7

Natural history and the emblematic world view

WILLIAM B. ASHWORTH, JR.

Natural history occupies a shallow niche in most accounts of the Scientific Revolution. One cannot claim that it is totally overlooked, for the typical survey usually contains a chapter on the new herbals of Otto Brunfels and Leonhard Fuchs and the zoological encyclopedia of Conrad Gesner. Pierre Belon's treatise on birds and Guillaume Rondelet's study of fish are usually discussed, and Belon's woodcut comparing the skeleton of a chicken with that of a human is invariably reproduced. But the subsequent period between 1560 and 1660 is either ignored or belittled. Passing attention is sometimes given to Andrea Cesalpino and his attempts at classification; Ulisse Aldrovandi occasionally gets a nod; one of the New World natural histories may be singled out for comment. But this treatment is perfunctory, at best, and many influential figures such as Joannes Jonston are not mentioned at all. Such accounts give the impression that natural history had a brief golden age in the decades between 1530 and 1560 and then stagnated, changing little in the next one hundred years. The implication, then, is that natural history played no formative role in those collective developments that we call the Scientific Revolution. Most historians seem to feel that the natural sciences became important only after 1660, during the era of John Ray, Edward Tyson, and the Paris school of comparative anatomists, and then only because the revolution in the physical sciences had finally begun to be assimilated by natural scientists. As a consequence, the intervening one-hundred-year period between Gesner and Ray is almost totally neglected, a neglect that extends far beyond the survey level of scholarship. Implicit in this neglect are the assumptions that natural history did not change between 1560 and 1660, that Aldrovandi, Gesner, and Jonston were all engaged in much the same kind of activity, and that it is an activity not really worth further study.[1]

Distorted perceptions of the role of natural history in the Scientific Revolution

I believe that our assumptions and conclusions concerning the nature of natural history are seriously flawed and have prevented us from understanding a crucial development in late Renaissance and early seventeenth-century thought. Before I attempt to demonstrate a more fruitful approach, I would like to suggest a reason why such assumptions have persisted, even though they may, in fact, be dead wrong. The problem seems to be that we have not, in recent years, reexamined our presuppositions about how one should write the history of the natural sciences, at least for the Renaissance period. This is surprising, since in the past three decades we have thoroughly reworked the historiographic principles we employ when writing about Copernicanism, or the mechanical philosophy, or practically any development in the physical sciences. Such retooling has not occurred for late Renaissance natural history; we still follow the lead of earlier historians, such as Charles Singer, F. J. Cole, and Erik Nordenskiold, who were primarily interested in such questions as who discovered the fish bladder or who first classified the bat with the mammals – historians, in short, who were looking for the origins of biology, and, if not that, then at least for the roots of modern zoology and botany.[2] Now, if one is looking for new discoveries about the chameleon, then it is natural to jump from Belon, who first drew it correctly, to the Paris school, which first took it apart to reveal its anatomical structure. If one has an interest in classification, it is natural to mention Cesalpino and then proceed directly to Ray, who was the first to make much of an advance beyond Aristotle.

I suspect that modern survey writers will passionately deny, with some justification, that they write history as F. J. Cole did, but when one reads the recent literature, the same assumptions are implicitly present. Gesner is lauded for his attempt to gather firsthand information and for his illustrations; he is chided for his humanist fondness for philology and for his lack of any critical sense. Aldrovandi is lightly praised for his anatomical investigations and then dismissed for his unchecked tendency to include biologically irrelevant material, such as fables and proverbs. Jonston is ignored because he seems to be only a truncated Aldrovandi. Rondelet and Belon, on the other hand, and perhaps Volcher Coiter, are given space far exceeding their contemporary importance, because they studied specimens firsthand, dissected them, drew them from life, and scorned the humanistic apparatus of Gesner; in short, because they practiced something faintly resembling biology.

I would like to suggest that our view of natural history has been distorted because we have not been asking ourselves the right questions. The questions we should be asking are these: Why did Renaissance scholars gather and publish information about the natural world? What kind of material was included in their compilations, and why? What was the intended audience of the publications; what was the intended use of the information contained in them? Was the study of nature part of some larger cultural endeavor; did it receive encouragement from patrons and princes; and if so, why? If Gesner and Aldrovandi were trying to write biological textbooks and failed in the attempt, then they may merit the criticism they have received. But if they were trying to do something quite different, perhaps we should first try to understand their motives, and the cultural setting of such motives, before dismissing their efforts so readily.

What I would like to do in this essay is to ask some of these questions, at least in preliminary form, and see where they lead us. I will limit my inquiry to the zoological side of natural history and will focus on the period 1550 to 1650. I hope to show, even in this brief reappraisal, that when we look at natural history through contemporary eyes, we see an entirely different world from ours, a world where animals are just one aspect of an intricate language of metaphor, symbols, and emblems. This "emblematic world view," as I choose to call it, was the single most important factor in determining the content and scope of Renaissance natural history.[3] Moreover, the nature of this world of symbols and correspondences changed considerably between 1550 and 1650; it grew considerably richer between Gesner and Aldrovandi, and dissipated completely by the time of Jonston. Viewed from this perspective, the natural histories of Gesner, Aldrovandi, and Jonston were markedly different, not stamped from the same mold. Most important, I hope to show that the demise of emblematic natural history was a crucial part of the development that we call the Scientific Revolution. It was not simply an aftermath of Descartes and the mechanical philosophy but an independent, and perhaps even broader, cultural shift that had profound consequences for the evolution of seventeenth-century science.

Gesner and humanist natural history

Perhaps the best way to open a window onto the emblematic world of the Renaissance is to open the *History of Animals* of Conrad Gesner (1516–1565) and read an article, with no expectations or preconceptions – to let the world reveal itself. What might one learn, for example, by consulting his chapter on *pavo*, the peacock? The article

begins with an attractive woodcut, followed by a list of the bird's names in different languages, and a description, pieced together from ancient authorities such as Aristotle and Pliny. Attention is then given to the peacock's habits and characteristics, where we learn, for example, that its flesh does not decay after death and that it is ashamed of its feet. On subsequent pages we encounter a discussion of all known peacock adjectives and their origins, such as "peacock blue," or the Peacock River in India, or the "peacock stone." We are told that the peacock was associated with the goddess Juno and appeared with her on ancient coins, and we are treated to several fables involving the pair. We are informed of the myth of Argus, who had one hundred eyes, which were transformed, after his death, into the spots on the peacock's tail. We also encounter peacock proverbs, peacock recipes, peacock medicines, and peacock legends. Every single statement is supported by a named authority, usually classical, but often contemporary. Gesner has provided us with the ultimate peacock concordance.[4]

Now, if what you seek is a collection of true statements about the peacock, or an anatomical description, or the peacock's place in a taxonomic scheme based on physical characteristics, then you are bound to be disappointed by Gesner's account. But if you are interested in confronting, in one place, that complex web of associations that links the peacock with history, mythology, etymology, the rest of the animal kingdom, indeed with the entire cosmos, then you are certain to be richly rewarded. Gesner believed that to know the peacock, you must know its associations – its affinities, similitudes, and sympathies with the rest of the created order.[5] Michel Foucault has suggested that this search for similitudes and resemblances was the principal guiding episteme for all of Renaissance thought, and, in the case of Gesner's natural history, he was absolutely right.[6]

From what sources does Gesner assemble his peacock network of associations? Some of them are well known to students of natural history, and we will not linger over these: Aristotle, of course, and Pliny, along with Aelian, Plutarch, Theophrastus, Varro, and practically every other classical writer who discussed animals. We would expect to find them in a compilation written by a humanist as knowledgeable as Gesner. But what are the names of Erasmus, Du Choul, and Horapollo doing in the margins? Ovid, Alciati, and the Greek *Florilegia*? What works do their names represent, and what do they have to do with natural history? Since these sources form an important part of Gesner's world view that is little acknowledged by historians of science, an accounting seems in order.

The cultural matrix of sixteenth-century natural history

There seem to have been six developments in sixteenth-century thought that, added to the classical literature on natural history, determined the cultural matrix of late Renaissance natural history. We might call these, for convenience, the *hieroglyphic, antiquarian, Aesopic, mythological, adagial,* and *emblematic* traditions. The number six is not intended to be canonical; we could just as easily organize them into five or ten groups, since all of these traditions were densely interwoven, but the six-part division works well for purposes of discussion.

