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DOCUMENT 9

Hugh of St. Victor On the Mechanical Arts

Hugh of St. Victor, first a monk and then a teaching master at the abbey of St. Victor near Paris from the 1100s until his death in 1141, is one of the most important figures in the history of medieval attitudes toward technology. Nicknamed by his contemporaries "a new Augustine," Hugh was a mystic, as well as a theologian and educator. He is best known for his vision of technology as part of man's religious and philosophical quest to restore himself to his happier life in Paradise before the Fall of Adam and Eve.

Although Hugh did not coin the term mechanical arts (artes mechanicae) for technology, he was the first to describe in detail how they were an essential part of human knowledge. Hugh paired the seven mechanical arts (fabric making, armament and architecture, commerce, agriculture, hunting and food preparation, medicine, and theatrics and games) with the seven liberal arts. He also argued that technology, like the liberal arts, demonstrated human intelligence and man's God-given ability to reason. This was an important statement because some traditions inherited from antiquity had denigrated crafts and craftsmanship as purely physical labor and, therefore, as not qualifying as "knowledge."

Hugh's conception of the mechanical arts was widely copied during the Middle Ages. He and other medieval writers on the classifications of the arts and sciences ensured that medieval culture would recognize technology as having an established and positive role in human life.

The first selection here places the mechanical arts in a biblical, philosophical, and religious context. Note that although Hugh, following Aristotle, says that art merely imitates nature, he also suggests in the last line that the ingenuity of the "artificer" or craftsman seems to rival that of nature. The second selection is comprised of Hugh's descriptions of the individual mechanical arts. Hugh puts each in a strikingly positive light, describing even commerce, often criticized by the Church as immoral, as pursued for the "common benefit of all." Together, the descriptions give a sense of daily life in the twelfth century.

Chapter Nine: Concerning the Three Works

"Now there are three works—the work of God, the work of nature, and the work of the artificer, who imitates nature." The work of God is to create that which was not, whence we read, "In the beginning God created heaven and earth"; the work of nature is to bring forth into actuality that which lay hidden, whence we read, "Let the earth bring forth the green herb," etc.; the work of the artificer is to put together things disjoined or to disjoin those put together, whence we read, "They sewed themselves aprons." For the earth cannot create the heaven, nor can man, who is powerless to add a mere span to his stature, bring forth the green herb.

Among these works, the human work, because it is not nature but only imitative of nature, is fitly called mechanical, that is adulterate, just as a skeleton key is called a "mechanical" key. How the work of the artificer in each case imitates nature is a long and difficult matter to pursue in detail. For illustration, however, we can show the matter briefly as follows: The founder who casts a statue has gazed upon man as his model. The builder who has constructed a house has taken into consideration a mountain, for, as the Prophet declares, "Thou sendest forth springs in the vales; between the midst of the hills the waters shall pass"; as the ridges of mountains retain no water, even so does a house require to be framed into a high peak that it may safely discharge the weight of pouring rains. He who first invented the use of clothes had considered how each of the growing things one by one has its proper covering by which to protect its nature from offense. Bark encircles the tree, feathers cover the bird, scales encase the fish, fleece clothes the sheep, hair garbs cattle and wild beasts, a shell protects the tortoise, and ivory makes the elephant unafraid of spears. But it is not without reason that while each living thing is born equipped with its own natural armor, man alone is brought forth naked and unarmed. For it is fitting that nature should provide a plan for those beings which do not know how to care for themselves, but that from nature's example, a better chance for trying things should be provided to man when he comes to devise for himself by his own reasoning those things naturally given to all other animals. Indeed, man's reason shines forth much more brilliantly in inventing these very things than ever it would have had man naturally possessed them. Nor is it without cause that the proverb says: "Ingenious

want hath mothered all the arts." Want it is which has devised all that you see most excellent in the occupations of men. From this the infinite varieties of painting, weaving, carving, and founding have arisen, so that we look with wonder not at nature alone but at the artificer as well.

Chapter Twenty: The Division of Mechanical Sciences into Seven

Mechanical science contains seven sciences: fabric making, armament, commerce, agriculture, hunting, medicine, and theatrics. Of these, three pertain to external cover for nature, by which she protects herself from harms, and four to internal, by which she feeds and nourishes herself. In this division we find a likeness to the *trivium* and *quadrivium*, for the *trivium* is concerned with words, which are external things, and the *quadrivium* with concepts, which are internally conceived. The mechanical sciences are the seven handmaids which Mercury received in dowry from Philology, for every human activity is servant to eloquence wed to wisdom. Thus Tully, in his book on rhetoricians, says concerning the study of eloquence:

By it is life made safe, by it fit, by it noble, and by it pleasurable: for from it the commonwealth receives abundant benefits, provided that wisdom, which regulates all things, keeps it company. From eloquence, to those who have acquired it, flow praise, honor, dignity; from eloquence, to the friends of those skilled in it, comes most dependable and sure protection.

