Comparative Civilizations Review

Volume 10
Number 10 *Civilizations East and West: A
Memorial Volume for Benjamin Nelson*

Article 7

1-1-1985

Nature on Trial: The Case of the Rooster That Laid an Egg

E. V. Walter

Follow this and additional works at: <https://scholarsarchive.byu.edu/ccr>

Recommended Citation

Walter, E. V. (1985) "Nature on Trial: The Case of the Rooster That Laid an Egg," *Comparative Civilizations Review*. Vol. 10 : No. 10 , Article 7.

Available at: <https://scholarsarchive.byu.edu/ccr/vol10/iss10/7>

This Article is brought to you for free and open access by the Journals at BYU ScholarsArchive. It has been accepted for inclusion in Comparative Civilizations Review by an authorized editor of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.

5. Nature on Trial: The Case of the Rooster That Laid an Egg

E. V. Walter

In 1474, a chicken passing for a rooster laid an egg, and was prosecuted by law in the city of Basel. Now, we are inclined to dismiss the event as fowl play, but in those days *lusus naturae* was no joke. The animal was sentenced in a solemn judicial proceeding and condemned to be burned alive “for the heinous and unnatural crime of laying an egg.” The execution took place “with as great solemnity as would have been observed in consigning a heretic to the flames, and was witnessed by an immense crowd of townsmen and peasants.”¹ The same kind of prosecution took place in Switzerland again as late as 1730.

In the case of the Rooster of Basel, the executioner found three more eggs in him, according to a chronicle of the city. A recent historian, E. P. Evans, reporting the case, refused to believe that part of the chronicle, declaring it absurd, and regarding the event “not [as] a freak of nature, but [as] the freak of an excited imagination tainted with superstition.”² Evans knew that eggs presumed to come out of roosters caused panic because people used to believe that cocks’ eggs were used in witchcraft. Moreover, the same egg, according to an ancient folk belief, might produce a dreaded monster known as the basilisk or cockatrice, a malignant, winged reptile with the head of a cock and the tail of a serpent, which destroyed men and things by its breath and its glance.³ Regarding the superstition as absurd, Evans considered it equally absurd to expect eggs from roosters. Like most of us, he assumed that any egg under suspicion could ultimately be traced to a hen.

Yet, neither the history of poultry nor the intimate record of the barnyard will support the dogmatism of Evans. In the winter of 1921–22, the *National Poultry Journal* of London was full of news about a chicken being exhibited in a poultry show at Westminster, which attracted a great

deal of interest. A Buff Orphington with the voice and manners of a hen but with the plumage of a rooster, it was reported to have laid eggs. The truth was obscured because a practical joker kept putting all kinds of eggs of different colors from different breeds into the pen. But a student at the Eyresford Training Centre, overcome by the zeal to know the truth, performed a crucial experiment, which has almost been lost to history. In the January 6, 1922 issue of the *National Poultry Journal*, Mr. H. M. B. Spurr reported his observations. On December 22, a fellow trainee had noticed that the bird in question had laid an egg. On the 24th, Mr. Spurr, who was on trapnesting duty, found the bird in No. 4 nest box, No. 6 pen, at 11:45 a.m. He immediately took possession of the poultry house key, locked the house, and continued this tour of duty. Returning at 12:25, he released the bird, and removed a small but typical Buff Orphington egg. In his own words, as reported in the *National Poultry Journal* of Great Britain, "Seeing is believing, Sir, and although previously doubtful I am now assured . . . that this 'cock of the south' does not lie—it lays."⁴

On this side of the Atlantic, the case of the Rooster of Madison was reported in the *Journal of Heredity* in 1927. The bird had the plumage of a Brown Leghorn cock, but was laying eggs, and was acquired as a curiosity by the Poultry Husbandry Department of the Wisconsin Experiment Station in 1922, the same year that the Buff Orphington was attracting attention in England. To a casual observer, the Wisconsin bird had the full plumage of a rooster, but anyone intimate with poultry would have recognized that the head and body of the bird were rather effeminate. In order to settle the question of egg production conclusively, the bird was put into a padlocked wire cage, with a screen that would not allow eggs to be sneaked into it, in a closed room. An unlaid egg in the oviduct had already been detected, and the following morning, a normal Brown Leghorn egg was found in the cage. Following that, the alleged rooster laid eggs about every other day.⁵

L. J. Cole, a geneticist at the University of Wisconsin, published a picture of the Rooster of Madison, taken on February 17, 1922, together with three of its eggs, arranged from left to right in the order they were laid on February 13, 15, and 17 respectively. Cole concluded that if Evans, writing in 1906, could have seen this picture, he would not have been so ready to doubt the chronicle telling that the executioner cut open the Rooster of Basel in 1474 and "found three more eggs in him." The Rooster of Madison continued to lay regularly over a long period of time.⁶

An explanation may be found in the dynamics of sex expression in poultry. Under certain conditions, a fowl may take on secondary sex characteristics that contradict its reproductive anatomy. Farmers know that sometimes hens exhibit male plumage and other masculine attributes,

and studies have shown that this condition is associated invariably with tumors or some other diseased condition of the ovary. If the ovary is removed, a hen grows male feathers, and the changes that accompany progressive ovarian tumors resemble the sequellae of ovariectomy. Some hens may experience a temporary disturbance of the ovarian function and grow male plumage, but as the ovary returns to normal, they continue to lay eggs. Meanwhile, the bird's dress will be out of harmony with its physiology, and it must wait until the next molt before it looks like a hen once more.

The alleged Rooster of Madison in the spring of 1922 did not fool a certain White Leghorn male. She was mated with that authentic rooster, behaving, in spite of her appearance, like a normal female, and lived happily ever after. The eggs hatched out of that union produced chicks that grew into ordinary barnyard citizens and lived uneventful lives. She recovered the normal plumage of a female in the fall molt of 1922, returned to the existence of an ordinary hen, and disappeared from history.⁷

Cole suggested that such a return to normal, while probably less common than a progressive course of ovarian disease, happened often enough to explain the references to "cocks' eggs" in ancient and medieval times. Contrary to Evans's assumption that the Rooster of Basel was framed, and that the eggs were really produced by some other bird, Cole believed that the accused bird had actually laid those eggs. He concluded that "its guilt lay in looking like a cock when it was in reality a hen."⁸

