From Fourth to Sixth Century: A No-Man's Land in the History of Sciences*

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Not many years ago Thomas Kuhn had no hesitation in defining the history of science as 'a discipline apart, with only very tenuous links with other kinds of historical study': thus drastically isolating it from other contexts of historical research. But are these barriers really so insuperable? The answer may be in the affirmative, whenever research is confined, as has been generally the case so far, to the carrying out of specialised enquiries within clearly defined sectors, whether they be medicine, astronomy, mathematics, geometry, architecture, hydraulics, mechanics, zoology, botany and so on, with the main aim (when it is not indeed the only one) of accumulating positive results for the 'experts in that field'; consequently this research is expressed in a technical language largely impenetrable to lay persons (including historians). But, above all, the results achieved are evaluated according to parameters of neo-positivist judgement and rationality which are wholly modern (Withold Kula's warning still serves: we may ask anachronistic questions of the past but we should not formulate anachronistic answers). And it is this state of affairs which causes research on sciences in the ancient world so often to talk of technical stagnation and lack of practical application, of progress and regression both in theory and in practice, often with stereotyped formulations and in any case always revealing a marked concern for technological development: an obvious preoccupation of an age such as ours, prostrate before the technological Leviathan, before the ideology of the machine and productive efficiency.

Indeed the historian can hardly avoid feeling a certain uneasiness when examining the endless literature at his disposal on the history of the ancient sciences, from the multithematic works of R.J. Forbes (1955), E. Singer (1956), F. Klemm (1959), E. Jaffé, N. Clow, R.H.G. Thompson (1960) to those on a more specific topic, such as J. Ramin (1977) and J.F. Healey (1978) on metal-

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lurgy and mines, J. Scarborough (1969), J. Edelstein (1945 and subsequently), M.D. Grmek (1983), D. Gurevich (1984), V. Di Benedetto (1986) and R. Jackson (1988) on medicine, O. Neugebauer (1957[2]) on the exact sciences, J.G. Landels on engineering (1978), F. Boll, C. Bezold, W. Gundel on astrology (1931[4]), and so forth. He may well feel that neither such collections of data and notions, however admirable they may be, nor the theories of the philosophy of science provide satisfactory answers to the questions he considers most important, aware as he is that historical thought is always — to quote E. Rothaker — 'Symptom und Instrumentum des menschlichen Selbsverständnißes', through the ability to contextualize phenomena within the social, cultural and mental realities from which they arise.

Thus the central historical problem is to understand what it is that activates mechanisms which conserve, which select, which render more or less permanently dormant, or which destroy a particular cultural patrimony; to understand why at certain moments in history technical or scientific knowledge, acquired long before, achieves 'visibility', crosses the 'threshold of manifestation' and — perhaps much later — also that of 'formalization' in the texts of the dominant culture (to adopt the terms of Michel Foucault, used also by Giusto Traina in his recent book on *La tecnica in Grecia e a Roma*).

Today research methodologies and techniques of ever greater sophistication facilitate the delicate task of combining evidence which is heterogeneous both in its nature and in its quantity (from archaeological monuments to coins, to inscriptions, to papyrus documents). All is channelled towards a recontextualization within defined geographical, social and cultural areas, thanks also to the contribution of the human sciences (anthropology, sociology, psychology), which, in such a way, can act as a common framework.

Such reflections — which apply to all the history of science and technology in the ancient world — are particularly valid when referring to the late-antique period, still today the object of the most complete indifference. In fact, it is surprising to note that William H. Stahl's monograph on *Roman Science* (1962) dates back to more than thirty years ago. It is the only general work to dedicate considerable space to the late-antique period — exclusively within the Latin world —, providing elements useful for an understanding of the epistemology of the sciences in some of their late-classical formulations and, at the same time, for placing such reflections on the principles and methods of scientific knowledge in the context of the respective cultures and societies; however, the author proceeds from premises which are highly debatable and which today may be regarded as obsolete (for example the Romans were incapable of pure science, which they vulgarized with a superficial and presumptuous encyclopaedic erudition destitute of creativity). A more lively interest in research concerning technological development — as already mentioned — arrives instead as far as the beginning of the barbaric age, elicited by a curiosity regarding the mecha-

nisms which at that time regulated (either preventing or accelerating) the development of technological knowledge (see also the work by G. Traina mentioned above, recently published). But after the second century AD the sciences, whether pure or applied, and including medicine and architecture, present us with formidable gaps in modern research. Why? I believe this is a question one should ask oneself before making any suggestion as to what should be done: the problems and the prospects of this enquiry are in fact many and of notable interest.

