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INTRODUCTION

The title of our book would lead the reader to believe that in speaking of the changing image of the *sciences*, we are taking for granted the multiplicity of sciences, as these are practiced, for instance, in modern universities. That was, of course, not always the case. Although we can point to some subjects, for instance mathematical astronomy, as being demarcated to some extent from other subjects as far back as Antiquity, the current division into individual sciences can hardly be traced back further than the nineteenth century. Moreover, the further we go back in history, the more we must subsume science under general knowledge or scholarship: *scientia*. Some of the earliest images of *episteme* or *scientia*, are those of forbidden knowledge – often related to technology – on the one hand, and the absent-minded scholar on the other. These are powerful metaphors – in word as well as image – that have been appropriated in various ages for different purposes.

The Greeks gave Western society its first images of the power of knowledge and those who produced it. Prometheus ridiculed the gods, stole their fire, and brought it down to Earth. For this, Zeus had him chained to a rock on Mount Caucasus, where a vulture fed on his liver during the day, while it grew back at night. He was finally freed by Heracles. From the perspective of humanity, Prometheus was a great benefactor: besides giving mankind fire, he taught it the cultivation and uses of plants and how to tame horses. Indeed, after he was freed, he joined the gods on Mount Olympus. Right from the beginning, we see here the two-edged sword of technical knowledge: on the one hand forbidden knowledge and on the other a great boon to mankind. For the later aspects he was especially celebrated among the English Romantics.

In European history, the image of forbidden knowledge was expressed strongly in the story of Faust, which began as a German folk tale (about a real scholar), first printed by J. Spies as *Volksbuch von Dr. Faust* in 1587, and made well-known by Marlowe into *The Tragical History of the Life and Death of Dr. Faustus* a few years later. Related is the Jewish legend of the Golem, an artificial man created from dust by rabbi Löw in Prague by means of Cabbalistic magic. Initially, the Golem helped the community solve its problem, but when his services were misused he turned on it. The themes of Faust and the Golem, of mankind's eternal quest for



Figure 1. Atlas, carrying the heavens, watches a vulture pecking at the liver of Prometheus. 6th century B.C. Vatican Museum. Permission of the Vatican Museum.



Figure 2. Dr. Faustus conjuring the earth-ghost. Title image of Christopher Marlowe: *Dr. Faustus*, 1636. Permission of the Mary Evans Picture Library.

(forbidden) knowledge crop up time and again in Western culture, from Goethe's *Faust* and Mary Shelley's *Frankenstein* to J. Robert Oppenheimer's citation of the *Bagava Gita* upon the first successful test of the atomic bomb. The power that comes with knowledge is always a two-edged sword: the motives are often pure, but the results are frequently disastrous.

The second theme, that of the absentminded professor, also has its origin in Antiquity, although the images were contradictory. Of Thales of Miletus (sixth century B.C.E.) it is said that on the one hand he correctly predicted a bountiful harvest of olives, obtained a monopoly on olive presses, and made a fortune when the harvest turned out to be in fact bountiful. It is related about him on the other hand that he was so intent on looking up at the heavens as he was walking, that he fell into a ditch. Archimedes (third century B.C.E.) helped defend the city of Syracuse from the

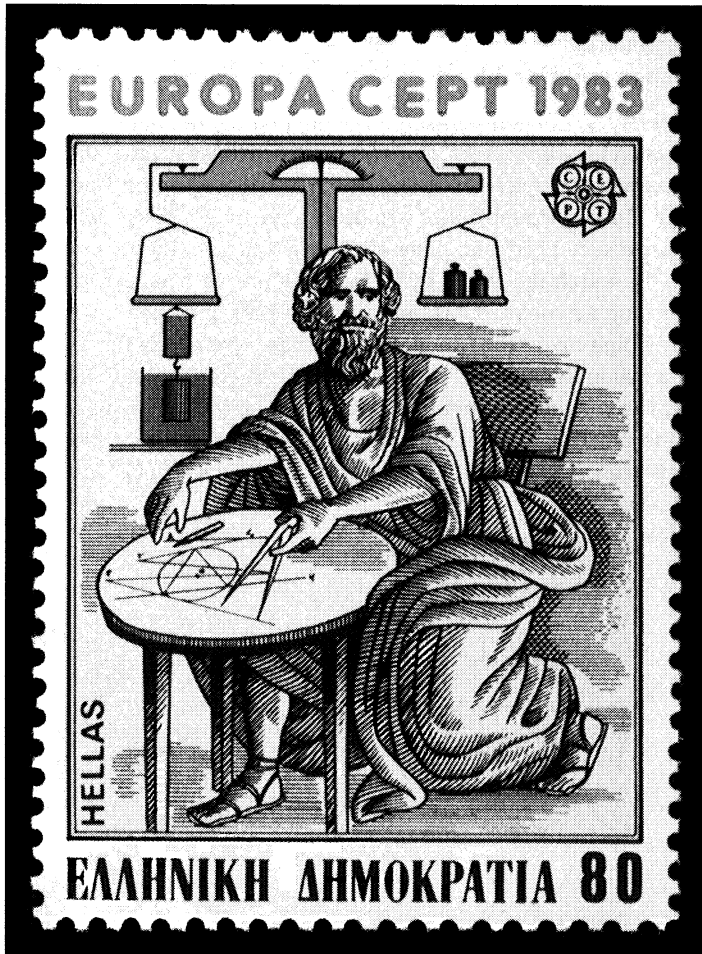


Figure 3. Greek stamp issued April 28, 1983. The illustration of Archimedes is adapted from a well-known Renaissance mosaic depicting his death. Source: Chris Rorres' website on Archimedes, <http://www.mcs.drexel.edu/~crorres/Archimedes/contents.html>