Let us examine comparatively the social impact of alleged roosters who have thrust upon them the reputation of laying eggs. The Rooster of Madison provokes little more than a chuckle—perhaps appearing as a curiosity in the pages of a newspaper, if the events were to happen today, or possibly inspiring a notice in Ripley's *Believe It Or Not*. A mechanistic explanation drawn from biology calms any disturbance we might feel. In contrast, the Rooster of Basel in the 15th century had gathered an enormous crowd and had generated a wave of fear and excitement. But in traditional China, Joseph Needham tells us, when an apparent rooster laid an egg, the chicken would go unharmed, but the provincial governor or even the emperor might be in serious trouble. He could be impeached and removed from office,⁹ for such a rare and frightening event would be regarded as a reprimand from Heaven. Although one finds numerous accounts of sex reversal in man and animals in Chinese literature, and even enlightened discussions of the phenomena, these occurrences remained prodigies. Seers and diviners pondered their implications for the future and for the affairs of state.¹⁰ Nature and society were expected to remain in a condition of organic harmony, and if the harmony were

disturbed by the appearance of biological anomalies, it was often assumed that the emperor or some other great official was at fault. Needham argues that animal trials were unthinkable in China because the Chinese were never so presumptuous as to pretend to know what God had in mind for delinquent roosters. Besides, the notion of the law of nature as a command that should be enforced was alien to the Chinese.

In Western civilization, Needham reminds us, the laws of nature, in a scientific sense, and natural law, in a juristic sense, shared a common root,¹¹ which had coercive implications. Things and animals and people were commanded to behave according to the rules given by the transcendent legislator, subject to divine sanctions. The Chinese sense of natural order, in contrast, depended on an idea of inevitable cooperation. In Needham's words, "The harmonious cooperation of all beings arose, not from the orders of a superior authority external to themselves, but from the fact that they were all parts in a hierarchy of wholes forming a cosmic pattern, and what they obeyed were the internal dictates of their own natures."¹²

Laws of nature, in the Western sense, Needham suggests, may have reached the limits of usefulness. Western science is abandoning mechanical causation for organic causality in a "great movement of our time towards a rectification of the mechanical Newtonian universe by a better understanding of the meaning of natural organisation."¹³ Modern science is being obliged "to incorporate into its own structure" an organic view of the world that is typically Chinese.¹⁴ Yet, Needham suspects that the old Western view of natural law may have been an essential phase in the rise of modern science. He wonders if "the recognition of . . . statistical regularities and their mathematical expression could have been reached by any other road than that which Western science actually travelled." He concludes with an intriguing question: "Was perhaps the state of mind in which an egg-laying cock could be prosecuted at law necessary in a culture which should later have the property of producing a Kepler?"

I intend to take the question seriously and explore the road that led from the Rooster of Basel to Kepler. It is my way of responding to what Benjamin Nelson called "Needham's Challenge." This program of inquiry seeks to explain, by comparative method, and by differentiating and clarifying specific factors, why modern science developed originally in Western Europe and nowhere else. My own inquiry takes a different turn and searches for the occasions that led up to the spiritual revolution that produced not only modern science, but also what Weber called "the disenchantment of the world." On the way, I have turned up what I believe are some modest clues to the great question posed by Needham's

Challenge as well. Needham tells us, "historically the question remains whether natural science could ever have reached its present state of development without passing through a 'theological' stage."¹⁶ In this paper I have enlarged that observation to understand that the word "theological" includes the term "demonological" as well. I shall go so far as to propose that demonology is a link that fastens, a hyphen that binds the idea of law to the idea of nature, at least until the end of the 17th century.

Because Needham's attention remains with the rational side of natural law, he prefers to neglect the demonic side. But in the minds of the people who executed them, egg-laying cocks were no ordinary lawbreakers. They inspired sacred dread, for they were possessed by evil spirits, their eggs might be used in witchcraft, or they might hatch preternatural monsters. Their moral and religious relationship to the demonic world obliged Christians to try those chickens and execute them. Chinese also believed in demons and bad spirits, but their system of belief differed in crucial ways. Unlike them, Western Christians were urged by a moral imperative to scrutinize nature and to put unusual phenomena on trial.

Until the modern world view made its familiar impact, all the great civilizations experienced nature through a system of perceptions and ideas that is usually called "animism." In this mode of experience, nature was full of spirits, and natural objects endowed with a living principle that also vitalized the human soul. In the most familiar varieties of animism, nature was a society of souls, often including minerals, plants, animals, and humans. The forces of nature, therefore, were understood as personal forces, and spirits held personally responsible for causing natural phenomena and their good or evil consequences. It does not matter if Durkheim is right and totemism was older than animism. Nor does it matter if Marett is right and animism was preceded by "pre-animism." For our purposes, it is enough to recognize that animism was widespread and, one is tempted to say, universal. However, it is also important to recognize that animistic systems differed from one another in important ways, and that these differences had consequences.

Nineteenth-century writers liked to associate animism with primitivity, but that connection loses its meaning if we recognize the varieties of Greek, Roman, Buddhist, Chinese, Christian, Egyptian, Hebrew, Indian, Japanese, Muslim, and Persian animism. The Hastings *Encyclopedia of Religion and Ethics* describes twenty demonological systems, setting "civilized" cheek by jowl with "primitive" forms. Previously, comparative inquiries have tended to stress the common features of animistic thinking. Now I am suggesting that we look at them differentially, and I shall argue that the peculiar features that distinguish Occidental Christian

animism from other systems may have an important bearing on Needham's question about the emergence of modern science in the West.

The history of science is the history of human relationships with nature. Werner Heisenberg writes that "science is but a link in the infinite chain of man's argument with nature," and science "cannot simply speak of nature 'in itself'."¹⁷ He insists, "When we speak of the picture of nature in the exact science of our age, we do not mean a picture of nature so much as a *picture of our relationships with nature*. . . . Science, we find, is now focused on the network of relationships between man and nature, on the framework which makes us as living beings dependent parts of nature, and which we as human beings have simultaneously made the object of our thoughts and actions. Science no longer confronts nature as an objective observer, but sees itself as an actor in this interplay between man and nature."¹⁸ Animistic thinking understood the interplay as a set of moral relationships. As the American Indian writer, Vine DeLoria, observes, when the white man wants to stop polluting the river, he does not stop thinking of the river as a mechanism. In contrast, the traditional Indian asks about his responsibility to the river as a living being. The modern European assumes that moral ideas are not relevant to the workings of inanimate things. He has drawn a boundary and placed the river on the other side of it. The history of the boundary settlement underlying such European assumptions is the subject of this paper. It is the history of the great transition from animism to mechanism.