Until the second century AD the field of research is undoubtedly more homogeneous, circumscribed within a Latin culture whose centre of gravity was still Italy and Rome and which held a dialectical position in relation to the still dominant Graeco-Hellenistic scientific tradition. Consequently we have at our disposal a noteworthy quantity of studies on the period that goes from the 'origins' of Greek science to the spread of the Roman Empire throughout the Mediterranean. Whereas in the late-antique political universe everything intermingles: intimations, influences and actual elements break in from other worlds and cultures previously submerged, in an endless proliferation, intersecting and stratification of different traditions and mentalities. Here lies the fascination but also the difficulty of the study of the late-antique cultures; we must correlate their ever-changing plurality with the differing natures not only of those producing technical and scientific knowledge (whether philosophers, families or workshops transmitting craft techniques) but also with the differing nature of those to whom it was directed, namely the social milieux which accepted or rejected each innovation, judging it according to their own 'images of knowledge', mutable in time and space and dependent on class and ethnic affiliation. The Christian scientific culture of the Middle Ages once again becomes the object of relatively abundant studies for the very reason that it is re-inserted in a coherent and homogeneous framework of new values (the fact that it still substantially contains scattered elements and mental attitudes of the classical age hardly matters).

But without any doubt the lack of interest in late-antique science is due above all to the deeply rooted prejudice towards the Late Empire ('Lower Empire' as Italian and French say). Even today the culture of the Late Empire is at times represented in negative terms as the limp and enfeebled repetition of the admirable creative learning possessed by the scientist-philosophers of the Graeco-Hellenistic world, from Aristotle to Euclid, Ptolemy, Poseidonius and Galen. However, the time now seems ripe for a less heteronomous evaluation of the late-antique period: the more mature tendencies in current research lead to a reappraisal of the period as an age endowed with its own particular and original physiognomy, laden with potentialities which still have be studied in depth but which promise new discoveries and results. Therefore we should also abandon that neo-positivist prejudice towards the scientific knowledge of the age, regarded as 'regressive', and no longer 'trusting in the intellect' (Ramsay

MacMullen); we should understand the importance already emphasized by that great philologist Hermann Usener at the end of the last century in his study of the Byzantine scientists, of investigating how and why at a particular point in time certain interests meet with hostility and fall into obscurity, are isolated or die out, or else undergo radical metamorphoses. The originality and the importance of the late-antique period are to be found in its specific function not simply as the bridge between two ages but above all as the 'transforming agent' in the transmission of the culture of antiquity. Any society — or at least the groups in it which count politically, economically and intellectually — evolves the types of knowledge it needs, through processes of continuous adjustment.

It is therefore important to comprehend what notion of 'usefulness' (in any case different from that of today directed towards production) underlies the interest for the theoretical sciences of the *Quadruvium* both on the part of the political power and on that of the Church in antiquity; and to follow the vicissitudes of the connection between theoretical formulation and practical application in the various sciences in different ages and personalities, from Varro to Martianus Capella, Boethius, and Bede. The exceptional propensity of Bede for mathematics and astronomy, for example, should be seen in relation to the fierce controversies within the seventh-century Church concerning the location of the movable feasts in the calendar; while in the ninth century, in that Irish milieu where the knowledge of Greek had not entirely disappeared, we see the monk Martin of Laon deriving the term *mechanicus* not as should be from *mechanikós,* but rather from *moichós* (i. e. the adulterer, he who sins furtively), unconsciously harking back to the condemnation of the *artes* already formulated by Seneca inasmuch as they were manipulations and adulterations of nature.

The uncompromising and absolute condemnation of all inventions and technical applications in Seneca (as in Philo and in Plato himself, who had both theorized the lack of homogeneity between theoretical and practical disciplines) had arisen from an animistic conception of nature seen almost as if it were a gigantic organism, intangible and divine, so that respect for it was even transformed into a religious taboo. We re-discover this taboo, now Christianized, in, for example, Basil of Caesarea and Ambrose of Milan in the second half of the fourth century AD, when they deplore the futile curiosity of the scientist-philosophers, who presumed to investigate the secret of the Lord of Creation (*arcana naturae*) whereas they did not not dare run the risk of *lèse-majesté* by enquiring into secrets of the earthly emperor (*arcana imperii*). But this was not the only school of thought existing at that time regarding the sciences, and for a long time it was not even the dominant one: in fact, in the imperial era, it was rather the attitude theorized by Poseidonius (and opposed by Seneca) that prevailed. Poseidonius had rejected the depreciation of manual work: he himself had practical experience of weaving. He had denied that there existed different levels of value between the theoretical arts and the practical; and had even considered as positive

the idea of enrichment, just like the pre-Platonic sophists such as Hippias of Helis and Gorgias of Leontini.

