

**Proof and persuasion: natural philosophy and its audiences 1200-1750**

Workshop der European Science Foundation in der Herzog August Bibliothek  
Wolfenbüttel, vom 25. bis 27. März 2004

From 25 to 27 March 2004, the Herzog-August-Bibliothek was host to the second workshop (of a series of sixteen) of the European Science Foundation's programme 'From Natural Philosophy to Science'. The workshop was the first of four which will discuss the material modes of the transmission of 'scientific' knowledge. Participants from the Universities of Bologna, Cambridge, Ghent, London, Mainz, Nijmegen, Orléans, Oxford and Paris were asked to address all or some of the following questions: what were the intellectual, political, economic and pragmatic reasons for choosing one type of medium or style of rhetoric over another? Were there types of medium or genres of writing that were especially suited to a particular discipline? What roles did these 'vehicles' of transmission play in the development and acceptance of facts and theories? Did they successfully promote acceptance of theories and facts, or impose constraints upon their development? In other words, was 'scientific proof' sufficient and adequate for acceptance of theories and facts, and for the formation of new disciplines or the modification of old ones? or did people need to be persuaded of the validity and authority of proofs and procedures? ('Scientific' appears here and below in inverted commas, in order not to prejudge the question whether natural philosophy is of a different order from the intellectual activities which have succeeded it in the modern world).

The contributions of the first morning all addressed the production of 'scientific' images in printed texts of the early modern period. *Laurent Pinon's* paper was entitled 'Self-publishing and copperplates in mid-16th century Rome: Ippolito Salviani's book on fish (1554-8)'. He set out the practical difficulties facing Salviani's project, which took four years to complete; these were not only technical in nature (given Salviani's determination to produce a book with splendid copperplates integrated into the text), but also financial. Pinon demonstrated that such an undertaking was only conceivable in the context of curial Rome, with its practices of patronage and its community of skilled artisans. *Isabelle Pantin* next spoke about the *Epitome astronomiae Copernicanae* (1617-21) of Johannes Kepler in the context of Kepler's pedagogical aims and his use of illustration. She argues that this book, although produced in the form of a manual, is the equivalent in Kepler's published output of Galileo's *Dialogo sopra i due massimi sistemi del mondo*. It is the work of a proselytiser of Copernican cosmology; its originality lies in Kepler's choice to begin from fundamental principles and proceed from there through the didactic medium of *quaestio* and *responsum* to advanced astronomical topics. The work suffered a slow genesis because of material constraints and the author's personal difficulties; however, like Salviani's work, its conception was unified and clear from the beginning, and incorporated a remarkable series of austere cosmological diagrams which demonstrated Kepler's physical geometry and the Copernican system in an uncompromising and unambiguous way. *Volker Remmert's* paper 'Picturing the Scientific Revolution: frontispieces, their functions and their audiences in the seventeenth century' argued that frontispieces are produced for (at least) three potential categories of readers: those who will also read the body of the text; those who will read nothing beyond the preliminaries; and those who will look only at the frontispieces themselves. Their function was therefore shown to be complex, including as it did the advertisement of books and their contents, the acknowledgement of their patrons or backers, their place in the 'scientific' debate of which they formed a part, and the legitimation of the works or of the disciplines which they represented.

The afternoon session began with a general account of the genre of commentary from the mid-thirteenth century to the Renaissance by *Hans Thijssen*, entitled 'Reading the book of nature: commentaries and commentators in medieval and Renaissance natural philosophy'. As well as producing a typology of commentaries and an analysis of their structure, Thijssen showed how the commentary tradition embodies a dynamic interaction with the parent text (the Aristotelian corpus) and with the previous tradition of commentary itself, and was driven by a hermeneutic which, while serving the needs of exposition, also fostered the subtle reworking of old topics and the inclusion of new material, as well as allowing the expression of a critical attitude to the works of the Stagyrte. *Barbara Obrist* spoke next about the status and function of early medieval cosmological diagrams from the seventh to the eleventh centuries. This constituted a prelude to the other papers, not only because it preceded them chronologically, but also because it revealed not the cumulative transmission of knowledge but rather its partial loss. The Roman cosmological tradition, which had been the prerogative of urban citizens, was preserved after the collapse of empire in rural and religious communities; through a study of the images transmitted in these contexts, Obrist showed the subjugation of the model of the universe to the needs of the communities using cosmological data, of which the most pressing were the establishment of the calendar and the computation of diurnal length. *Ian Maclean's* paper concentrated on the transmission of explanatory techniques expressed through diagrams from the disciplines of logic and mathematics to that of medicine in the period 1480 to 1580. The use of the square of contraries and the latitude of forms to represent complex medical doctrine about the humours, physiology and pathology was shown to relate not only to the different styles of teaching and exposition in Europe, but also to the impassioned defence in the middle years of the sixteenth century of one particular textbook, Galen's *Ars parva*, by Italian medical professors reacting to attacks on Galen's theories of health and sickness by Parisian Hippocratic doctors and independent thinkers (such as Cardano) in their own midst. The fact that the dichotomised table often associated with Petrus Ramus, which was highly popular in Northern Europe, was rarely employed by Italians also revealed these regional differences in styles of teaching and learning.