Hieroglyphics

Renaissance fascination with hieroglyphics began in the early fifteenth century, when the *Hieroglyphics* of Horapollo (dates unknown) was recovered and translated from the Greek. Horapollo's treatise is essentially a dictionary of symbols, of which a large proportion is animal. It reveals, for example, that when the Egyptians drew a pig, it was meant to symbolize a pernicious person, whereas a weasel represented weakness, a fly impudence, and so forth. The humanist mind was fascinated with such revelations, because hieroglyphics seemed to be a language of symbolic images – a language in which understanding is conveyed immediately, much as God understands things, without the mediation of conventional language. Marsilio Ficino, in particular, was vastly impressed with the possibilities of such a Platonic language, and so were many of his followers. Horapollo was first printed in 1505, and the *Hieroglyphics* went through many more editions by the end of the sixteenth century.[7]

The early impact of Horapollo on natural history is best seen in the example of Albrecht Dürer (1471–1528). In 1512 his friend Willibald Pirckheimer translated Horapollo's treatise. Dürer illustrated the manuscript, and although the original is lost, a copy survives, containing Dürer's meticulous depictions of such hieroglyphs as a dog wearing a stole (representing the judgment of kings) and a lion (representing fear). More interesting, shortly thereafter Dürer designed a large triumphal arch for Maximilian I, at the top of which sits the emperor, surrounded by symbolic animals: the lion, the dog with stole, a crane on raised foot (a guard against enemies), a bull (courage with temperance), and others. Pirckheimer himself then "translated" these Horapollonian images into a message in praise of the emperor.[8]

The effect of the hieroglyphic revival on natural history was im-

mediate and profound. Weasels, cranes, and lions became part of a visual language; they were symbols, but even more, they were Platonic ideas, whose meaning the mind could immediately perceive. Animals were living characters in the language of the Creator, and the naturalist who did not appreciate or understand this had failed to comprehend the pattern of the natural world.

Antique coins and Renaissance medals

Closely related to the interest in hieroglyphics was the Renaissance fascination with antiquities, especially medals and coins. Antique Roman coins typically had a portrait on one side, and, on the reverse, an image that seemingly had symbolic meaning. The coins of Titus Vespasian, for example, showed a dolphin twined around an anchor. Renaissance humanists, already by the mid-fifteenth century, began to devise medals in imitation of ancient coins, and here again the impulse seems to have come from a fascination with symbolism. Leon Battista Alberti, in 1438, graced his medallic reverse with an eye surrounded by a laurel wreath, with the motto, from Cicero, "Quid tum" (What then?). Pisanello designed a medal for Belloto Cumano, in 1447, that has a weasel or ermine on the reverse, representing purity.[9]

The early medals developed apart from the hieroglyphic tradition, but by the early sixteenth century the two were closely intertwined. Erasmus, in his *Adagia*, which I will discuss shortly, commingled the two; after mentioning that his friend, the printer Aldus Manutius, had taken Vespasian's dolphin and anchor as his own personal device, he says that the symbol means "festina lente" (Make haste slowly), "as the books on hieroglyphics tell us," and he then proceeds to explain the importance of a symbolic language.[10]

Interest in numismatics continued to increase through the middle of the sixteenth century, when there began to appear the first antiquarian treatises on ancient coinage, filled with plate after plate of symbols and mottoes, many of them animal. The most important of these compilations were Aeneas Vico, *Images of Emperors from Antique Coins* (1553); and Guillaume Du Choul, *Religion of the Ancient Romans* (1556). Works such as these were very important sources for late Renaissance humanists, because they were based on artifacts, not written history, and antiquarianism was just then developing as an alternative method of studying the past.[11] Moreover, the frequent appearance of peacocks, lions, and eagles on ancient coins was convincing evidence that the study of antiquities was an important aspect of natural history.

Aesopic fables

The third tradition was that of the fable, especially the Aesopic fable. The collection of fables ascribed to Aesop has a convoluted history; it came down to the Renaissance in verse and prose forms, in Greek and Latin versions, and with varying numbers of fables. For our purposes, it suffices to note that one version, printed around 1476, was rapidly translated into vernacular languages and was reprinted constantly throughout the Renaissance.[12] Particularly nice editions were published in Paris in 1547, with illustrations by Bernard Salomon, and in 1567, with illustrations by Marcus Gheeraerts; both were often reissued.[13] So when sixteenth-century humanist naturalists became interested in the symbolic meanings of animals, the Aesopic corpus became an important source. No student of the peacock would want to ignore the fable of Juno and the peacock, in which the peacock complains that he does not have a voice like the nightingale, because there is a moral here for those who are not content with their station in life.

Classical mythology

The fourth tradition that made an important contribution to the multilayered world view of the Renaissance was the mythological. It is well known that classical mythology had an overwhelming impact on Renaissance art and literature, but it also left its mark on natural history. Animals, after all, romped around Mount Olympus along with the deities, and it is difficult even today to picture Hera without her owl, Jupiter without his eagle, and Juno without the aforementioned peacock; in the Renaissance it was impossible. The principal source for the zoology of myth was Ovid's *Metamorphoses*, and Gesner was as familiar with this work as he was with Aristotle. In the sixteenth century, however, Ovid was supplemented by other scholarly treatises, most notably those of Lilio Giraldi, Natale Conti, and Vincenzo Cartari, all published around midcentury. The work of Cartari, *Images of the Gods*, published in 1556, was particularly influential as a sourcebook of mythological animal imagery.[14]

Near the end of the sixteenth century, the mythological tradition spawned an offshoot that is best called "iconology," after the master treatise in that genre, Cesare Ripa's *Iconologia*, first published in 1593 and often reissued. Ovid provided attributes for the gods; Ripa provided attributes for personifications of all kind: nature, intellect, envy, modesty, heresy. Many of Ripa's attributes were drawn from natural history; thus a veiled woman with an elephant by her side represents

religion; a long-eared woman pointing with her finger and holding a peacock represents arrogance. In the late sixteenth century these animal attributions joined those drawn from Horapollo and Pliny to create an impressively rich language of associations for the natural world.[15]

Adages and epigrams

There are two traditions left to elucidate, however, and it might be argued that these two are the most important and influential of all. First, and the fifth in our catalog, is the tradition of the adage, or proverb. In the sixteenth century the adage was synonymous with the name of Desiderius Erasmus (1466?–1536). In 1500 Erasmus published a collection of proverbs, the *Adages*, culled from ancient writings and illuminated by his own very personal commentary.[16] The work was enlarged and reprinted continually for almost four decades, and by the last edition there were over forty-one hundred adages in the collection, the total collected aphoristic wisdom of antiquity. Many of them are still quite familiar: "Omnem movere lapidem" (Leave no stone unturned) or "Ligonem ligonem vocat" (Call a spade a spade).[17] And many of them concern animals. Thus Erasmus tells us: "Multa novit vulpes, Echinus vero unum magnum" (The fox knows many ways [to survive]; the hedgehog one great one), referring to the hedgehog's sole but effective defense of rolling up into a ball. Erasmus's compendium of proverbs was one of the most widely influential works of the entire sixteenth century; Gesner, in particular, seems to have read the entire work most carefully.[18]

One body of ancient writings that Erasmus drew on should be singled out, since some would argue that it has a separate life of its own: the so-called Greek Anthology. This collection of ancient epigrams was assembled by Planudes in the thirteenth century; it was first printed in Greek in 1494, and in a number of Latin editions after 1520. The Greek Anthology contains few epigrams that concern animals – Aesop had more or less cornered this market – but it helped create a taste for the clever, pithy aphorism that, by the middle of the sixteenth century, spread to include observations about the natural world.[19]

Emblems and devices

The sixth and last tradition that I wish to single out is the emblematic. The emblem was one of the most influential creations of the late Renaissance.[20] The original intention of the inventor, Andrea Alciati (1492–1550), was to devise epigrams that were especially enigmatic, so that readers would get a sudden and pleasing illumination when they figured them out, with the help of a commentary; an accompanying image was not intended. But when Alciati's *Emblemata* was first published in 1531, woodcut illustrations were added, and by midcentury the visual image had become an indispensable part of the emblem. The emblem proper ultimately came to consist of three parts: a visual image, a short motto, and a slightly longer epigram. In the ideal emblem, each element was necessary, but not sufficient, for comprehension; taken together, they provided a pleasing and useful insight.[21] A pleasant example, taken from a late emblem book, shows a peacock gazing at its feet, in defiance of Pliny's claim, with the wonderful motto: "Nosce te ipsum" (Know thyself).[22]

Closely related to the emblem was the "device," or *impresa*. A device was a sort of personal emblem, with an image and motto particularly appropriate to the owner, and the device actually predates the emblem by half a century, originating as a badge worn in battle. But emblems and devices rode to ascendancy in tandem in the sixteenth century, and in the late sixteenth century personal devices were often expanded into emblems, and emblems were converted into devices. A good example of an animal device that acquired general circulation is that of King Louis XII of France, which showed a porcupine with the motto "Cominus et eminus" (Hand to hand and from afar), cleverly suggesting that the king, like a porcupine, can triumph in battle as well as by diplomatic action.[23]

The emblem tradition blossomed in a manner that is almost unimaginable to the modern student who is unfamiliar with it. Alciati's book went through dozens of expansions and reissues, and these spawned, in turn, a proliferating host of rivals. By 1600 there were hundreds of different emblem treatises in print, and production continued unabated for several more decades, finally beginning to slacken off only after 1650. One reason why the emblem tradition was so important was that it brought together most of the other traditions we have outlined. The emblem is clearly an outgrowth of the love for proverbial wisdom, and Alciati was very much influenced by Erasmus and the Greek Anthology.[24] Hieroglyphics played an important role in the development of the emblem, as did the mottoes and images on ancient coins and the moral lessons from Aesop and Ovid.[25] Because of the unifying character of the emblematic tradition, and because of the fact that it struck such a resounding chord in late Renaissance thought, I have called the mental outlook that welcomed it the "emblematic world view."[26]

The emblematic world view

The emblematic world view is, in my opinion, the single most important factor in determining late Renaissance attitudes toward the natural world, and the contents of their treatises about it. The essence of this view is the belief that every kind of thing in the cosmos has myriad hidden meanings and that knowledge consists of an attempt to comprehend as many of these as possible. To know the peacock, as Gesner wanted to know it, one must know not only what the peacock looks like but what its name means, in every language; what kind of proverbial associations it has; what it symbolizes to both pagans and Christians; what other animals it has sympathies or affinities with; and any other possible connection it might have with stars, plants, minerals, numbers, coins, or whatever. Gesner included all this, not because he was uncritical or obtuse, but because knowledge of the peacock was incomplete without it. The notion that a peacock should be studied in isolation from the rest of the universe, and that inquiry should be limited to anatomy, physiology, and physical description, was a notion completely foreign to Renaissance thought.