In every human society, people believe that some unobservable order, personal or impersonal, includes causes and reasons that transcend and explain the phenomena of experience. Nathan Sivin has observed that even though the idea of the Unseen Order does not fit the standard categories of intellectual history, it is one of the greatest of man's imaginative conceptions. As William James observed, "Such is the human ontological imagination, and such is the convincingness of what brings it to birth. Unpicturable beings are realized, and realized with an intensity almost like that of an hallucination. . . . They are as convincing to those who have them as any direct sensible experiences can be, and they are, as a rule, much more convincing than results established by mere logic ever are."¹⁹

The Unseen Order in traditional China was understood by impersonal, abstract concepts, such as *yang* and *yin* and the five elements. It was also filled with personal spirits: ghosts, demons, gods, and so forth. In the world of Chinese medicine, Sivin has shown us, the impersonal abstract concepts belonged to the "great tradition" of China's tiny educated elite. But for vitality, it depended on the "small tradition" of the common folk, "whose world was not only much more intellectually restricted but

full of personal forces, spirits and ghosts, which brought and took away sickness and other visitations of fate. . ." Although the two realms enjoyed a symbiotic relationship, it was always possible, over centuries, to discern the border between "the spiritualistic world view of folk medicine and the abstract speculative cosmology of classical medicine. . ." ²⁰

In the Chinese scheme, the boundaries between ghosts, demons, and gods were fluid, and a single spirit might become all three. The Occidental scheme maintained rigid boundaries, and ghosts, demons, and gods always had distinct identities and did not cross class lines. Another difference was the presence or absence of moral segregation. Max Weber pointed out that the Chinese demonology lacked a principle of radical evil, and that spirits would commit good or evil deeds depending on their circumstances. Both Confucianism and Taoism, the major forms of religious expression in China, "lacked even traces of a satanic force of evil against which the pious Chinese, whether orthodox or heterodox, might have struggled for his salvation." ²¹ In contrast, the Occidental demonology segregated the invisible world into realms of good and evil spirits. Christian dualistic animism imposed certain obligations on religious communities. One of these obligations was to stand guard in the realm of nature, ready to place natural phenomena on trial, testing them for good and evil. From the middle of the 14th century until the 18th century, Europeans tried to control the demonic forces in nature by trials for witchcraft. As Lea wrote, "All destructive elemental disturbances—droughts or flood, tempests or hail-storms, famine or pestilence—were ascribed to witchcraft." ²²

For religious reasons, then, European Christians were obliged to carry out experiments. They could not leave nature alone. These experiments, we shall see, were carried out not in laboratories, but in the courts. Christian dualistic animism inspired a conspiratorial view of the universe, leaving men confronted with the terrors of a vast spiritual underworld bent on ruining them for eternity. The church assumed the responsibility of exorcising the Devil in all his manifestations. It was the province of the courts to cooperate in this spiritual police action against *maleficia*, or evil magical actions, against diabolic agencies, malicious spirits, watchful fiends, and crowds of demons. Both church and judiciary expressed a horror of collaboration with evil spirits, trying to limit the power of demons over mankind by catching their agents *in flagrante delictu*. As Langton observes, "The belief in demons and the belief in witches are but two aspects of the same belief; for the witch is a person through whom the demon chooses to manifest itself." ²³ Studies in comparative demonology will reveal no other animistic system in which law and judicial proceedings play such an important part. Like the trials for witchcraft,

animal trials illustrate the unique and peculiar legalism of Occidental demonology.

Lynn White has shown the importance of the moral and "emotional basis for the objective investigation of nature" in the later Middle Ages.²⁴ He has also observed that modern science, emerging in that period, "was more than the product of a technological impulse: it was one result of a deep-seated mutation in the general attitude towards nature, of the change from a symbiotic-subjective to a naturalistic-objective view of the physical environment."²⁵ Although scientific thought developed apart from the courtroom, the changing moral and emotional relation to nature may be traced in the trials that tested the presence or absence of demons in the behavior of animals as well as humans.

The moral imagination of the West is juridical, and the courts have remained near the center of moral and spiritual life, and never remote from the vital currents of intellectual concern. For centuries, courtroom debates enlarged or defined the boundaries of scientific as well as theological issues. As Coulton observed, "just as legal theories crept into medieval demonology, so did demonology creep into the law-courts."²⁶ The legalistic demonology of the West made the Christian form of dualistic animism different from any other kind.

Before disenchantment, the natural world was not differentiated from the world, and the world was experienced and understood through categories that were not only moral but also theological and demonological. God may have "owned" the world, but the Devil "possessed" it, or at least a good part of it. For the early Christians, the Devil was the prince of this world. However, they also believed, as the Vulgate tells us, that "... *princeps huius mundi iam iudicatus est*" (John 16:11): the prince of this world has already been judged. The case was closed, but, as Tertullian put it in his *Apologia*, written around the beginning of the 3rd century, even though the evil demons had been condemned, it gave them some comfort before their ultimate punishment to act out their malignant dispositions. According to Tertullian, "Their great business is the ruin of mankind" (*Apol.* 22, 26). Sermons, tales, and other pious writings shaped a collective experience of the world that personified danger and evil. Through this literature, people learned to ascribe an uncanny or unusual experience to the Devil. As a medieval historian put it, the Devil "inspires evil thoughts, instigates crimes, and causes any unhappy or immoral happening. It is just as much a matter of course as if one should say to-day, I have a cold, or John stole a ring, or James misbehaved with So-and-So."²⁷

The world was an arena in which God and the Devil made competing claims on human loyalty. Men and women who chose to ally themselves with the Devil were guilty of spiritual treason. That is why witches in the

15th and 16th centuries drew such heavy retribution. In giving aid and comfort to the Eternal Enemy, they had committed high treason or *lèse majesté* against God.

