International Max Planck Research Network
"History of Scientific Objects"

organized by

Professors Lorraine Daston, Jürgen Renn, Hans-Jörg Rheinberger,
Max Planck Institute for the History of Science

and

Professor Günter Abel, Technical University, Berlin
Professor Jochen Brüning, Humboldt University, Berlin
Professor Peter Galison, Harvard University, Cambridge
Professor Paolo Galluzzi, Institute and Museum of the History of Science, Florence
Professor Friedrich Kittler, Humboldt University, Berlin
Professor Eberhard Knobloch, Technical University, Berlin
Professor Wolfgang Krohn, University of Bielefeld
Professor Peter Lipton, University of Cambridge
Professor Thomas Macho, Humboldt University, Berlin
Professor Everett Mendelsohn, Harvard University.
Professor Dominique Pestre, Ecole des Hautes Etudes en Sciences Sociales, Paris
Professor Claudio Pogliano, University of Pisa, Consortium of Tuscan Universities
Professor Allan Brandt, Harvard University, Cambridge
Professor Simon Schaffer, University of Cambridge
Professor Peter Weingart, University of Bielefeld
Professor Michael Hagner, ETH Zürich
ProfessorJacob Tanner, University of Zurich
Professor Helmuth Trischler, Deutsches Museum, Munich

The modern sciences would be inconceivable without a highly developed material culture that embraces objects of study, from bacteria to galaxies, instruments with which to study them, from the microscope to the cyclotron, and dedicated spaces in which to study them, from the laboratory to the field station. Yet only recently have historians of science begun to address these aspects of scientific inquiry, and then only separately from one another. Moreover, the objects themselves, especially scientific instruments and models, have been kept and investigated largely in the context of museum collections rather than mainstream academic programs in the history of science. This situation is however changing rapidly, with important consequences for how historians of science understand innovation and transmission of knowledge. The Max Planck Institute for the History of Science proposes to establish a five-year international research network on the History of Scientific Objects to promote an integrated approach to the topic, involving junior and senior scholars in leading institutions worldwide (see *List of Participating Institutions*, below). In addition to links with ongoing research projects at the Max Planck Institute for the History of Science, this topic also lends itself to collaborations with other Max Planck Institutes, particularly within the framework of the Max Planck Society initiative "Dynamics of Science and Society" (see Max Planck Society, *Building Excellence* [2004], p. 74). The Research Network on the History of Scientific Objects would have four principal foci: the emergence of new objects of scientific inquiry; the relationship between scientific artifacts (e.g. instruments) and technological systems; scientific things as historical evidence; and the triangular interaction among scientific things, images, and texts.

Emergence of New Objects of Scientific Inquiry

Of all the things that populate the natural and social worlds, only a select few become objects of sustained scientific inquiry. The specific historical circumstances under which, for example, bodily organs, projectiles, monsters, and markets generated sciences of anatomy, mechanics, teratology, and economics indicate the range of factors that may play a role in the emergence of new objects of scientific inquiry. First and foremost, the objects must become scientifically salient: there is a great difference between phenomena that exist on the fringes of scientific collective consciousness and those that coalesce into domains of inquiry. Often the precondition for scientific salience is the recognition of regularity; only when human mortality or cloud formations came to be understood as regular rather than random phenomena did they attract scientific attention. But stability is not a necessary precondition for salience: highly irregular phenomena – wind turbulence or the stock market – many become objects of scientific inquiry because of their economic or social importance. Second, scientific objects may emerge as genuine novelties, with no equivalent in the vernacular world of mundane experience. The mathematical entities studied since Antiquity in sciences such as astronomy and mechanics are examples of emergence; planetary orbits and centers of gravity require abstraction from everyday experience. Third, scientific objects qualify as such by their productivity: they generate results, implications, surprises, connections, manipulations, explanations, applications – in short, they drive research. Even the most stable phenomena are unlikely to become objects of scientific inquiry if they are completely inert. A particularly relevant example are what have been called “challenging objects”—including the pendulum, the hanging chain, and artillery -- which triggered the transformation of the knowledge system of Aristotelian natural philosophy into that of classical mechanics. These challenging objects draw their productivity from their character as material embodiments of the practical knowledge of the great engineering endeavors of early modern Europe. Experimental science might be regarded as a system designed to discover and pursue such productive scientific objects, which often flout the boundaries between established disciplines: cytoplasmic particles for example engaged the attention of cytomorphologists, biochemists, and molecular biologists, ultimately becoming a tool for the investigation of a new scientific object, the genetic code. These factors are far from exhaustive, but they suggest the direction that a more comprehensive and comparative historical study of the emergence of scientific objects might take.