Once the modern student becomes comfortable with this complex world of symbols and associations and starts to read Renaissance natural histories with more awareness of the way these different discourses interacted, certain developments appear, in this new light, more understandable. We begin to see, for example, why Pierre Belon (1517–1564) and Guillaume Rondelet (1507–1566) did not have more impact in the late Renaissance, if they were in fact better zoologists than Gesner. Historians have fumbled for explanations, but it now seems evident that Belon and Rondelet attempted to place animals in a context that was much too limited. Anatomy, physiology, and classification may be the heart of modern zoology, but in the sixteenth century they were only several strands of a much more complex web, and contemporaries obviously felt that such a stripped-down world was incomplete; the zoological world depicted by Belon and Rondelet was not the zoological world inhabited by Renaissance man; it had lost too much of its richness and meaning. Gesner's world, on the other hand, was complex and interwoven, and the success enjoyed by his works and that of his successors is evidence that readers shared and cared for this world of resemblances.

We can also realize what a mistake it is to call the outlook of Gesner and his followers "medieval," as historians have often done.[27] The adjective crops up because medieval bestiaries also incorporated animal symbolism and morals. But we can now understand that Gesner's symbolism is of quite a different kind and a higher order. Gesner's ancient sources were mainly classical, rather than Christian, and in addition he drew on many contemporary traditions that were unknown to the Middle Ages. It is noteworthy that bestiary symbolism was drawn primarily from the *Physiologus*, and Gesner hardly used the *Physiologus* at all (perhaps because it was not printed until 1587). There are many tales included by Gesner that are also in the *Physiologus*, but that is because both have a common source in Pliny. And Gesner rarely includes the medieval Christian morals that were the core of the bestiary tradition. So Gesner's world view may have been rich in animal symbolism, but there was nothing distinctively "medieval" about it.

Another thing we notice is that the world of associations inhabited by Gesner was something quite different from what is sometimes called the "magical world view." Gesner was indeed familiar with magical treatises, most notably the *Kiranides*, and his discussions of sympathies usually come from such sources, if they were not drawn from Pliny.[28] But they form only a small fraction of his sources and his world view. Magic, or hermetism, has come in for a lot of attention in the last decades and has been offered up by some as *the* world view of the Renaissance, the outlook that was to be replaced by the mechanical philosophy. I merely wish to point out here that in fact magic, or hermetism, was only one element of a much larger picture; only one tradition among dozens that fused to form the emblematic world view.[29]

Aldrovandi and emblematic natural history

And finally, we are ready to appreciate the difference between Aldrovandi and Gesner. Ulisse Aldrovandi (1522–1605) must be the most underappreciated naturalist of the early modern era. His thirteen massive folios stand high and dry on library shelves, like so many beached whales, forbidding in their bulk, alien in their contents, and apparently seldom read. The encyclopedic format has led most historians to conclude that he was just another Gesner, except that he did not know when to stop.[30] This opinion is unfortunate, because Aldrovandi was not "Gesner redivivus." If one concentrates on the biological parts of his compendiums, there are indeed great similarities. But if one reads on for the associations, one discovers that there has been a great change in fifty years. Suppose we turn to Aldrovandi's article on the peacock.[31] We notice, first of all, that it is thirty-one pages long, compared to Gesner's eight. Gesner divided

his article into eight sections; Aldrovandi has thirty-three topics in all, and it is well worth listing the titles of these:

aequivoca	aetas	moralia
synonyma	volatus	hieroglyphica
genus	mores	symbola
differentiae	ingenium	proverbia
descriptio	sympathia	usus in sacris icones
locus	antipathia	usus in externis
coitus	corporis affectus	usus in medicina
partus	cognominata	usus in cibis
incubatus	denominata	apologi
educatio	praesagia	fabulosa
vox	mystica	historica

It is one thing to talk about a "web of associations"; it is much more impressive to see this web laid out, strand by strand, as Aldrovandi does. Aldrovandi's network is similar in kind to Gesner's but many times more intricate. What has happened to the emblematic world in the intervening fifty years to swell it to such splendor?

Gesner had compiled his encyclopedias in the 1550s. At that time the adages of Erasmus were in wide circulation, as was the mythology of Ovid, and Gesner utilized both freely. But many of the other traditions were just beginning to flower. Horapollo had been available in print for quite some time, but only with the publication of the *Hieroglyphics* (Basel, 1556) of Piero Valeriano (1477–1558) did fascination with hieroglyphics really begin to spread. So we find in Gesner only passing attention given to hieroglyphic meanings. The great numismatic encyclopedias did not appear until the mid–1550s. Ripa's *Iconologia* was unavailable to Gesner, as was the printed *Physiologus*. The fable tradition was just catching hold, and most of the best editions of Aesop did not appear until the 1570s. And most important, the emblematic tradition was barely a bud when the first volume of the *History of Animals* lumbered off the presses. Few animal emblems were in circulation in Gesner's day, and although he utilized the ones available, they do not dominate his descriptive associations.

It is the efflorescence of the emblem tradition that marks the biggest difference between Gesner and Aldrovandi, and I would like to demonstrate the growth of animal emblematics before returning to Aldrovandi. Animals did not play a central role in Alciati's *Emblemata;* they were present, but not omnipresent. But when others began composing emblem books, they turned to Horapollo and Piero Valeriano for inspiration, and there animal symbols are abundant. So from 1560 on we begin to see more and more attention given to the epigrammatic

meanings of the natural world. This trend culminated in the publication of the *Collection of Symbols and Emblems* of Joachim Camerarius (1534–1598) from 1593 to 1604. This set of four volumes contains four hundred emblems, and every one involves an animal or plant. In the second volume, on quadrupeds, we find emblems for one hundred animals – not only horses and lions, but hedgehogs, ichneumons, chameleons, weasels, and even the New World *simivulpa*, or opossum.

It is important to understand that Camerarius was as much a student of nature as Gesner, and his emblem book was intended as a contribution to natural history, as well as to emblematics. The commentary to his peacock emblem, for example, refers to Aristotle, Pliny, Ovid, Isidore, as well as earlier emblem books, and Camerarius apparently saw no contradiction between his emblem-book production and his botanical work; both illuminated the emblematic world of nature.[32]

By the beginning of the seventeenth century, there was available a cornucopia of animal allegories and symbolism for anyone interested in adding to the traditional animal similitudes. Aldrovandi was very much interested. Just after Camerarius's first volumes of emblems rolled off the press, Aldrovandi began to issue the first volumes of his natural history. The *Ornithology* was the first to appear, in three volumes published between 1599 and 1603. The volume on insects followed. Aldrovandi died, and the production slowed slightly, but not much, as his assistants and heirs took over responsibility for bringing the Aldrovandi corpus to light. The first volume on quadrupeds came out in 1616, and subsequent huge volumes plopped into view with intermittent regularity, right up until 1648. Why did Aldrovandi need three volumes on birds and three for quadrupeds, where Gesner had one for each? The reason is that Gesner's humanist text had been swollen by incorporating all of the new contributions of the sixteenth-century students of hieroglyphics, emblems, adages, and antiquities. Let us consider another specimen animal, this time from the world of quadrupeds.

The *echinus*, or hedgehog, was well known to classical authorities; should one look up the entry in Gesner, one would find most of the interesting hedgehog stories gathered together.[33] One would learn that the hedgehog carries home grapes and apples on its spines – never in its mouth. When *echinus* walks, it squeaks like a cartwheel; when a male and a female copulate, they do so face to face. Gesner transcribes two proverbs from Erasmus's *Adages*: One we have already discussed; the other, *Echinus partum differt* (The hedgehog delays childbirth), likens a poor man, who puts off payment of debts, to the

hedgehog mother, who tries to retard the delivery of her spiny whelps. Gesner also adds a long section on medicinal uses. But there are no examples drawn from hieroglyphics, emblems, or numismatics.