Christian speculation about the world developed a legalistic theory about the relation between God and Satan. The world, lost through sin, had become the Devil's property through right of possession. In order to remain just, God would not injure the Devil or remove him by force. The world must be ransomed by something more valuable than the world, and God exchanged his Son for the world. Christ's death, therefore, bought Humanity back from Satan. Roman thought tended to legal formulations, and this theory, which began in the East, took hold in the West. "The Western church, therefore, took kindly to that view of the Atonement which represented it as the result of a lawsuit between God and the Devil."²⁸ Medieval writers described imaginary dialogues in a cosmic courtroom between God and the Devil. In some of them, God and the Devil divided the real estate of the world. Usually, the Devil claimed the largest expanses, but those turned out to be deserts and arid mountain tops.²⁹ That helped to explain why deserts and wild places were haunted by demons. Sometimes, the Devil went to court to defend his demons, witches, and other associates. Pierre de Lancre, a distinguished magistrate of Bordeaux, who investigated sorcery allegations in the Basque region, wrote a book in 1611. It included an anecdote about a Witch's Sabbath. The Devil had missed several previous Sabbaths, and when he finally reappeared, the witches and warlocks greeted him eagerly and asked where he had been. He replied that he had been in court, pleading their cause against the Savior, and that he had won the case, meaning that they would not be burned.³⁰ In some of the trials, God and the Devil dispute claims to the souls of mankind in a series of legal quibbles. In others, God is the judge, Satan the prosecuting attorney, and the Blessed Virgin the advocate for the defense. In France as in some other European Kingdoms, the queen actually held an important position in the judicial system, and she could be petitioned to intercede for defendants. Terrestrial queens may have inspired the judicial role imagined for the Queen of Heaven.³¹ In a juristic fantasy, *The Trial of Satan*, ascribed to the great writer of Roman Law, Bartolus of Sassoferrato, who revived jurisprudence at Perugia, Satan objected that the Virgin Mary must not be admitted to the bar as an advocate: first, because no woman was eligible to be a barrister, and second, because of her kinship to the Judge. Since the Judge was her son, the hearing would be biased. Mary responded to the objection by warning her son to ignore that shyster, who made quibbling allegations to cause confusion, and she urged him to get on with the case.³²

Legal imagery pervaded medieval ideas about the relation to Satan. In verse and fable, "the Devil is very careful to establish his title to the soul of man by a faultless legal document," in later centuries signed in blood.³³ The Faust legend is the most familiar story of a pact with the Devil, but that was preceded by the story of Theophilus the Penitent.³⁴ Faust was a heroic figure of grand proportions, but Theophilus was a little man, not a gifted scholar in search of universal knowledge, but merely a frustrated bureaucrat. His story could serve as a model for the subtitle of Hannah Arendt's book on Adolph Eichmann: "the banality of evil."

According to the story, which was one of the best-known romances in the Middle Ages, frequently represented not only in folk lore, but also in sculpture and on painted glass, Theophilus was a church administrator in Cilicia around 538, during the reign of Justinian and a few years before the Persian invasion. He was known for his piety, his competence as an administrator, and his liberality to the poor.³⁵ When the post of bishop fell vacant, he was urged by the people as well as the church officials to occupy the office, but he refused out of feelings of humility. Someone else was raised to the seat, and later, hearing false rumors against Theophilus, the new bishop removed the latter from his administrative post. Hurt and brooding, Theophilus made a pact with Satan through a necromancer to get his job back. The pact with the Devil was inscribed on parchment and signed in blood. Subsequently, the bishop restored Theophilus to his old position, and the people cheered. Then, conscience got the best of Theophilus and allowed him no rest. He resolved on a solemn fast, praying in church all night. During his long vigil, the Blessed Virgin appeared one night, listened to his pleas for mercy, and agreed to intercede for him. The next night she reappeared and assured him that Christ had forgiven his sins. He woke with a cry of joy and found on his breast the document that had deeded his soul to the Devil. Without the contract, the Devil held no power over him. The next Sunday, Theophilus confessed in public during the liturgy, and displayed the contract, recovered from the Evil One by the mercy of the Mother of God. The bishop gave him absolution, and presided over the public burning of the document. Theophilus received communion, left the church in a fever, and died three days later.³⁶

Although the story is probably a religious romance, the *Acta Sanctorum* include Theophilus as a saint, honoring him on February 4. The legend was first written in Greek by Eutychian, who claimed to have lived in the house of Theophilus and to write from personal experience of the events. It was translated into Latin by Paul the Deacon in the 8th century, dramatized in the 10th century by Hrosvitha, the illustrious nun of Gandersheim in Saxony, and inspired a number of morality plays,

perhaps ultimately suggesting the Faust theme. The iconography of Theophilus is extensive, and the legend often appears in stone, including two representations in the cathedral of Notre-Dame in Paris.

A detail of the central sculpture of the north transept tympanum of Notre Dame, made around 1250, shows the story in four scenes. The first scene shows Theophilus kneeling, pledging fealty by placing his folded hands between the palms of the Devil. The last scene shows the Virgin wielding a cross to threaten Satan, who crouches before her and surrenders the contract. The earliest image of the Theophilus legend appears in a sculptured relief on the tympanum of a portal in the domed church of Souillac, a Romanesque structure completed around 1130 in southern France.³⁷

The sculptured relief at Souillac appears over an arched portal. Two lower figures flanking the arch are Old Testament representations: Joseph on the left, Isaiah on the right. To the right of Isaiah stands a sculptured column, an intricate *trumeau* of straining, tangled figures. The face of the *trumeau* is covered by interlocking beasts, men, reptiles, and monsters devouring one another. The central scene over the arch represents three episodes in the life of Theophilus. The flanking figures of St. Benedict on the left and St. Peter on the right place the scene in the context of ecclesiastical administration.³⁸

A detail of the central field shows two pairs of figures in the lower register: two representations of the Devil and Theophilus. The images of the Devil show an emaciated body with visible ribs, the hideous head of a monster, and, indeed, the spurs of a cock on the calves of his legs. The feet are different in each scene, and the Devil on the right has the claw of a predatory bird for one foot and a cloven hoof for the other. In the left pair, the Devil and Theophilus are holding the document and drawing up their legal contract. In the right pair, the Devil is grasping the hands of Theophilus between his own, making him his liege man in a ceremonial gesture of feudal homage. In the upper register, the final scene, which transcends the others, the Queen of Heaven and an angel are descending to the sleeping-praying Theophilus, who lies adjacent to the church in which he spent his vigil of forty nights. The Holy Mother is returning the contract, assisted by an angel who has one hand on her shoulder and the other on Theophilus. In all three scenes, the most important images are dominated by legal symbols—the document of the pact and the feudal oath of fealty.

The legalistic imagery of the Middle Ages turned the forces of evil into a vast spiritual underworld, permitted within limits to act in nature on men. The divine purpose was to test the loyalty of men and to strengthen their moral fiber in the crucible of temptation. The essentials

of the theory of nature implied in the cosmology and demonology were spelled out by St. Augustine. Centuries later, the treatises and manuals on witchcraft—Lea lists about forty of them in his materials on the history of witchcraft—may be understood as footnotes to the work of Augustine. The *Malleus Maleficarum*, or “Hammer of Witches,” published around 1486 by the inquisitors, Sprenger and Kramer, provided the model for this literature. The *Malleus*, incidentally, was one of the first books to be printed in pocket editions. Judges and lawyers questioned the accused with their copies of the *Malleus* ready for reference under the table or up their sleeves. Lea writes that the *Malleus* acquired such great authority that it “fastened on European jurisprudence for nearly three centuries the duty of combating the devil and saving mankind from his clutches.”³⁹

During the peak of the witchcraft trials, animals shared some of the burden of persecution.⁴⁰ Pigs suffered the most, since it was thought they were especially vulnerable to demonic possession. The legion of devils that had entered the herd of Gadarene swine in the New Testament story, it was remembered, had said to Jesus, “Send us among the pigs and let us go into them” (Mark 5: 12). Pigs ran freely in the streets of medieval towns and often got into trouble. Besides, animals were often distinguished as “sweet beasts” or “stenchy beasts.” The hart and the hind, panting after the flowing brooks as the soul thirsts for the living God, as the Psalmist said, led the list of sweet beasts. The pig, of course, led the stenchy beasts. Goats and polecats provided other stenchy habitats enjoyed by unclean spirits.