These sciences are called mechanical, that is, adulterate, because their concern is with the artificer's product, which borrows its form from nature. Similarly, the other seven are called liberal either because they require minds which are liberal, that is, liberated and practiced (for these sciences pursue subtle inquiries into the causes of things), or because in antiquity only free and noble men were accustomed to study them, while the populace and the sons of men not free sought operative skill in things mechanical. In all this appears the great diligence of the ancients, who would leave nothing untried, but brought all things under definite rules and precepts. And mechanics is that science to which they declare the manufacture of all articles to belong.

Chapter Twenty-one: First—Fabric Making

Fabric making includes all the kinds of weaving, sewing, and twisting which are accomplished by hand, needle, spindle, awl, skein winder, comb, loom, crisper, iron, or any other instruments whatever; out of any material made of flax or fleece, or any sort of hide, whether scraped or hairy, out of cane as well, or cork, or rushes, or hair, or tufts, or any material of this sort which can be used for the making of clothes, coverings, drapery, blankets, saddles, carpets, curtains, napkins, felts, strings, nets, ropes; out of straw too, from which men usually make their hats and baskets. All these pursuits belong to fabric making.

Chapter Twenty-two: Second—Armament

Armament comes second. Sometimes any tools whatever are called "arms," as when we speak of the arms of war, or the arms of a ship, meaning the implements used in war or on a ship. For the rest, the term "arms" belongs properly to those things under which we take cover—like the shield, the breastplate, and the helmet—or those by which we strike—like the sword, the twofaced axe, and the lance. "Missiles," however, are things we can fling, like the spear or arrow. Arms are so called from the arm, because they strengthen the arm which we customarily hold up against blows. Missiles (*tela*), however, are named from the Greek word *telon*, meaning "long," because the things so named are long; therefore, we use the word *protelare*, or "make long," to mean "protect." Armament, therefore, is called, in a sense, an instrumental science, not so much because it uses instruments in its activity as because, from some material lying shapeless at hand, it makes something into an instrument, if I may so name its product. To this science belong all such materials as stones, woods, metals, sands, and clays.

Armament is of two types, the constructional and the craftly. The constructional is divided into the building of walls, which is the business of the wood-worker and carpenter, and of other craftsmen of both these sorts, who work with mattocks and hatchets, the file and beam, the saw and auger, planes, vises, the trowel and the level, smoothing, hewing, cutting, filing, carving, joining, daubing in every sort of material—clay, stone, wood, bone, gravel, lime, gypsum, and other materials that may exist of this kind. Craftly armament is divided into the malleable branch,

which forges material into shape by beating upon it, and the foundry branch, which reduces material into shape by casting it—so that “founders” is the name for those who know how to cast a shapeless mass into the form of an implement.

Chapter Twenty-three: Third—Commerce

Commerce contains every sort of dealing in the purchase, sale, and exchange of domestic or foreign goods. This art is beyond all doubt a peculiar sort of rhetoric—strictly of its own kind—for eloquence is in the highest degree necessary to it. Thus the man who excels others in fluency of speech is called a Mercurius, or Mercury, as being a *mercatorium kirrius* (= *kyrios*)—a very lord among merchants. Commerce penetrates the secret places of the world, approaches shores unseen, explores fearful wildernesses, and in tongues unknown and with barbaric peoples carries on the trade of mankind. The pursuit of commerce reconciles nations, calms wars, strengthens peace, and commutes the private good of individuals into the common benefit of all.

Chapter Twenty-four: Fourth—Agriculture

Agriculture deals with four kinds of land: arable, set aside for sowing; plantational, reserved for trees, like the vineyard, the orchard, and the grove; pastoral, like the meadow, the hillside pasture, and the heath; and floral, like the garden and rose-hedges.

Chapter Twenty-five: Fifth—Hunting

Hunting is divided into gaming, fowling, and fishing. Gaming is done in many ways—with nets, foot-traps, snares, pits, the bow, javelins, the spear, encircling the game, or smoking it out, or pursuing it with dogs or hawks. Fowling is done by snares, traps, nets, the bow, birdlime, the hook. Fishing is done by drag-nets, lines, hooks, and spears. To this discipline belongs the preparation of all foods, seasonings, and drinks. Its name, however, is taken from only one part of it because in antiquity men used to eat merely by hunting, as they still do in certain regions where the use of bread is extremely rare, where flesh is the only food and water or mead the drink.

Food is of two kinds—bread and side dishes. Bread (*panis*) takes its name either from the Latin word for one’s laying a thing out (*ponis*), or from the Greek word for all (*pan*), because all meals need bread in order to be well provided. There are many kinds of bread—unleavened, leavened, that baked under ashes, brown bread, sponge-cake, cake, pan-baked, sweet, wheaten, bun-shaped, rye, and many other kinds. Side dishes consist of all that one eats with bread, and we can call them victuals. They are of many sorts—meats, stews, porridges, vegetables, fruits. Of meats, some are roasted, others fried, others boiled, some fresh, some salted. Some are called loins, flitches also or sides, haunches or hams, grease, lard, fat. The varieties of meat dishes are likewise numerous—Italian sausage, minced meat, patties, Galatian tarts, and all other such things that a very prince of cooks has been able to concoct. Porridges contain milk, colostrum, butter, cheese, whey. And who can enumerate the names of vegetables and fruits? Of seasonings some are hot, some cold, some bitter, some sweet, some dry, some moist. Of drink, some is merely that: it moistens without nourishing, like water; other is both drink and food, for it both moistens and nourishes, like wine. Of the nutritious drinks, furthermore, some are naturally so, like wine or any other liquor; others accidentally so, like beer and various kinds of mead.

