literature on science and religion, it is persistently stressed that religion often had a very positive influence on the development of science, and even Catholic religious orders such as the Jesuits made many significant scientific contributions. Even the Galileo affair, often used as a case to illustrate the antagonism between religion and science, has been reinterpreted and Galileo's condemnation has been explained as the result of local power politics and personal relations between the main historical actors.[21]

20. Max Weber, "Wissenschaft als Beruf," in *Gesammelte Aufsätze zur Wissenschaftslehre* (Tübingen: Mohr, 1922) 524–55. Originally, the phrase was coined by Schiller. On Weber, see Lawrence Scaff, *Fleeing the Iron Cage* (Berkeley: University of California Press, 1989) esp. 223–41. On disenchantment, see e.g., Ralph Schroeder, "Disenchantment and its discontents," *The Sociological Review* 43(2) (1995) 227–50; Charles Webster, "Paracelsus, Paracelsianism, and the Secularization of the Worldview," *Science in Context* 15(1) (2002) 9–27; Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth- and Seventeenth-century England.* (Harmondsworth: Penguin, 1973). For the impact of Weber's disenchantment thesis, see e.g., John McCormick, "Transcending Weber's categories of Modernity?" *New German Critique* 75 (1998) 133–77; Richard Jenkins, "Disenchantment, Enchantment and Re-Enchantment," *Max Weber Studies* 1 (2000) 11–32. For Merton, see Robert K. Merton, *Science, Technology and Society in Seventeenth-Century England* (New York: Howard Fertig, 1938); Merton, "Puritanism, Pietism and Science," in *Social Theory and Social Structure* (New York: Free Press, 1957) 574–606.

21. Maurice A. Finocchiaro, *The Gallileo Affair: A Documentary History* (Berkeley: University of California Press, 1989); Mario Biagioli, *Galileo Courtier: The Practice of Science in the Culture of Absolutism* (Chicago: University of Chicago Press, 1993).