Pigs were often judged for injuring and sometimes killing children. In 1386, a sow of Falaise that had attacked and killed a child was mutilated and then executed in the village square, dressed up as a human being. The expense of the case included a pair of new gloves for the executioner, so that he might come out with clean hands. Even though pigs were rarely shown mercy, in one case youth was a reason for clemency, when in 1457 at Lavegny, a sow and her litter were charged with having murdered and partially devoured a child. The sow was condemned to death, but the piglets were released because of their tender age and because their mother had set them a bad example.⁴¹

An execution without a proper trial could stir a great deal of indignation. In 1576 in Schweinfurt in Franconia, a sow that had mutilated a child was delivered into custody. Without legal authority, the executioner “hanged it publicly to the disgrace and detriment of the city.” The hangman was forced to flee and never dared to return. The case gave rise to the proverbial phrase, “*Schweinfurter Sauhenker*,” meaning “sow hanger from Schweinfurt,” used to characterize a ruffian and vile sort of fellow. As Evans wrote, “It was not the mere killing of the sow, but the

execution without a judicial decision, the insult and contempt of the magistracy and the judicatory by arrogating their functions, that excited the public wrath and official indignation."⁴²

As Needham has shown, the frequency of animal trials followed a curve rising from three recorded instances in the 9th century, to a peak of about sixty in the 16th century, dropping to nine cases in the 19th century. They fall into three types: one, actions against domestic animals for attacking human beings (e.g., the execution of pigs for devouring infants); two, actions against swarms, resulting in anathemas or excommunicatory rituals—a kind of spiritual pesticide; and three, the condemnation of *lusus naturae*: e.g., the laying of eggs by putative roosters.⁴³

The animal trials collected by Evans (1906) account for more than two hundred cases extending over a thousand years. The latest in his record, the case of a dog executed in Switzerland for homicide, took place in 1906, the very year the book went to press. Some celebrated cases were located in Switzerland and France, but the list names a large number of Occidental countries, including Belgium, Denmark, Germany, Italy, Portugal, Russia, Spain, Turkey, England, Scotland, Canada, and the United States.⁴⁴ A whole range of insects and animals were brought to the bar of justice, "including asses, beetles, bloodsuckers, bulls, caterpillars, cockchafers . . . cows, dogs, dolphins, eels, field mice, flies, goats, grasshoppers, horses, locusts, mice, moles, rats, serpents, sheep, slugs, snails, swine, termites, turtledoves, weevils, wolves, worms, and non-descript vermin." The most common defendants were pigs, for reasons I have discussed. The condemned animals were dispatched in various ways, depending on the local forms of punishment. The Russians, for example, continued to use banishment in one or two cases, and at the end of the 17th century, the record shows a billy goat exiled to Siberia.⁴⁵

Karl von Amira, a historian of law writing at the end of the 19th century, insisted on a technical distinction between secular animal punishments for crimes such as homicide, and ecclesiastical animal trials. The trials, he showed, led back to the demonology of the Middle Ages,⁴⁶ and were associated with certain formal adjurations, particularly the *maledictio* and the anathema found in the ritual of excommunication, as well as the more familiar rite of exorcism. These procedures were directed not primarily at the animals on trial, but at the evil spirits believed to inhabit them. The ritual was intended to prevent further devastation of orchards, vineyards, and fields, and to halt the depletion of soil and water by the action of noxious vermin possessed by demons. The effectiveness of the imprecation or interdiction depended on the proper judicial ritual. In other words, these supernatural sanctions were not expected to work without due

process of law. Evans showed, "Before fulminating an excommunication the whole machinery of justice was put into motion in order to establish the guilt of the accused, who were then warned, admonished, and threatened. . . ." ⁴⁷

In the tenth century, the pious Archbishop of Trèves was saying mass in the church of St. Peter when an irreverent swallow dipped and soared over his head. If he enjoyed a halo, it offered no protection against this winged creature, for it defecated on the venerable head, and the holy man transcended his piety to roar an excommunication. From that moment, swallows kept scrupulously out of the building, leaving in peace the worshippers within, and if one of them intruded into the entry, it promptly fell dead upon the pavement. A case still better known is recorded for the 11th century. St. Bernard, preaching in the monastery at Foigny, which he had founded, was tormented by the flies buzzing around his head. He shouted at them, "I excommunicate you!" The flies fell on the floor in heaps so high that shovels were needed to get rid of them. ⁴⁸ The case of the Flies at Foigny became so well known that the only point left open for speculation was the question of how long it took for the flies to experience the impact of the excommunication. The flies had been executed without due process of law, but the chronicler explains that the situation was desperate and no other remedy at hand.

In the early part of the 16th century, Bartholomew Chasseneux, the leading authority on ritual procedures against animals, became one of the most distinguished jurists in France. Starting out as an advocate in Bourgogne, he was elected in 1531 to the rank of counselor in the *Parlement de Paris*, and in the following year appointed to the *Parlement de Provence*, where he held the post of Premier Président, a position equivalent to the rank of Chief Justice. Chasseneux was the author of a wide-ranging work he called *A Catalogue of the Glories of the World*, and he was also known as a commentator of the customary law of Burgundy. A collection of seventy-nine of his principal *consilia* appeared in 1531, ⁴⁹ and the first *Consilium* in this collection became his most celebrated work. It was a lengthy, definitive treatise explaining and justifying the procedures of excommunication against animals and insects. He provided a long list of cases, beginning with the cursing of the serpent in the Garden of Eden, in which anathemas and excommunications had worked against creatures that crawl and creep and fly. This treatise, the *Consilium Primum*, established his eminence as a theorist, but he won his laurels as a barrister from his work in a celebrated trial before the ecclesiastical court of Autun. In that trial, and in similar cases that followed, he made a brilliant reputation defending rats. As Evans put it, "the ingenuity and acumen with which Chasseneux conducted the defence, the legal learning which

he brought to bear on the case, and the eloquence of his plea enlisted the public interest and established his fame as a criminal lawyer and forensic orator."⁵⁰ Lest you think there was nothing extraordinary in a criminal lawyer making a brilliant career defending rats, you must understand that they were four-legged rats.