Aldrovandi's discussion is much more extensive.[34] There is now a lengthy paragraph on *antipathia*, or antipathies, informing us that the hedgehog is a bitter enemy of the wolf, detests serpents, and is not fond of those plants that have spines themselves. Under the heading "Emblemata & Symbola" one can find both of Camerarius's emblems quoted in full, with motto and epigram. Aldrovandi includes a section on *simulacra*, or images, where he reveals his familiarity with Ripa's *Iconology*, pointing out that Ripa's figure of *laesiones*, or oratory, has a hedgehog in one hand.

And in other sections on hieroglyphics, morals, omens, symbols, and so forth, one finds every reference to the hedgehog that is made by Piero Valeriano, Horapollo, the Physiologus, Erasmus, and most of the important emblem writers. With all these resources Aldrovandi is able to spin a net of associations and similitudes that is far more complex than anything that Gesner was able to achieve. Aldrovandi's world needed thirteen volumes to contain it.

The emblematic view of nature continued to prevail through the first half of the seventeenth century, periodically refreshed by the appearance of additional Aldrovandi zoological volumes. And while Aldrovandi was a major force in its persistence, other zoologists fashioned similar world views, often independently. The *Historie of Four-Footed Beastes* (1607) by Edward Topsell (1572–1638) provides a good example. Topsell has been much maligned as an unimaginative plagiarist of Gesner, and some of the criticism is deserved.[35] But it is of interest that Topsell frequently added new material to that he took from Gesner, and most of it consisted of references drawn from emblematic and hieroglyphic literature. Since Topsell wrote before the appearance of Aldrovandi's volumes on quadrupeds, he must have gleaned this new material on his own, by perusing the works of Camerarius and Piero Valeriano. Moreover, whatever his failings as a zoologist, Topsell knew exactly what he was trying to do in his book. His "Epistle Dedicatory" is a hymn to animals as symbolic images. He suggests that a history of beasts is preferable to a historical chronicle, because it reveals "that Chronicle which was made by God himselfe, every living beast being a word, every kind being a sentence, and al of them togither a large history, containing admirable knowledge & learning, which was, which is, which shall continue, (if not for ever) yet to the worlds end."[36]

Jonston and the demise of emblematic natural history

The dominance of natural history by similitude is so complete in the first half of the seventeenth century that one certainly expects Joannes Jonston's multivolume *Natural History* of 1650 – which looks for all the world like another Renaissance encyclopedia – to conform to the Aldrovandi model.[37] All the Aldrovandi illustrations are there, as well as those of Gesner and assorted other Renaissance naturalists. It is a shock, then, to read the text of Jonston's work and realize that, with its publication, the bottom has suddenly dropped right out of the emblematic cosmos.

Joannes Jonston (1603–1675) is not well appreciated by historians of science. He is usually portrayed – when he is portrayed at all – as a secondhand Aldrovandi, and thus a thirdhand Gesner – the last of the Renaissance encyclopedists. It is hard to understand how this image of Jonston has persisted, for the text of his work reflects a remarkable metamorphosis. The entry on *pavo* can serve again to illustrate these changes.[38] It has been trimmed to a tidy two pages. There is a full description – nothing has been cut here – and a discussion of medical applications and culinary uses. But if one looks for peacock emblems, proverbs, or hieroglyphics, there are none to be found. Not a single reference to Camerarius, or Horapollo, or Erasmus – not in the peacock article, not in any article. Even the medicinal uses have been weeded out: The ones that suggest sympathetic cures are gone; those that allow a physical cause are retained.[39] In fact, Jonston's description of the peacock is virtually identical to that of Francis Willughby twenty-five years later. It is apparent that emblematic natural history began to wane long before the Royal Society took a dislike to it.[40]

It was Michel Foucault who suggested that Jonston's encyclopedia marked a clear break with earlier Renaissance natural history, and he does seem to have pointed his finger in the right direction, if not to the precise spot.[41] Something profound had indeed occurred around midcentury, and historians of other fields have noticed it, although they have placed the date of transition earlier or later. One description of the transformation, by François Jacob, is particularly eloquent:

> Living bodies were scraped clean, so to speak. They shook off their crust of analogies, resemblances and signs, to appear in all the nakedness of their true outer shape. . . . What was read or related no longer carried the weight of what was seen. . . . What counted was not so much the code used by God for creating nature as that sought by man for understanding it.[42]

Historians of linguistics have called this metamorphosis the "decontextualization" of the world; historians of magic the "disenchantment" or "desymbolization" of nature.[43] Historians of the natural sciences have simply not noticed it. But Foucault is right; Jonston's natural history is indeed a watershed publication. To Foucault, however, the "event" of Jonston's work is an enigma, one of those transitions that cannot be explained. In truth, there are some explanations for the sudden death of "animal semantics," to use Foucault's own evocative term. I would like to offer several here.

New World natural histories

Certainly one important factor in this mild revolution was the appearance, in the early decades of the seventeenth century, of the first natural histories of New World animals: Charles L'Ecluse's *Exotica* (1605), Jan de Laet's *New World* (1625), Juan Nieremberg's *History of Nature* (1635), and most important, the *Natural History of Brazil* (1648) by Georg Markgraf (1610–1644).[44] These natural histories are occasionally brought into survey accounts of the Scientific Revolution, but their significance is usually seen to lie in their demonstration of a Baconian explosion of knowledge. This, of course, is true, but New World narratives had a far greater influence than simply enlarging the subject matter of natural history. Their impact derived from one simple fact: The animals of the new world had no known similitudes. Anteaters and sloths do not appear in Erasmus or Alciati or Piero Valeriano; they are missing from all the writings of antiquity. They came to the Old World naked, without emblematic significance. Thus naturalists could not approach this new fauna in the manner of Aldrovandi. Instead, they were forced to limit their descriptions to discussions of appearance, habitat, food, and whatever tales could be assembled from native populations. The tension between Old World and New World natural history is particularly evident in the narrative of Juan Nieremberg (1595–1658). He begins his work with a sixteen-page first chapter that is a masterful – indeed rhapsodic – restatement of the emblematic view of nature.[45] Then he parades by the reader a host of capybaras, marmosets, and pacas, and not a single one has a known similitude or emblematic meaning. All he can provide is a physical description and a picture. The contrast between a page of Nieremberg and a page of Aldrovandi is remarkable.

Jonston compiled his natural history from both kinds of sources: Aldrovandi and Gesner on the one hand, Nieremberg and Markgraf on the other. He was confronted – really the first to be so confronted – with this great incongruity of style: Old World animals, clothed in

similitudes; New World animals, bereft of associations. Perhaps for uniformity, perhaps for personal preference, perhaps because he did not feel able to create an emblematic New World out of whole cloth, Jonston adopted the model of the New World description. The Old World animals lay naked to the observer's eye for the first time. And never again would they resume their emblematic garb.

Browne and the quest for truth in natural history

There were other factors involved, however, in the demise of the emblematic world view, for we can also see it under attack in a work radically different from Jonston's *Natural History*, namely the *Pseudodoxia epidemica* (1646) of Thomas Browne (1605–1682) or, as it is sometimes called, the *Vulgar Errors*.[46] The *Pseudodoxia* is a concerted attempt to purge natural history of commonly, but erroneously, perceived truths. Many people believed that the badger has legs that are shorter on one side than the other; that the chameleon subsists on air and the salamander survives in fire; that a dead kingfisher, hung by the bill, will point in the direction of the wind. Such ascriptions, and hundreds more, can readily be found in the tomes of Gesner, Aldrovandi, and Topsell. But in the *Pseudodoxia*, Browne asks the remarkable questions: Are these stories true? Can they be demonstrated? By appealing to a threefold criterion of reason, experiment, and authority, Browne proceeds to evaluate a large number of such Vulgar Truths. Can a dead kingfisher truly function as a weathervane? Browne hangs several birds outside and finds that no two point in the same direction. Do toads and spiders have a mutual, innate antipathy? Browne decides the matter by placing a toad and several spiders in a jar, and he relates that the spiders crawled all over the unperturbed toad, who swallowed them contentedly, one by one, as they came near his mouth.[47]

Interestingly, in view of our specimen bird, Browne even puts the peacock to the test. Two of Aldrovandi's statements attracted Browne's notice: that peacocks are ashamed of their own feet, and that cooked peacock meat does not spoil.[48] Concerning the first, Browne says that the notion probably arose because the peacock must keep its head back to maintain its display of feathers; if the head inclines forward, the train collapses. It is not a matter of shame but of mechanics. Browne also does an experiment to test the purported nonputrefaction of roasted peacock flesh and discovers it to be true. But, as he points out, it is also true of the meat of many fowl – turkey and pheasant, for example – and so it is hardly a special virtue of the peacock.

Browne clearly has a different view of nature from Aldrovandi; he is uninterested in aphorisms or emblems that are not *true*. His skepticism is even more remarkable when we note that Browne was a true romantic (if the term makes sense when applied to the English baroque), a writer whose most famous sentiment was "I love to lose my self in a mystery, to pursue my Reason to an *O altitudo*."[49] Where did such a man acquire the idea that natural history involves the separation of the true from the false? He did not arrive at these views by reading New World natural histories. I would like to suggest that the inspiration came from seventeenth-century antiquarianism.