Hunting, therefore, includes all the duties of bakers, butchers, cooks, and tavern keepers.

Chapter Twenty-six: Sixth—Medicine

“Medicine is divided into two parts”—“occasions” and operations. “The ‘occasions’ are six: air, motion and quiet, emptiness and satiety, food and drink, sleep and wakefulness, and the reactions of the soul. These are called ‘occasions’ because, when tempered, they occasion and preserve health,” or, when untempered, ill-health. The reactions of the soul are called occasions of health or ill-health because now and again they either “raise one’s temperature, whether violently as does wrath or gently as do pleasures; or they withdraw and lower the temperature, again whether violently as do terror and fear, or gently as does worry. And among them are some which, like grief, produce their natural effects both internally and externally.”

Every medicinal operation is either interior or exterior. “The interior

are those which are introduced through the mouth, nostrils, ears, or anus, such as potions, emetics, and powders, which are taken by drinking, chewing, or sucking in. The exterior are, for example, lotions, plasters, poultices, and surgery, which is twofold: that performed on the flesh, like cutting, sewing, burning, and that performed on the bone, like setting and joining."

Let no one be disturbed that among the means employed by medicine I count food and drink, which earlier I attributed to hunting. For these belong to both under different aspects. For instance, wine in the grape is the business of agriculture; in the barrel, of the cellarer, and in its consumption, of the doctor. Similarly, the preparing of food belongs to the mill, the slaughterhouse, and the kitchen, but the strength given by its consumption, to medicine.

Chapter Twenty-seven: Seventh—Theatrics

The science of entertainments is called "theatrics" from the theatre, to which the people once used to gather for the performance: not that a theatre was the only place in which entertainment took place, but it was a more popular place for entertainment than any other. Some entertainment took place in theatres, some in the entrance porches of buildings, some in gymnasia, some in amphitheatres, some in arenas, some at feasts, some at shrines. In the theatre, epics were presented either by recitals or by acting out dramatic roles or using masks or puppets; they held choral processions and dances in the porches. In the gymnasia they wrestled; in the amphitheatres they raced on foot or on horses or in chariots; in the arenas boxers performed; at banquets they made music with songs and instruments and chants, and they played at dice; in the temples at solemn seasons they sang the praises of the gods. Moreover, they numbered these entertainments among legitimate activities because by temperate motion natural heat is stimulated in the body and by enjoyment the mind is refreshed; or, as is more likely, seeing that people necessarily gathered together for occasional amusement, they desired that places for such amusement might be established to forestall the people's coming together at public houses, where they might commit lewd or criminal acts.

Source: *The Didascalicon of Hugh of St. Victor: A Medieval Guide to the Arts*, trans. Jerome Taylor (New York: Columbia University Press, 1961), pp. 55–56, 74–78. Reprinted with the permission of the publisher.

DOCUMENT 10

Roger Bacon (c. 1219–92) On Experimental Science; from the *Opus maius*

Roger Bacon stands out among medieval natural philosophers for his explicit and strongly worded plea that science be used for the practical benefit of humankind. Although many medieval scientists were interested in the utility of nature and natural products, few expressed in such forthright terms the view that one of the primary purposes of science was to produce dramatic inventions, such as the fearsome weapons he describes in these excerpts from his *Opus maius* (Greater Work). His mention of the explosive powers of saltpeter, the primary ingredient in gunpowder, is the first known in European writing. In his section on optics (not reproduced here), he suggests that lenses could be made so that "from an incredible distance we might read the smallest letters and number grains of dust and sand" (p. 582). Even more imaginatively, he suggests a sort of biological mind-control, in which the will of the enemy could be controlled by changing the complexion of the air. In other writings, he also refers to the possibility of building flying machines and cars that went by themselves.

Bacon also is unusual in his emphasis on "experience," as well as reason, in scientific method. On the one hand, by "experience" he clearly means that the scientist should personally test out his ideas in a concrete fashion whenever possible. On the other hand, he also believes that divine inspiration is a key element in scientific discovery.

The influences on Bacon's thought were complex. Like most thirteenth-century natural philosophers, he was strongly influenced by Aristotle and Arabic scientific writings. In addition, however, he absorbed the Augustinian notion of the divine illumination of the mind as a route to knowledge and, most probably, was influenced by the apocalyptic prophecies of Joachim of Fiore (d. 1202), whose late thirteenth-century followers predicted the imminent coming of the Anti-Christ. Finally, he had an interest in alchemy, which had a tradition of emphasizing the powers of human art over nature.

The *Opus maius* (c. 1266) was written in an effort to persuade the