The rats were being charged with devouring the barley crop in the countryside of Burgundy. The people, complaining that the infestation was intolerable, petitioned the bishop to excommunicate the varmints. The episcopal court, knowing Chasseneux's reputation as an expert on spiritual pesticides, appointed him as defense attorney to the rats. He prepared the case with great skill. It was believed that no excommunication or other adjuration against animals could be effective unless the beasts had been provided with a proper and scrupulous legal defense.

Chasseneux's first maneuver was to challenge the summons. He argued that the rats had a bad name and suffered the disability of having public opinion against them. They were improperly summoned, because they were dispersed all over the countryside, dwelling in numerous villages, and a single summons was insufficient to notify them all. The second citation, then, was read from the pulpits of every parish inhabited by the rats. This proclamation took more time, and at the end of the period assigned, the rats still did not appear. Chasseneux argued that since there were so many rats living in so many places, great preparations were necessary for a mass migration, and this required more time. When the rats still did not appear, he got an additional postponement, and excused the default of his clients on the grounds that their journey was difficult and made hazardous by the presence of their natural enemies, the cats. These mortal foes of the rats, Chasseneux contended, watched all their movements and lay in wait for them at every turn. He showed that a proper summons implied the right of safe conduct, and that if the way were full of peril and without protection, the defendants were justified in not obeying the writ. Finally, he demanded that the plaintiffs—the farmers—be required under bond to prevent their cats from frightening the rats. The plaintiffs demurred, but the case moved from one delay to another. The record does not tell us who won, but it is safe to infer that the rats eventually lost by default, and that ultimately an excommunication was fulminated against them.⁵¹

Throughout the Middle Ages, treatises were written to protest the absurdity of animal trials, most of them criticizing the folly of maledictions, anathemas, and excommunications against pests. Occasionally, a prelate would forbid fulminations against animals without special permission or specific license.⁵² Some Spanish theologians were prone to dismiss the trials as vain and superstitious,⁵³ arguing that insects, being devoid of

reason, cannot comprehend the meaning of prayers and curses launched at them, and since their depredation is caused by their natural appetites, and since they have no free will, they were not guilty of sin. Joseph Needham suggests that the medieval attitude wavered: "Sometimes the field-mice or locusts were considered to be breaking God's laws, and therefore subject to prosecution and conviction by man, while at other times the view prevailed that they had been sent to admonish men to repentance and amendment."⁵⁴

I believe that the medieval attitude was not a single wavering viewpoint, but a triad of contrary positions. One position considered the animals hungry creatures of God, with neither reason nor responsibility, simply following the inclinations given to them by nature. The second position considered them instruments of God, sent to punish a community for some sin committed by the inhabitants. The third position viewed them as the temporary vehicles of demons or as instruments of the Devil. The first two positions implied decent treatment: they were persuaded to stop their devastation and given another place to go. The third required some kind of exorcism, or some kind of powerful intervention. The argument for the prosecution proceeded from the third position. The defense argued from the first or the second, sometimes both.

It was an empirical question in each case to determine if the animals were acting simply as creatures, or as special instruments of God, or as the instruments of evil spirits. Anathemas hurled at the animals were directed inferentially at the Devil or at the demons contained within them. Thomas Aquinas argued that it was either blasphemous or vain to curse beasts if they were agents of God or simply creatures behaving according to instinct. They were properly cursed only if they were agents of Satan and inspired by the powers of hell.⁵⁵

Every animal trial tested natural phenomena to ascertain if they represented divine agency, diabolic agency, or nature working alone. Just as witchcraft cases placed phenomena on trial, so also animal trials sought confirmation of one of the three hypotheses. Moreover, the trials of delinquent animals as well as witches were forums in which lawyers and judges argued the precise location of the boundaries between natural and supernatural events.

In his book on the decline of witchcraft trials in France, Robert Mandrou (1968) shows the importance of those trials in establishing a line of demarcation between the natural and the supernatural, and also shows how the trials provided the occasion for lawyers, judges, priests, physicians, and scientists to collaborate in that "collective adventure" that a "spiritual revolution" represents.⁵⁶ Out of that collaboration in the 17th century there emerged a new jurisprudence, a new theory of abnormal psychological states, and a new view of natural processes. The magistrates

of the sovereign courts, Mandrou demonstrates, in their new integration of medical knowledge and theology, occupied the first rank in the progress of rationalism in 17th century France.

In the past three centuries, the most striking change, Lecky tells us, may be found in the common response to the idea of the miraculous. Now, when the spirit of rationalism predisposes men to attribute all kinds of phenomena to natural rather than to miraculous causes, the account of a miracle would draw "an absolute and even derisive incredulity which dispenses with all examination of the evidence." To ascribe unexplainable phenomena to supernatural agency "is beyond the range of reasonable discussion." In contrast, a few centuries before, miraculous accounts were not only credible but ordinary.⁵⁷ The vocabulary of disenchantment provided alternative expressions for experiences that had previously been identified by names for supernatural or preternatural agency.

The great astronomer, Johannes Kepler, helped to invent the scientific idiom of disenchantment by repudiating the old animistic ideas of planetary motion. Before Kepler, celestial motion was believed to be the product of souls or minds, usually represented as divine agencies.⁵⁸ Kepler used the term "force or energy"—*vis seu energia*—to explain the movement of the planets.⁵⁹ He did not invent the Latin word *vis*, but before him, Pliny in his *Natural History*, which appeared about 77 A.D. and remained one of the most important scientific works of the ancient world, had used the term *vis* in a very general and ambiguous way, to mean all kinds of forces, including psychic and occult effects as well as physical force. Kepler restricted the concept to mechanical force. He explicitly distinguished it from any kind of psychic, spiritual, or mental force.

In his *Epitome of Copernican Astronomy*, which completed publication in 1621, Kepler concluded that the motion of the planets was not the work of mind, as the ancients believed, but the work of the natural power of bodies.⁶⁰ The common practice of reducing celestial movement to the hidden forces of some soul, he wrote, was the sanctuary of all ignorance and the death of all philosophy. He preferred to think of the cause of planetary motion as impetus only—that is, as movement produced by "a uniform exertion of forces" (for "forces" he used the Latin word *virium*, the genitive plural of *vis*), without the work of mind.⁶¹ In the same year,⁶² he proposed that the word *vis*, which means "force," should replace the word *anima*, which means "soul." That substitution, Dijksterhuis observes, implies nothing less than "a radical revision of thought."⁶³ The action of "souls" in nature was understood by principles of magic. The laws of mechanics are expressed in the language of mathematics.