Antiquarianism and the quest for historical truth

Antiquarian studies changed markedly in the early seventeenth century, as part of what has been called, perhaps overenthusiastically, a "historical revolution."[50] The antiquarianism of sixteenth-century Italy was not considered a historical discipline. As Arnaldo Momigliano pointed out in a now-classic essay, antiquities in Italy were not used as the tools of history, because the history of ancient Rome and Greece had already been written – by Livy and Caesar and Polybius.[51] Thus the coins and relics unearthed in such abundance were put to other uses; they were mined for their emblematic value, as we have already seen, or they were simply amassed in collections, in the museums of Francesco Calzolari, Ferrante Imperato, Michele Mercati, and Aldrovandi.[52] In very few instances in the sixteenth century do we find a historian treating a coin or burial urn as a piece of historical evidence to be used in reconstructing the past.

But antiquarianism began to take quite a different turn in the northern countries around the end of the sixteenth century. Antiquarians in England and Denmark, in particular, began to see their artifacts as vital historical clues. The reason for the different attitude in the north is straightforward: Northern countries had no classical, canonical histories.[53] Except for brief mentions in Caesar and Tacitus, the ancient history of England was a blank. There were, of course, medieval histories that purported to take England back to its first "plantation" – the works of Geoffrey of Monmouth, Gildas, and Bede – but as their authenticity came to be challenged in the late sixteenth century, the void began to be filled with reconstructions based on artifactual evidence.

In England we see this quite clearly in the work of William Camden (1551–1623), whose *Britannia* of 1586 was a prodigious attempt to reconstruct the entire face of Roman Britain from such things as coins, inscriptions, and the remains of Roman roads.[54] The artifact was being

given a new power, and the antiquaries were consciously aware of it. Camden declares, for example, that you can learn more about medieval dress from monuments, glass windows, and reliefs than from the writers of those times.[55] The artifact does not lie. It is this obsession with truth that really distinguishes post-Camden antiquarians from earlier collectors of antiquities and from literary historians. Camden says in the preface of his history of Queen Elizabeth's reign: "For the love of truth, as it hath beene the only spurre unto me to undertake this work; so hath it also been my onely scope and aime."[56] When we bear in mind that truth was not high on the list of the essential qualities of literary history – certainly it ranked below moral education as a virtue – we see what a revolution the artifact has wrought.

Antiquarianism and natural history

Antiquarian history did not have an immediate impact on literary history. Bacon kept "Antiquarianism" and "Perfect History" quite separate in the *Novum organum*, and they remained apart until after the middle of the seventeenth century.[57] But the antiquarian spirit did have a considerable effect on natural history, because the two fields overlapped considerably. There was, after all, no firm line between the Saxon urn, the stone axhead, the fossilized shark tooth, the unicorn horn, and the agate. Most of the great museum collections of the first half of the century – those of Basil Besler of Nuremberg, Ole Worm of Copenhagen, or the Habsburg emperors in Prague and Vienna – contained a mixture of natural and antiquarian artifacts.[58] And so natural historians who were exposed to the antiquarian attitude toward evidence came to see the natural world quite differently from Aldrovandi.[59]

Thomas Browne certainly falls into this category. He had a passionate interest in antiquities. One of his finest prosodic rhapsodies, the *Hydrotaphia*, or *Urn-Burial*, was inspired by the discovery of several Saxon burial urns in a Norfolk tomb, and in many of his other writings and letters Browne manifested a great fondness for the artifacts of the past.[60] All his works reflect an intimate familiarity with the antiquarian scholars of his century: Camden, Worm, John Twyne, John Stow, Richard Verstegan, Jan Goropius Becanus, William Dugdale, and many more. He was much impressed by the ability of the antiquarian to wrest a truth from "the ruins of forgotten time" on the basis of slight, but incontrovertible, evidence.[61] Browne tested Roman artifacts for residual magnetism, attempted to determine the age and sex of exhumed skeletons, and

suggested how barrows could be dated by the presence of "distinguishing substances."[62] In other words, he made artifactual evidence the standard for determining historical truth, and he tended to ignore or downplay the evidence of literary history, in spite of his own literary inclinations. It is not surprising, then, that when Browne approached the writing of natural history, he subjected the literary tradition there to the test of empirical evidence. And with this new conception of what constitutes natural history, the entire emblematic tradition fell apart – or, more accurately, became irrelevant. For Browne, animal symbolism was no longer a part of the study of nature, because it had no basis in truth.

It would seem, then, that Thomas Browne and Joannes Jonston reformulated natural history for quite different reasons but with rather similar results, and, most interestingly to note, at almost exactly the same time.[63] But this is still not the whole story. There is a third factor that should at least be considered in the decline of the emblematic world view, and that is Baconianism. Several observers have pointed to Bacon as being an instrumental force in the rise of a new natural history in the latter part of the seventeenth century,[64] and it is not unreasonable to suppose that Bacon's views might also have been felt in the earlier age of Browne, Markgraf, and Jonston.

Bacon and the real language of nature

Bacon never wrote a natural history; his posthumous *Sylva sylvarum*, of 1627, which is often called his "natural history," is in reality a heterogeneous collection of random observations and suggestions for further inquiry. But Bacon did have definite ideas on how a proper natural history should be written, and he thought that the existing natural histories were unsatisfactory, because, as his executor William Rawley put it, they showed the world as men made it, not as God made it; Bacon's natural history, in contrast, would have "nothing of Imagination" in it. And Rawley elaborated:

> For those Natural Histories which are Extant, being gathered for Delight and Use, are full of pleasant Descriptions and Pictures; and affect and seek after Admiration, Rarities, and Secrets. But contrariwise, the Scope which his Lordship intendeth is to write such a Naturall History, as may be Fundamental to the Erecting and Building of a true Philosophy; For the illumination of the Understanding; the extracting of Axiomes, and the producing of many Noble Workes, and Effects.[65]

What makes Bacon particularly striking, however, is that he not only spurned the use of the emblematic tradition in natural history; he rejected the entire emblematic world view as invalid. There is no web of correspondences for Bacon; similitudes do not lead to understanding; the universe is not written in a code that reveals the attributes of God.[66] Bacon was one of the first natural philosophers to take this stance. As early as the "Valerius terminus" of around 1603, Bacon had stated: "For if any man shall think by view and inquiry into these sensible and material things, to attain to any light for the revealing of the nature or will of God, he shall dangerously abuse himself."[67] And in his later writings Bacon regularly warns against trying to impose patterns on nature that do not really exist in nature. "There is a great difference," Bacon says, in aphorism 23 of his *Novum organum*, "between the Idols of the human mind and the Ideas of the divine. That is to say, between certain empty dogmas, and the true signatures and marks set upon the works of creation as they are found in nature."[68] And elsewhere, more flatly: "The world is not the image of God."[69]

Bacon's rejection of the notion that the natural world is a divine language, encoded by God, is almost certainly related to his views on human language. The prevalent, Platonic tendency of the late Renaissance, as we have seen, was to consider the meanings of words as inherent in the words themselves, just as the meanings of animals lay embedded in their very natures. Words and things were all of a piece, and the entire world of objects, letters, signs, and symbols was part of one language, the meaning of which was built in by God.

Bacon argued for separating words from things. Words are not intrinsically connected to objects but are arbitrary and conventional. Their only meanings are the ones we assign to them.[70] Such a view of language, which ultimately (and ironically, considering Bacon's reputation) is derived from Aristotle, undermines to a considerable extent the emblematic world view. If words have no hidden meanings, why should nature? If the language of man is arbitrary, can there be a language of nature at all? How can the Book of Nature shed light on God's plan, if the language of that book is devoid of meaning? Bacon seems to have realized the implications and to have decided that nature is not a multilayered complex of signs and hieroglyphics and that philosophers need not concern themselves with such matters.

The impact of Baconianism on natural history

Baconianism thus contained the seeds of insurrection against the emblematic world view. But did these seeds bear immediate fruit? Did

Baconianism play any role in the demise of that view? It seems that the answer is no. Thomas Browne was indebted to Bacon in various ways, especially in the importance he ascribed to experiment and observation, but Browne's view of nature seems independently arrived at and, in any event, is not especially Baconian. Jonston was not touched by Bacon at all, nor were the New World naturalists on whose work Jonston relied, such as Markgraf. In truth, Bacon's attitude seems to have had little impact on naturalists before the era of the Royal Society. If his presence was felt before then, it was so subtle as to be, shall we say, occult.

Natural history, antiquarianism, and the Scientific Revolution

We must conclude then that the dismantling of the emblematic world view was an event prior to, and independent of, the rise of Baconianism. It was also prior to, and independent of, the spread of Cartesian mechanism. Consequently, we historians might well rethink some of *our* commonly perceived truths about the relationship between the rise of the mechanical philosophy and the decline of the world of magic. We seem to take it for granted that the former caused the latter; that nature was stripped of its correspondences and occult forces by a generation of Cartesians committed to a philosophy that allowed only explanations grounded on matter in motion. In truth, Browne, Jonston, and their generation dispensed with sympathies and correspondences for entirely different reasons, because of developments outside the physical sciences, and even outside science itself.