Friday morning's session was opened by *Jeanne Peiffer*, whose case study of the transmission of mathematical knowledge in the *Journal des Savants* (first published in 1665) was entitled 'Periodical communication and the dynamics of knowledge'. The new medium for communication constituted by the scientific journal not only opened up opportunities for the exchange of facts and theories beyond those afforded by monographical publication and epistolary exchange, but also imposed the constraint of brevity and accelerated the production of knowledge. The journal thus became both the motor and the witness of progress in mathematics. It also generated a belief in the perfectibility of knowledge, creating an ideology of communication which even encouraged the publication of error in the name of scientific advance; at the same time it turned scientific discovery into a race, giving rise thereby to heated debates about the temporal priority of such discovery. The journal furthermore allowed for communication at various levels; to the interested reader on the one hand, and to the professional mathematician on the other, who alone would be able to complete the texts which did not reveal all the steps of a proof. *Jean Pierre Vittu's* broader study of scientific journals from the mid-seventeenth century to the Revolution concentrated on the tools for the recovery and location of knowledge included in the journal. The various tables, bibliographies and indices, and the cumulative decennial reference publications were shown actively to configure the information imparted by the journals in a way which evolved over the period in question. Vittu's comparison of the *Journal des Savants* with the *Acta Eruditorum* of Leipzig led to a consideration of the national traditions of journal organisation, influenced by differing styles of library classification, the vogue for *historia litteraria*, and the rhetoric of the individual *renvois* or entries in indices and tables. *Michael Hunter's* paper was entitled 'Interrogating nature: Bacon, Boyle and the significance of article of enquiry'. He showed how Boyle, 'Francis Bacon's greatest disciple', borrowed from his chosen mentor the practice of collecting particulars under 'heads' or 'articles of enquiry' which set an agenda for the subject to be investigated, offered initial clarification as to its scope and nature, and set out the observations and 'trials' (i.e. experiments) to be made. This procedure

was neither wholly a priori, in that the 'heads' were provisional, nor wholly a posteriori, in that the classification of results did not occur after the experiments. The founding of the Royal Society in 1660 occasioned Boyle to adopt this procedure, and the publication of the *Philosophical Transactions* from 1665 onwards allowed for its dissemination to the larger scholarly community. *Marta Cavazza* gave an account in her paper of the Istituto delle Scienze of Bologna. She described the Istituto's foundation in 1715 in the papal city with its powerful and traditionally-minded university by Luigi Ferdinando Marsili; its role was to teach new subjects 'through the eyes rather than the ears'. Whereas the neighbouring University continued its practice of lecturing and its requirement of Latin, Marsili's foundation taught through the medium of experiments, instruments, collections of natural objects, drawings and engravings, and models of various kinds. In this institution, instruction was offered in a remarkable range of subjects, including obstetrics, natural history, astronomy and the military arts.

The session of Saturday morning was devoted to the role of instruments in the transmission of knowledge. *Catherine Eagleton* spoke about two related late medieval instruments – the navicula and the Organum Ptolomei – their origin, illustration in manuscripts, history and uptake. In a close study of the sparse evidence available, she considered now these instruments related to the texts which illustrate them and set out their geometry, the possible manner of their production from diagrams, and demonstrated how it came about that an instrument initially of English provenance – the navicula – came to be supplanted even in England by one of its German descendants in the course of the sixteenth century. *Alexander Marr's* study of attitudes to automata in the period 1570 to 1640 showed how these self-moving machines had to be liberated (together with thaumaturgy) from connotations of occult magic, deceit (of those who wondered at them), 'mala curiositas' and futility, and dignified by association with the mechanical arts and a revived conception of wonderment as the source of philosophical progress. In his regretted absence, *Adam Mosley's* paper was summarized and read out by *Sachiko Kusukawa*. It concerned the role of instruments in the demonstration of the new celestial theories of the sixteenth century and their function as media of persuasion. His paper charted the rise in the status of mathematics and other mixed sciences (including astronomy) and the arguments offered to establish that these sciences could lead to demonstrative (causal) knowledge in the Aristotelian sense and at the same time produce realist affirmations about the physical world, though examples drawn from Tycho Brahe and Johannes Kepler. *Sven Dupr e's* paper on optical instruments, machines and diagrams looked at the concave mirror and its properties from the work of Witelo to that of Galileo, showing the importance of Leonardo's account of the mode of production of such mirrors with long focal lengths, and elucidating the highly original drawing made by Ettore Ausonio in the middle years of the sixteenth century, in which text and diagram are interdependent, and which combined in a novel way the optical and combusive properties of concave mirrors.

The conclusion of the workshop took place not in the Bibelsaal but in the Anna-Vorwerk-Haus; a table ronde was led by Richard Scholar, who undertook to be the rapporteur of the workshop. He opened the general discussion with a synthesis of the papers and the issues they raised; this was followed by a lively discussion during which the questions set out above which had been sent to the contributors to the workshop were critically scrutinized, and new topics suggested for future investigation by subsequent workshops. The fact that the Herzog-August Bibliothek kindly agreed to host the workshop was of inestimable benefit; not only were many of the books discussed intensively by the papers available in the Library and present during the papers in the Bibelsaal, but also various members of the Library Staff were instrumental in introducing the Herzog-August-Bibliothek to those among the contributors who were not already acquainted with it. Warm thanks must therefore be expressed to the Director (for agreeing to be the nominal local organizer of an ESF project), to Professor Niew hner and his secretary Frau Meyer, for undertaking the detailed work of organization, to Dr Bepler for giving an account to participants of the fellowship programme of the Library, to Herr Hoguefe for explaining the operation of the catalogues (Friday afternoon being left clear for those

wishing to consult books in the course of the workshop, which all chose to do), and to Dr Schneider for his presence and assistance at the table ronde.

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