Kepler's substitution removed the magic from motion. In Collingwood's words, Kepler's "momentous step" of replacing *anima* by *vis* implied that "the conception of vital energy producing qualitative changes should be

replaced by that of a mechanical energy, itself quantitative, and producing quantitative changes." Before that replacement, "man's mastery over nature was conceived not as the mastery of mind over mechanism but as the mastery of one soul over another soul, which implied magic. . . ." ⁶⁴

Albert Einstein, in his Preface to Kepler's *Life and Letters*, suggests that the two opposing principles of animism and mechanism struggled within Kepler, and that he never succeeded in entirely extricating himself from animistic thinking. ⁶⁵ Max Caspar, Kepler's biographer, agrees that Kepler, who "founded the mechanistic explanation of the heavenly motions, remained suspended between an animistic and a mechanistic view of nature." ⁶⁶ But Kepler remained enmeshed by animism in another way as well.

How does the Rooster of Basel, the victim of medieval animism, lead to Kepler, Needham asks. The answer is ironic, for Kepler suffered a narrow escape from similar victimization. In 1621, the *Epitome of Copernican Astronomy* completed publication, substituting the concept of *vis* for the concept of *anima*. But Kepler himself wrote about 1621: "I spent the whole year on my mother's trial." ⁶⁷ His mother was being tried for witchcraft, and he had assumed the burden of preparing her legal defense. In a document of 128 pages, he did not deny a belief in witches—just as his British contemporary, Francis Bacon, did not deny it. Edward Rosen observes that "like many another great man in his time Kepler never expressed any disbelief in the existence of witches." ⁶⁸ Caspar agrees that "the belief in demoniac influences and effects" remained part of Kepler's thinking. ⁶⁹ Nevertheless, in his brief for the defense and in his bill of exceptions, he carefully accounted for every act for which his mother was being charged by referring it to a natural process. He drew the line and saved her life.

Caspar writes that after Kepler, a later era "raised the completely mechanistic explanation of the models of nature to a principle and, with a remarkable shyness of everything which is called soul, required, in the name of science, the weeding out of every psychic power." ⁷⁰ This passage from animism to mechanism evolved through specific and remarkable historic occasions—juridical occasions as well as scientific. In Kepler's own words, which I take the liberty to translate from Latin: "To me, the occasions by which men arrive at the knowledge of celestial things seem no less astonishing than the very nature of celestial things." ⁷¹ The courts, I have argued, in the trials that tested demonic influences, provided some astonishing occasions for the progressive disenchantment of nature.

When nature is full of souls, their actions and the consequences of their behavior may be understood through moral categories. Spirits acting in

nature were held personally responsible for certain natural phenomena. Kepler's substitution of *vis* for *anima*, extended from the celestial to the terrestrial sphere, does much more than submit nature to the languages of mathematics. It is also a declaration of the innocence of nature, or at least a proclamation that moral conceptual categories are irrelevant to the understanding of natural phenomena.

In the 17th century, animals still went on trial, but Racine wrote *The Litigants*, his only comedy, about a trial in which a dog is charged with stealing a capon, and when it was shown in 1668 it made Louis XIV laugh. In 1672, Colbert forbade the sovereign courts of France to hear cases of witchcraft.⁷²

In the physical sciences, Newton drew a boundary line and stood on it like Janus, with faces to both centuries. Keynes called him "the last of the magicians."⁷³ As Keynes observed, Newton dropped the 17th century behind him and became the 18th century figure, which is the unmagical, traditional Newton—the sage of the Age of Reason.

At the end of his eight-volume *History of Magic and Experimental Science*, Lynn Thorndike breathed a sigh of relief and concluded, "animism had been replaced by mechanism." As he explained, "a dividing line had been drawn between science and superstition which was sharper and more satisfactory than any that had been previously attempted. . . . The boundaries of natural and experimental science seemed to be more distinctly defined than they ever had been before. They had been so drawn as to lie outside theology as well as of magic, and to exclude miracles, demons and diabolical or spiritual action as well as other forms of the occult."⁷⁴

The courtroom exploration of demonological issues had helped settle those boundaries. It had inspired a collective effort of reinterpretation and disenchantment: a radical revision of thought. It helped change the contours of animistic thinking so that it did not remain what Gaston Bachelard called an "epistemological obstacle" to the scientific world view.⁷⁵ Instead, the legalistic demonology of Christian animism shaped a forensic matrix for the expression of scientific thought and for its extension beyond the boundaries of science. Within that matrix, lawyers and judges, who were in touch with the changing scientific currents of the 16th and 17th centuries, carried on debates about the boundaries of nature. Within that matrix we may trace the changing map of the universe.

NOTES

-
1. E. P. Evans, *The Criminal Prosecution and Capital Punishment of Animals* (New York: Dutton, 1906), p. 162. Joseph Needham, *Science and Civilisation in China*, Vol. II (Cambridge: Cambridge University Press, 1969), p. 574.
 2. Evans, p. 162.
 3. P. A. Robin, *Animal Lore in English Literature* (London: Murray, 1932), pp. 84–95.
 4. L. J. Cole, "The Lay of the Rooster," *Journal of Heredity* 18 (1927):97–105.
 5. Cole, p. 99.
 6. Cole, p. 99.
 7. Cole, p. 100.
 8. Cole, p. 105.
 9. Needham, *Science and Civilisation*, II, p. 575.
 10. Joseph Needham, *Clerks and Craftsmen in China and the West* (Cambridge: Cambridge University Press, 1970), p. 310.
 11. Needham, *Science and Civilisation*, II, p. 518.
 12. Needham, *Science and Civilisation*, II, p. 582.
 13. Needham, *Science and Civilisation*, II, p. 291.
 14. Needham, *Science and Civilisation*, II, p. 286.
 15. Needham, *Science and Civilisation*, II, p. 582; *The Grand Titration* (London: Allen & Unwin, 1969), p. 330.
 16. Needham, *The Grand Titration*, p. 330.
 17. Werner Heisenberg, *The Physicist's Conception of Nature*, tr. by A. J. Pomerans (New York: Harcourt, Brace, 1958), p. 15, ital. removed.
 18. Heisenberg, *The Physicist's Conception of Nature*, p. 29, ital. in the original.
 19. William James, *The Varieties of Religious Experience* (New York: Modern Library, 1902).
 20. S. Nakayama and N. Sivin, *Chinese Science* (Cambridge: M.I.T. Press, 1973), pp. 206–207.
 21. Max Weber, *The Religion of China*, tr. by H. H. Gerth (New York: Free Press, 1951), pp. 153, 206, 228.
 22. Henry Charles Lea, *A History of the Inquisition of Spain*, Vol. IV (New York: Macmillan, 1907), p. 207.
 23. Edward Langton, *Essentials of Demonology* (London: Epworth, 1949), p. 29.
 24. Lynn White, Jr., "Natural Science and Naturalistic Art in the Middle Ages," *American Historical Review* 52 (1947):421–435.
 25. White, "Natural Science," p. 435.
 26. G. G. Coulton, *Five Centuries of Religion*, Vol. I (Cambridge: Cambridge University Press, 1923), p. 66.
 27. Henry Osborn Taylor, *The Mediaeval Mind*, Vol. I, 4th ed. (Cambridge: Harvard University Press, 1949), p. 504.
 28. Coulton, *Five Centuries*, p. 62.
 29. Coulton, *Five Centuries*, pp. 466–467.
 30. Coulton, *Five Centuries*, pp. 65–66.
 31. Meyer Shapiro, "The Sculpture of Souillac," in *Medieval Studies in Memory of A. Kingsley Porter*, ed. by W. R. W. Koehler, Vol. II (Cambridge: Harvard University Press, 1939), p. 379.