One final point seems worth stressing. We have squeezed antiquarianism in through the back door here, by demonstrating its impact on natural history. But the influence of antiquarianism, and of seventeenth-century historical thought in general, is broader than this, and the interplay of science and history is one of the most neglected facets of seventeenth-century studies. The Scientific Revolution was, after all, itself a historical revolution. It changed forever the way we would view Aristotle, Ptolemy, Galen. It altered the very concept of historical process. It is no simple coincidence that scientists of the seventeenth century developed keen interests in such matters as the origins of language, the early geological history of the earth, the settlement of the New World, the chronology of Egyptian and Chinese history, the collection of fossils, the early history of Christianity. The union of antiquarianism with literary history fashioned by historians was very similar to the approach of natural philosophers who forged a workable alliance between experiment and authority.

Both groups developed, really for the first time, a true historical sense, which allowed them to place the past in proper perspective and, consequently, opened up the possibilities of the present and future. I merely suggest here that the similarities are perhaps not coincidental. It may well be that the historical revolution played a greater role than we now appreciate in the reconstruction of world views that we call the Scientific Revolution.

Notes

1 Since it is hard to know whom to blame for our distorted view of natural history's role in the Scientific Revolution, I prefer not to blame anyone, or rather, to blame us all. Survey writers, after all, must rely on secondary scholarship, and in the field of natural history they have not had much to read in recent years. There are exceptions, which I will gratefully acknowledge as we proceed.

2 I refer here to Charles Singer, *A Short History of Biology* (New York: Schuman, 1931, subsequently revised); F. J. Cole, *A History of Comparative Anatomy from Aristotle to the Eighteenth Century* (London: Macmillan, 1944); and Erik Nordenskiold, *The History of Biology: A Survey*, trans. Leonard B. Eyre (New York: Tudor, 1946).

3 My choice of the term "emblematic world view" is discussed, and defended, in Note 26, this chapter.

4 Conrad Gesner, *Historica animalium Lib III: De avium* (Zurich: Froschover, 1555), pp. 630–9.

5 There is a great deal of literature on Gesner, but most of it fails to deal with the questions raised; nevertheless, I should mention Hans Wellisch, "Conrad Gesner: A Bio-bibliography," *Journal of the Society for the Bibliography of Natural History*, 7 (1975):151–247; J. G. Helmcke, "Der Humanist Conrad Gessner auf der Wende von mittelalterliche Tierkunde zur neuzeitlichen Zoologie," *Physis*, 12 (1970):329–46; Charles E. Raven, "Gesner and the Age of Transition," in his *Natural Religion and Christian Theology: The Gifford Lectures, 1951. First Series: Science and Religion* (Cambridge: Cambridge University Press, 1953), pp. 80–98. Still worth consulting is Henry Morley, "Conrad Gesner," in *Toward Modern Science*, ed. Robert M. Palter (1961; reprint edition, New York: Dutton, 1969), pp. 358–82, which at least discusses Gesner's far-ranging interests without a hint of apology. There is also a recently published doctoral dissertation that is considerably above the norm of that genre: Caroline Aleid Gmelig-Nijboer, *Conrad Gessner's "Historia animalium": An Inventory of Renaissance Zoology*, Communicationes Biohistoricae Ultrajectinae, no. 72 (Meppel: Krips, 1977); this contains a translation of Gesner's Preface to volume 1, in which he gives his own explanation of his enterprise, pp. 145–73.

6 Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Pantheon Books, 1970), pp. 17–45. Foucault's work has come in for considerable criticism from historians, although most of the spleen

has been vented on Foucault's proposed transition from the classical age to the "age of man" that, Foucault argued, occurred around the turn of the nineteenth century; see for example Hubert L. Dreyfus and Paul Rabinow, *Michel Foucault: Beyond Structuralism and Hermaneutics*, 2nd ed. (Chicago: University of Chicago Press, 1982). Little attention has been directed toward Foucault's characterization of the Renaissance as the "age of similitude." An exception is George Huppert, "'Divinatio et eruditio': Thoughts on Foucault," *History and Theory*, 13 (1974):191–207, which focuses on the sixteenth century; Huppert is highly critical of Foucault's methods and flatly denies his conclusions. I am inclined to be more charitable; Foucault may not have been a good historian, or a historian at all, but he somehow managed to see a feature of the Renaissance that proper historians have overlooked, or else ascribed only to a marginal group of natural magicians and alchemists. As for the term "episteme," see this chapter, Note 26.

7 The best introduction to Horapollo is George Boas's introduction to his edition, *Hieroglyphics of Horapollo*, Bollingen series, no. 23 (New York: Pantheon Books, 1950). On hieroglyphics in the Renaissance, see Rudolf Wittkower, "Hieroglyphics in the Early Renaissance," in *Allegory and the Migration of Symbols* (Boulder, Colo.: Westview Press, 1977), pp. 115–28, 210–12; Erik Iversen, *The Myth of Egypt and Its Hieroglyphics* (Copenhagen: Gec Gad, 1961); E. H. Gombrich, "Icones symbolicae: Philosophies of Symbolism and Their Bearing on Art," in *Symbolic Images: Studies in the Art of the Renaissance II* (Oxford: Oxford University Press [Phaidon Press], 1978), pp. 123–95, 228–35.

8 Erwin Panofsky, *The Life and Art of Albrecht Dürer* (Princeton: Princeton University Press, 1943), pp. 173–77. The Dürer drawings and woodcuts after Horapollo are reproduced in Karl Giehlow, "Die Hieroglyphenkunde des Humanismus in der Allegorie der Renaissance," *Jahrbuch der kunsthistorischen Sammlungen der Allerhöchsten Kaiserhauses*, 32 (1915):1–232; frontispiece and pp. 170–218.

9 Renaissance fascination with coin symbolism is discussed in Don C. Allen, *Mysteriously Meant: The Rediscovery of Pagan Symbolism and Allegorical Interpretation in the Renaissance* (Baltimore: Johns Hopkins University Press, 1970), esp. pp. 249–76. The Alberti and Cumano medals are discussed in Wittkower, "Hieroglyphics," pp. 120–2. Many other Renaissance medals may be conveniently examined in Graham Pollard, *Renaissance Medals from the Samuel H. Kress Collection at the National Gallery of Art* (London: Phaidon Press, 1967).

10 See the reference in Note 16, this chapter.

11 Arnaldo Momigliano, "Ancient History and the Antiquarian," in his *Studies in Historiography* (New York: Harper & Row [Harper Torchbooks], 1966), pp. 1–39. This article first appeared in *Journal of the Warburg and Courtauld Institutes*, 13 (1950):285–315.

12 The Aesopic tradition in the Renaissance can be partially unraveled by consulting Ben Edwin Perry's introduction to his translation of *Babrius and Phaedrus* (Loeb Classical Library, 1965), pp. xi–cii, and Joseph Jacobs, *The Fables of Aesop . . .*: vol. 1, *History of the Aesopic Fable* (1889; reprint edition, New York: Franklin, 1970).

13 The title notwithstanding, there is much useful information on sixteenth-century Continental editions of Aesop in Edward Hodnett, *Aesop in England: The Transmission of Motifs in Seventeenth-century Illustrations of Aesop's Fables* (Charlottesville: University Press of Virginia, 1979), pp. 34–50.

14 Lilio Giraldi, *De deis gentium varia et multiplex historia* (Basel, 1548); Natale Conti, *Mythologiae* (Venice, 1551); Vicenzo Cartari, *Le imagini colla sposizione degli dei degli antichi* (Venice, 1556). The best introduction by far to the sixteenth-century mythological tradition is still Jean Seznec, *The Survival of the Pagan Gods: The Mythological Tradition and Its Place in Renaissance Humanism and Art*, trans. Barbara F. Sessions (1953; reprint edition, New York: Harper & Row [Harper Torchbooks], 1961), esp. pp. 219–56. See also Don C. Allen, *Mysteriously Meant*, pp. 201–47.

15 Cesare Ripa, *Iconologia* (Rome, 1593; first illustrated ed., Rome, 1603). On the importance of Ripa, both for the Renaissance and for the modern scholar, see D. J. Gordon, "Ripa's Fate," in *The Renaissance Imagination*, ed. Stephen Orgel (Berkeley and Los Angeles: University of California Press, 1975), pp. 51–74.

16 Desiderius Erasmus, *Adagiorum collectanea* (Paris: Phillip, 1500); *Adagiorum chiliades* (Venice: Aldi, 1508); *Adagiorum chiliades* (Basel: Froben, 1536). There were many other editions; see Margaret Mann Phillips, *The "Adages" of Erasmus: A Study with Translations* (Cambridge: Cambridge University Press, 1964). An English translation of the entire collection is now in publication: Desiderius Erasmus, *Adages*, trans. Margaret Mann Phillips, annot. R. A. B. Mynors (Toronto: University of Toronto Press, 1982–), but so far only two volumes – containing the first one thousand adages – of the projected seven have appeared.