During the Roman, Gothic and Byzantine ages those in power had no reserves of any sort about adopting the Poseidonian conviction regarding the essentiality of the link between theory and practice, between manual skills and the intelligence of men, between the liberal arts and the so-called 'banausic' arts. Let us leave to one side the technology connected with offensive and defensive armaments and with war, which obviously gained importance in proportion to any growth in the threats of hostility from enemies along the borders and the difficulties of recruitment, as well as suffering the influence of the barbarians who served under the Roman insignia. A sequence of normative provisions reveals how from the fourth to the sixth century the State tried to ensure a certain self-image by making it 'visible' and publicizing it through a correct functioning of the *artes,* above all, those associated with building, with land-surveying and with medical treatment; and how it encouraged such activities by means of subsidies and tax exemptions The great scientist-philosopher Severinus Boethius in the time of Theoderic was pleased to cultivate mathematics, astronomy-astrology, geometry, mechanics and music for the very reason that he believed the study of the mysteries of the universe through the arts of the *Quadruvium* (it was indeed he who coined this highly successful term) enabled man to progress towards the knowledge of God without, in this way, incurring the opprobrium of sacrilege.

Thus the questions to be asked by a study of the late-antique sciences and the research to be carried out to give concrete and accurate substance to the possible answers are many:

a) In different periods we need to investigate the relationships existing between the political and economic hegemonies in society and the scientists (let us call them so, even though Graeco-Romans consistently refused to define the sciences as such, while conceding them a separate dominion within philosophy: and that, too, is significant).

b) We should build up a sort of *Prosopography* — as detailed as possible — of all the personages (major and minor) who cultivated technical and scientific interests and/or activities. For example, it was a surprise for me when I discovered in certain constitutions of the *Theodosian Code* how generally elevated at that time was the social standing of the builders, *architecti* and *artifices,* who were often members of the municipal *curiae* and therefore middling landowners. I was also surprised to discover in the middle of the fourth century AD a wide circle of Gallic senators all actively engaged in political matters and at the same time not only endowed with an elevated culture (possessing an excellent knowledge of Greek at a time when Greek letters were increasingly uncommon in the West, thus encouraging Latin translations), but also expert in medicine, in contact with one another (Marcellus Empiricus, Ausonius the father and his sister-in-law Aemilia Hilaria, Syburius, Eutropius and others).

c) The existence of an exhaustive register of this kind would also enable us to reconstruct currents and schools: without doubt the circle of Gallic doctors mentioned above — well read in Greek scientific texts but proud of their own 'Catonian' tradition and ready at times to adopt even folk remedies — was totally different from the schools of neo-Platonic iatrosophists in Pergamon and Alexandria described by Eunapius of Sardis, even though reciprocal contacts were not lacking between various members of the two groups (e. g. between Eutropius and Oribasius at the time of Julian in the East and in Gaul). Similarly in the fourth and fifth centuries the neo-Platonic school of Alexandria differed profoundly from that of Athens of strict observance, as it took an interest not only in the symbolism of numbers elaborated by Nicomachus of Gerasa (first-second century), but also in the work of Diophantus who in the third century AD endowed calculation with central importance (whereas Euclidean geometry and Aristotelian arithmetic had repudiated them as exposed to the risk of degrading practical application in business and profit).

d) Furthermore, each case should be investigated singly to discover to what degree there existed an élitist detachment on the part of those who cultivated or taught sciences, in other words how accessible such knowledge was to a wider public (as, for example, in the case of Theon and, later, of his daughter Hypatia in fourth-fifth century Alexandria).

e) As far as possible we should accurately define the channels through which knowledge of the sciences was transmitted. Undoubtedly the exchange of books and the use of libraries prevailed in the West, whereas in certain great centers of the *Pars Orientis,* such as Alexandria or Athens, Academies and teaching posts (official or otherwise) continued operating. In these places, the debates concerning the classical scientific texts usually evolved into exegetical writings also containing original contributions, such as, for example, the doctrine of *phantasía* (imagination) to explain the creative aspect of geometry in the commentary on Euclid by Proclos — scholarch in Athens in the late fifth century but of Alexandrian formation —, as recent research by Giuseppe Cambiano has shown.

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