32. Coulton, *Five Centuries*, p. 64.
33. Paul Carus, *The History of the Devil and the Idea of Evil* (New York: Land's End Press, 1969, 1st pub. 1900), p. 414.
34. J. B. Russell, *Witchcraft in the Middle Ages* (Ithaca: Cornell University Press, 1972), p. 19.
35. A. C. Fryer, "Theophilus, The Penitent, as Represented in Art," *Archaeological Journal* 92 (1935):287–333. S. Baring-Gould, *The Lives of the Saints*, 3rd ed., Vol. II (Edinburgh: Grant, 1914), pp. 88–91.
36. S. Baring-Gould, *Curious Myths of The Middle Ages*, Second Series (London: Rivingtons, 1868), pp. 363–370.
37. Schapiro, "The Sculpture," p. 380. Fryer, "Theophilus," p. 289. Paul Deschamps, *French Sculpture of the Romanesque Period: Eleventh and Twelfth Centuries* (New York: Hacker Art Books, 1972), p. 27.
38. Schapiro, "The Sculpture," p. 378.
39. Henry Charles Lea, *Materials Toward a History of Witchcraft*, Vol. I (Philadelphia: University of Pennsylvania Press, 1939), p. 305.
40. Evans, *The Criminal Prosecution*, p. 165.
41. E. A. Westermarck, *The Origin and Development of the Moral Ideas*, Vol. I (London: Macmillan, 1912), p. 257.
42. Evans, *The Criminal Prosecution*, p. 147.
43. Needham, *Science and Civilisation*, II, p. 574. *The Grand Titration*, p. 328.
44. W. W. Hyde, "The Prosecution and Punishment of Animals and Lifeless Things in the Middle Ages and Modern Times," *University of Pennsylvania Law Review* 64 (1916):709.
45. Hyde, "The Prosecution," p. 712.
46. Karl von Amira, *Thierstrafen und Thierprocesse* (Innsbruck: Verlag der Wagner'schen Universitäts-Buchhandlung, 1891), p. 548.
47. Evans, *The Criminal Prosecution*, p. 4.
48. Henry Charles Lea, *Studies in Church History* (Philadelphia: Henry C. Lea's Son & Co., 1883), pp. 428–429.
49. J-H. Pignot, *Un jurisconsulte au seizième siècle: Barthélemy de Chasseneuz* (Paris: Larose, 1880), p. 211.
50. Evans, *The Criminal Prosecution*, p. 21.
51. Evans, pp. 18–19. Hyde, "The Prosecution," pp. 706–707. Lea, *Studies in Church History*, p. 430. S. Baring-Gould, *Curiosities of Olden Times*, Rev. ed. (Edinburgh: Grant, 1896), p. 65.
52. Baring-Gould, *Curiosities*, p. 67.
53. Lea, *Studies in Church History*, p. 432.
54. Needham, *The Grand Titration*, p. 330.
55. Evans, *The Criminal Prosecution*, pp. 54–55.
56. Robert Mandrou, *Magistrats et sorciers en France au XVII^e siècle* (Paris: Librairie Plon, 1968), p. 564.
57. W. E. H. Lecky, *History of the Rise and Influence of the Spirit of Rationalism in Europe*, Vol. I (New York: Appleton, 1868), p. 17, 27.
58. Max Jammer, *Concepts of Force* (Cambridge: Harvard University Press, 1957), p. 51.
59. Jammer, p. 87.
60. Johannes Kepler, *Epitome Astronomiae Copernicae, Opera Omnia*, ed. by C. Frisch, Vol. VI (Frankfurt and Erlangen: Heyder & Zimmer, 1866), p. 372.
61. Kepler, p. 393.
62. Jammer, *Concepts of Force*, p. 90, refers to a note that appeared in the second edition of *Mysterium cosmographicum*.

63. E. J. Dijksterhuis, *The Mechanization of the World Picture* tr. by C. Dikshoorn (London: Oxford University Press, 1961), p. 310.
64. R. G. Collingwood, *The Idea of Nature* (London: Oxford University Press, 1945), p. 102, 96.
65. Carola Baumgardt, *Johannes Kepler: Life and Letters* (New York: Philosophical Library, 1951).
66. Max Caspar, *Kepler*, tr. by C. D. Hellman (London and New York: Abelard-Schuman, 1959), p. 383.
67. Johannes Kepler, *Somnium*, tr. by Edward Rosen (Madison: University of Wisconsin Press, 1967, 1st publ 1634), p. xix.
68. Edward Rosen, "Kepler and Witchcraft Trials," *The Historian* 28 (1966):449.
69. Caspar, *Kepler*, p. 240.
70. Caspar, p. 384.
71. Alexander Koyré, *The Astronomical Revolution*, tr. by R. E. W. Maddison (London: Methuen, 1973), p. 119.
72. Jules Michelet, *Satanism and Witchcraft*, tr. by A. R. Allinson (Secanuis, NJ: Lyle Stuart, 1939), p. xx.
73. J. M. Keynes, *New Tercentenary Celebration* (London: Royal Society, 1947).
74. Lynn Thorndike, *A History of Magic and Experimental Science*, Vol. VIII (New York: Columbia University Press, 1923–1958), p. 604.
75. Gaston Bachelard, *La formation de l'esprit scientifique*, 6th ed. (Paris: J. Vrin, 1969).