17 Margaret Mann Phillips, *Erasmus on His Times: A Shortened Version of the "Adages" of Erasmus* (Cambridge: Cambridge University Press, 1967), pp. xi–xii.

18 Rosalie Colie, in her wonderful lecture "Small Forms: Multo in parvo," explains the popularity of adages, calling them "keys to culture, or convenient agents of cultural transfer" and suggesting that an adage "compresses much experience into a very small space; and by that very smallness makes its wisdom so communicable"; see Rosalie L. Colie, *The Resources of Kind: Genre-theory in the Renaissance*, ed. Barbara K. Lewalski (Berkeley and Los Angeles: University of California Press, 1973), pp. 32–75, esp. pp. 33–4.

19 For a thorough study of the influence of the Greek Anthology in the sixteenth century, see two books by James Hutton: *The Greek Anthology in Italy to the Year 1800* (Ithaca, N.Y.: Cornell University Press, 1935) and *The Greek Anthology in France and in the Latin Writers of the Netherlands to the Year 1800* (Ithaca, N.Y.: Cornell University Press, 1946).

20 The literature of Renaissance emblematics is vast, although much of it is

highly specialized. The best introduction is still the first volume of Mario Praz, *Studies in Seventeenth-century Imagery*, 2 vol., Studies of the Warburg Institute, no. 3 (London: Warburg Institute, 1939–1947); vol. 2 is a bibliography. See also Daniel S. Russell, *The Emblem and Device in France*, French Forum Monographs, no. 59 (Lexington, Ky.: French Forum, 1985), and Peter M. Daly, *Literature in the Light of the Emblem: Structural Parallels between the Emblem and Literature in the Sixteenth and Seventeenth Centuries* (Toronto: University of Toronto Press, 1979).

21 A variorum translation of Alciati has recently been published: Peter M. Daly, ed.; with Virginia W. Callahan, assisted by Simon Cuttler, *Andreas Alciatus*: Vol. 1, *The Latin Emblems Indexes and Lists*; Vol. 2, *Emblems in Translation* (Toronto: University of Toronto Press, 1985). Still useful is Henry Green, *Andrea Alciati and His Books of Emblems: A Biographical and Bibliographical Study* (1872; reprint edition, New York: Franklin, 1965). For an idea of the impact of Alciati, see Daniel Russell, "Alciati's Emblems in Renaissance France," *Renaissance Quarterly*, 34 (1981):534–54.

22 Peter Iselburg, *Emblemata politica* (Nuremberg, 1617), no. 3.

23 The device can be found in Paolo Giovio, *Dialogo dell'Imprese militari et amorose* (Lyons, 1559), p. 20, and in many subsequent device and emblem books.

24 Hessel Miedema, "The Term *emblema* in Alciati," *Journal of the Warburg and Courtauld Institutes*, 31 (1968):234–50; Alison Saunders, "Alciati and the Greek Anthology," *Journal of Medieval and Renaissance Studies*, 12 (1982):1–18.

25 Daniel Russell, "Emblems and Hieroglyphics: Some Observations on the Beginnings and Nature of Emblematic Forms," *Emblematica*, 1 (1986): 227–43.

26 The choice of the term "emblematic" seems defensible enough, although one could make a good case for "symbolic" (but *not* "magical" or "hermetic," which reflect a serious misunderstanding of the source of these traditions). But why "world view"? Why not "episteme," or "paradigm," or "discourse"? The answer is simply that all of these terms are laden with connotations that say more about twentieth-century historiography than sixteenth-century epistemology. "World view," at least for the moment, seems to mean exactly, and only, what it says. If it buzzes too badly, I would be happy to abandon it for a more acceptable label for the Renaissance outlook I have tried to identify.

27 Raven, *English Naturalists*, p. 47; Paul Delaunay, *La zoologie au seizième siècle*, Histoire de la pensée, no. 7 (Paris: Hermann, 1962), pp. 63–81; Lynn Thorndike, *A History of Magic and Experimental Science*, 8 vols. (New York: Columbia University Press, 1923–1958), 6:277 (discussing Aldrovandi).

28 Very little attention has been given to the impact of the *Kiranides* – the purported writings of Kiranus, king of Persia – on Renaissance thought, perhaps because the work never saw its way into print. Lynn Thorndike did devote a short chapter to it in the second volume of his *History of Magic and Experimental Science*, 2:229–35, but he never picked up on it again, and neither has anyone else. And yet Gesner obviously had a manuscript of the *Kiranides*, which he cited regularly for the magical attributes of animals.

29 Since the prospect of citing the current literature on hermeticism is too daunting, I will seek relief in the almost certain fact that the subject is well discussed elsewhere in this volume.

30 Aldrovandi is ignored, or deplored, in virtually every English-language discussion of Renaissance natural history, whether survey or specialized. Fortunately Italian scholars have launched a rescue effort for their beleaguered countryman; see Sandra Tugnoli Pattaro, *Metodo e sistema delle scienze nel pensiero de Ulisse Aldrovandi* (Bologna: CLUEB, 1981); Giuseppe Olmi, *Ulisse Aldrovandi: Scienze e natura nel secondo cinquecento*, Quaderni di storia e filosofia della scienze, no. 4, (Trent: University of Trent, 1976), and the same author's "Arte e natura nel cinquecento Bolognese: Ulisse Aldrovandi e la raffigurazione scientifica," in *Le arti a Bologna e in Emilia dal XVI al XVII secolo*, ed. Andrea Emiliani (Bologna: CLUEB, 1982), pp. 151–71 and Figures 195–201.

31 Ulisse Aldrovandi, *Ornithologia II* (Bologna, 1600), pp. 1–31.

32 Joachim Camerarius, *Symbolorum & emblematum ex re herbaria desumtorum centuria una collecta* (Nuremberg, 1590 [i.e., 1593]); *Symbolorum & emblematum ex animalibus quadrupedibus desumtorum centuria altera collecta* (Nuremberg, 1595); *Symbolorum & emblematum ex volatilibus ex insectis desumtorum centuria tertia collecta* (Nuremberg, 1596); *Symbolorum et emblematum ex aquatilibus et reptilibus desumptorum centuria quarta* (Nuremberg, 1604). The importance of Camerarius for natural history is stressed by Wolfgang Harms, "On Natural History and Emblematics in the Sixteenth Century," in *The Natural Sciences and the Arts*, ed. Allan Ellenius, Acta Universitatis Upsaliensis, Figura Nova, no. 22 (Uppsala: Almqvist & Wiksell, 1985), pp. 67–83. Harms is one of the very few to argue for the unity of natural history and emblematics in the late Renaissance; he is, interestingly, a historian of emblematics, not science. By contrast, we might note that Agnes Arber, in her still-definitive book on herbals, devoted three pages to Camerarius's botanical work, without once mentioning his emblem books; see *Herbals: Their Origin and Evolution* (1938; reprint edition, Cambridge: Cambridge University Press, 1986), pp. 76–8.

33 Gesner, *Historia animalium Lib. I. de quadripedibus viviparis* (Zurich, 1551), 1:399–409.

34 Ulisse Aldrovandi, *De quadrupedibus digitatis* (Bologna, 1637), pp. 459–70.

35 The harshest criticism of Topsell came from Charles E. Raven, *English Naturalists from Neckham to Ray: A Study of the Making of the Modern World* (New York: Kraus Reprint, 1968), who called Topsell "unimaginative, commonplace. . . . He was not a man of high distinction, intellectual or practical," pp. 219–20.

36 Edward Topsell, *A Historie of Four-Footed Beastes* (London, 1607), sig. A5v.

37 Joannes Jonston, *Historia naturalis*, 6 vols. (Frankfurt, 1650–1653). The six volumes are on quadrupeds, birds, serpents, fish, marine invertebrates, and insects; all except the last were published in 1650.