Roman forces with his war machines, but it is said that he really only cared about abstract mathematics, and when the city fell and a Roman soldier entered his house, Archimedes was working on a mathematical problem and did not wish to be disturbed: the soldier killed him.

In more recent times, these images become mixed with that of the pursuit of useless knowledge. Early in the seventeenth century, Francis Bacon wrote:

Men have entered into a desire of learning and knowledge, sometimes upon a natural curiosity and inquisitive appetite; sometimes to entertain their minds with variety and delight; sometimes for ornament and reputation; and sometimes to

enable them to victory of wit and contradiction; and most times for lucre and profession; and seldom sincerely to give a true account of their gift of reason, to the benefit and use of men.¹

The Royal Society of London set itself a Baconian program, but their work was often satirized. When in his *Micrographia* of 1665 Robert Hooke praised the progress made in the improvement of the telescope and spoke of a day when perhaps animals might be seen on the Moon, Samuel Butler published a poem, *The Elephant in the Moon*, in which “A learned society of late, / The glory of a foreign state, / Agreed upon a summer’s night, / To search the Moon by her own light; / To make an inventory of all, / Her real estate and personal . . .” Needless to say, the gentlemen found all manner of human affairs going on on the Moon. Indeed, they were observing a war, in which a large elephant had broken loose. “It is a large one, far more great / Than e’er was bred in Africa yet; / From which we boldly may infer, / The Moon is much the fruitfuller.”²

Some of the other activities of the Royal Society also raised the hackles of the satirists. In his *Travels in Several Remote Nations of the World* (1726) Jonathan Swift



Figure 4. The Golem from the film “Der Golem” by Paul Wegener (1914). Source: <http://www.davkamusic.com/images/golem.jpeg>

reported that the gentlemen of the Academy of Lagado carried out research into “extracting Sun-beams out of Cucumbers,” “to reduce human Excrement into its original Food,” and “softening Marble for Pillows and Pincushions.”³ That sort of criticism of the pursuit of useless knowledge, often with a serious purpose, has not ceased. It was not so many years ago that the American Senator William Proxmire, a watchdog of governmental spending on science, published a monthly “Golden Fleece Award,” in which he singled out such apparently nonsensical scientific research projects as finding out why people fall in love.⁴ The image was very much that of scholars who had lost touch with reality and were fleecing the public.

The papers in this volume pursue some of these themes in the modern period. The first group pursued the theme in individual sciences. Michael Mahoney chooses as his subject a device, the computer, and the new science it has generated over the past half century. We now see the computer as the basic ingredient in an emerging new electronic medium that is as different from its predecessors, as many now say, as print was from manuscript. But as Mahoney points out, the image of the computer began very differently, and it has gone through several changes since then. Half a century ago the machine itself was the central icon, associated with cleanliness, temperature control, and an almost priestly class of initiates. Today the central image is that of a network in which the computer itself is all but invisible, and when we do see it, it is as a small decentralized home- or office-appliance, soon to be merged with our telephones and televisions.

But computers have also changed the way science is often done. The awesome calculating power of even small computers means that models can be built in which one can change the initial parameters and see the results. Increasingly, problems involving complexity that could never be solved before the computer can now be calculated by models and algorithms. Computers have given rise to a middle area between experimental and theoretical/mathematical science that has in effect become a new branch of science.

Bernadette Bensaude-Vincent’s paper is about the problem one level down from biology, and very much related to Allen’s paper. The chemists (and Bensaude-Vincent focuses precisely on *synthetic* chemistry) are seen as being historically in competition with Nature itself. Here we are not talking about describing, imaging, nature so much as competing with nature’s creative aspects. In its modern form, this competition goes back to Wöhler’s supposed synthesis of urea from “inorganic” substances. Regardless of the fact that Wöhler did not exactly start with inorganic reagents, the synthetic chemist was increasingly seen, and saw him/herself, as a benevolent creator of useful substances for mankind: better living through chemistry. Obviously, this image has become hopelessly fractured since Hiroshima and *Silent Spring*. Yet, in the pharmaceutical laboratories, in spite of all the arguments about the costs of new medicines, increasingly effective new medicines are created every year. We have had to learn to live with the Janus face of synthetic chemistry.

It is interesting to see, in Bensaude’s paper, how the normative use of the notion of *nature* in the popular mind often clashes with the chemist’s notion. Where *natural* on the packaging in the supermarket stands for *pure*, to the chemist reagents found in nature are anything but pure, so that for him/her *natural* often stands for *impure*. Each generation of (synthetic) chemists has to (re)construct the image of its

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