38 Jonston, *Historia naturalis de avibus*, pp. 56–8.
39 Our other specimen animal, the hedgehog, has an entry in the volume *De quadrupetibus*, pp. 170–1. The entry is about one-tenth the size of Aldrovandi's article.
40 Willughby's *Ornithologia* (London, 1676) is often referred to as an example of the "new" natural history inspired by the Royal Society.
41 Foucault, *Order of Things*, pp. 128–130 (citing Jonston, *Historia naturalis*, 1:1); the page cited might provide ammunition to those who question the depth of Foucault's scholarship. Foucault gives 1657 as the "date of birth" of this new classical natural history; in fact, that is the date of birth only of the Amsterdam reprint of Jonston's work. Although Foucault then claims that the date is not definitive, but only symbolizes a landmark, it still seems that if we are going to use a date at all, it might as well be the right one, that is, 1650.
42 François Jacob, *The Logic of Life: A History of Heredity*, trans. Betty E. Spillman (New York: Vintage Books, 1976), pp. 28–9 In typical Parisian fashion, Jacob and Foucault do not acknowledge each other's existence, but it is hard to believe they were not peeking at one another's work now and then.
43 M. M. Slaughter, *Universal Languages and Scientific Taxonomy in the Seventeenth Century* (New York: Cambridge University Press, 1982), pp. 56–7; Peter Fingesten, *The Eclipse of Symbolism* (Columbia: University of South Carolina Press, 1970), p. 54. See also Owen Hannaway, *The Chemists and the Word: The Didactic Origins of Chemistry* (Baltimore: Johns Hopkins University Press, 1975), who does not give the transformation a name but describes it beautifully.
44 Charles L'Ecluse, *Exoticorum libri decem* (Leiden, 1605); Jan de Laet, *Novis orbis* (Leiden, 1633); Juan Eusebius Nieremberg, *Historia naturae* (Antwerp, 1635); Georg Markgraf, *Historia naturalis Brasiliensis* (Leiden, 1648). Of these four, only Markgraf has been well studied – perhaps because he was such a "good" zoologist. See the various excellent publications of P. J. P. Whitehead, especially "Georg Markgraf and Brazilian Zoology," in *Johan Maurits van Nassau-Siegen, 1604–1679: A Humanist Prince in Europe and Brazil*, ed. E. van den Boogaart (The Hague: Johan Maurits van Nassau Stichting, 1979), pp. 424–71. Markgraf's book is often cataloged under the name of his colleague, Willem Piso.
45 Nieremberg, *Historia naturae*, pp. 1–16.
46 Thomas Browne, *Pseudodoxia epidemica: Or, Enquiries into very many received Tenents, and common presumed truths* (London, 1646).
47 Browne, *Pseudodoxia epidemica*, pp. 175 (toad), 157–63 (chameleon), 138–40 (salamander), 127–9 (kingfisher), 115 (badger). Two of the best studies of the *Pseudodoxia* are by Robert R. Cawley: "The Timeliness of *Pseudodoxia epidemica*" and "Sir Thomas Browne and His Reading." Both are in *Studies in Sir Thomas Browne*, ed. Robert R. Cawley and George Yost (Eugene: University of Oregon Books, 1965), pp. 1–40, 104–66.
48 Browne, *Pseudodoxia epidemica*, pp. 172–3.
49 Thomas Browne, *Religio medici*, in *Works*, 6 vols., ed. Geoffrey Keynes (London: Faber & Gwyer, 1928–1931), 1:13.

50 F. Smith Fussner, *The Historical Revolution: English Historical Writing and Thought, 1580–1640* (New York: Columbia University Press, 1962). For one reaction, see Joseph H. Preston, "Was There an Historical Revolution?", *Journal of the History of Ideas*, 38 (1977):353–64.
51 Momigliano, "Ancient History and the Antiquarian."
52 On the nature of the sixteenth-century museum, see the collection of essays in Oliver Impey and Arthur MacGregor, eds., *The Origins of Museums: The Cabinet of Curiosities in Sixteenth- and Seventeenth-century Europe* (Oxford: Oxford University Press [Clarendon Press], 1985).
53 Momigliano, "Ancient History and the Antiquarian," p. 7.
54 On William Camden, see Stuart Piggott, "William Camden and the 'Britannia,'" in *Ruins in a Landscape: Essays in Antiquarianism* (Edinburgh: Edinburgh University Press, 1976), pp. 33–53; T. D. Kendrick, *British Antiquity* (London: Methuen, 1970), pp. 143–59; Hugh Trevor-Roper, "Queen Elizabeth's First Historian: William Camden," in *Renaissance Essays* (Chicago: University of Chicago Press, 1985), pp. 121–48; F. J. Levy, *Tudor Historical Thought* (San Marino, Calif.: Huntington Library, 1967), pp. 148–63; Fussner, *Historical Revolution*, pp. 230–52.
55 Camden, quoted in Piggott, "William Camden and the 'Britannia,'" p. 37.
56 William Camden, *The Historie of the Most Renowned and Victorious Princesse Elizabeth* (London, 1630), "To the Reader," sig. B1v; partially quoted (from a different translation) in Herschel Baker, *The Race of Time: Three Lectures on Renaissance Historiography* (Toronto: University of Toronto Press, 1967), p. 20.
57 J. G. A. Pocock, *The Ancient Constitution and Feudal Law: A Study of English Historical Thought in the Seventeenth Century* (Cambridge: Cambridge University Press, 1957; reprint edition, New York: Norton, 1967), pp. 6–7.
58 On early seventeenth-century museums, see Impey and MacGregor, *Origins of Museums*.
59 There is a good discussion of the interaction between natural history and antiquarianism (as well as other historical disciplines) in Barbara Shapiro, "History and Natural History in Sixteenth- and Seventeenth-century England: An Essay on the Relationship between Humanism and Science," in *English Scientific Virtuosi in the Sixteenth and Seventeenth Centuries* (Los Angeles: William Andrews Clark Memorial Library, 1979), pp. 1–55. See also my earlier dissertation, "The Sense of the Past in English Scientific Thought of the Early Seventeenth Century: The Impact of the Historical Revolution," University of Wisconsin at Madison, 1975, which covers similar ground.
60 Browne's *Hydrotaphia – Urne-Burial, or, A Brief Discourse of the Sepulchrall Urnes lately found in Norfolk* was originally published in 1658; it is found in *Works*, ed. Keynes, 4:7–50.
61 A splendid example of an antiquarian deduction was John Stow's claim that the Romans buried at least some of their dead in coffins, a claim buttressed solely, but powerfully, by the discovery of tiny nailheads set in a coffin-shaped array around many graves in a Roman cemetery at Spitalfields. Browne refers to Stow and Spitalfields in the *Hydrotaphia*

(*Works*, 4:17). On Spitalfields, see M. C. W. Hunter, "The Royal Society and the Origins of British Archaeology," *Antiquity*, 65 (1971):113–21, 187–92; p. 118.

62 Browne, *Hydrotaphia*, in *Works*, 4:18, 26; "Of Artificial Hills, Mounts, or Burrows," *Miscellany Tracts*, in *Works*, 5:99–103, p. 102.

63 This conjunction of "discontinuities" would no doubt have pleased Foucault, although, were he still with us, he would doubtless reject my attempts to give the transition a causal explanation.

64 See especially Joseph M. Levine, "Natural History and the History of the Scientific Revolution," *Clio*, 13 (1983):57–73. Levine argues that John Ray and his contemporaries viewed natural history as central to the new science. What was significant to them was the accumulation of new facts, and the ordering of these facts, and they saw Francis Bacon as their founder in this approach. Levine argues that we must not ignore "this primacy of natural history" if we wish to understand seventeenth-century science (p. 69).

65 William Rawley, "To the Reader," in Francis Bacon, *Sylva sylvarum* (London, 1627), sig. A3r, A1v; or James Spedding et al., eds., *The Works of Francis Bacon*, 14 vols. (London: Longmans, 1857–1874), 2:335–7.

66 Paolo Rossi, "Hermeticism, Rationality, and the Scientific Revolution," in M. L. Righini Bonelli and William R. Shea, eds., *Reason, Experiment, and Mysticism in the Scientific Revolution* (New York: Science History, 1975), pp. 247–73; citing pp. 258–9.

67 Bacon, *Valerius terminus*, in *Works*, 3:218.

68 Bacon, *Novum organum*, in *Works*, 4:51.

69 Bacon, *De augmentis*, in *Works*, 4:341.

70 Martin Elsky, "Bacon's Hieroglyphs and the Separation of Words and Things," *Philological Quarterly*, 63 (1984):449–60.

8

From the secrets of nature to public knowledge

WILLIAM EAMON

Power told is power lost.

Zuni proverb

The social function of secrecy as an instrument of discipline in the acquisition of knowledge is well known; so too is its use as a political mechanism by which ruling groups try to ensure that they remain in power. Secret societies, fraternities, and "mysteries" have existed in traditional and modern societies alike, and specialized forms of knowledge, including craft skills, religious doctrines, and scientific knowledge, are often protected from public discourse by exclusive orders. Initiation into such mysteries, often strictly controlled by elaborate rules or rituals, separates the select few who know secrets from the many who do not, thereby preserving knowledge as a sacred domain and knowers as rulers. In many cases, particularly in primitive societies, secrecy and initiation are dual means by which status and social stability are maintained.[1]

Secrecy, however, is in principle universally rejected in modern science. Free and open communication of research is regarded as a sine qua non of scientific progress and a major component of the "ethos" governing science.[2] The ideology of openness in science is an important, although hitherto largely neglected, contribution of the Scientific Revolution. It emerged as a reaction against the traditional doctrine of the esotericism of science, which in the sixteenth and seventeenth centuries was widely interpreted in political terms. Classical and medieval attitudes toward the disclosure of scientific knowledge were largely governed by the principle that the "secrets of

An earlier version of this paper was published as "From the Secrets of Nature to Public Knowledge: The Origins of the Concept of Openness in Science," in *Minerva*, 23 (1985):321–47. I am grateful to Edward Shils, the editor of *Minerva*, for allowing it to reappear in revised form here.