Relationship between Scientific Things and Technological Systems

Since the mid-nineteenth century, science-based technologies have transformed the world. Our modern world is shaped and dominated by small-scale and large-scale technical systems. But the relationship is reciprocal: technological systems have also transformed science. After all, it was not the science that were in the first instance the founding forces of modern technology. Just the other way round: historically, it was a technological form of life – that of Renaissance engineers - that gave that particular epistemic activity we call „modern science“ its socio-economic clout and its irresistible drive. A short survey of the breathtaking development that the gene-based life sciences underwent during the long century between the rediscovery of Mendel's laws and the complete sequencing of the human genome exemplifies the impact that new research technologies have had on the development of this scientific field. At each turning point, new techniques of analysis – such as ultracentrifuges, radioactive isotopes, or sequencers - and new model organisms – such as flies, bacteria, and viruses - decisively shaped the dynamics of the respective epoch. It can be safely claimed that the decisive breakthroughs in the history of genetics were made due to the combination of model organisms and experimental techniques into highly dynamic experimental systems. But it was also within such systems that completely new concepts took shape and hold, such as the idea of genetic information that has come to dominate the molecular biological conception of life.

We are thus not dealing with a science in search of technical implementation, but a science that is taken and accepted as science *because* it moves and is always already in the realm of the applicable. The very epistemological constitution of contemporary science has a technical dimension, because application is built into the very meaning of concepts and into the rules of concept formation, and because the technical is built into the experimental phenomena. Conversely and symmetrically, the concepts are built into the instruments; they take on an instrumental form that further serves to develop the whole machinery. Thus, to understand the intricate interaction between the technical aspects of scientific objects and the epistemic aspects of technological systems is one of the great challenges for a history of science interested in the material basis of its culture.

Scientific Artifacts as Historical Evidence

The material culture of science – its instruments, collections, architecture, and models – has been preserved largely through the efforts of museums. Yet most research in the history of science has traditionally taken place in libraries and archives, on the basis of texts and images. As a result, the objects in museums have been displayed with little indication as to historical

context, and the history of science has been written as if it were the development of disembodied ideas. The recent historiography of scientific practices has done a great deal to bring the matter and mind of science together, but collaborations between museums and academic historians of science are still the exception rather the rule. Several member institutions in the proposed research network (Institute and Museum of the History of Science, Florence, Harvard University, University of Cambridge, Centre Alexandre Koyré, Paris, Humboldt Universität Berlin, the Deutsches Museum, Munich) have pioneered such collaborations on hand from rich object collections of their own or of allied institutions (e.g., in the case of the Centre Alexandre Koyré, the Muséum National de l'Histoire Naturelle).
Moreover, museums themselves are an important part of the history of scientific objects, as well as the sites where such objects are now preserved. The long alliance, beginning with the natural history and ethnographic collections of the sixteenth and seventeenth centuries and continuing to the present day, between the field sciences and museums has defined the working objects of sciences such as botany and zoology through the selection of specimens and the designation of holotypes.

This part of the research network is particularly directed towards younger scholars, predocs and postdocs, interested in learning how to use objects as sources and as illustrations for the ways in which science is and has been done. How to find, interpret, and display things as well as texts that testify to the ways in which science was done in the past? Here the knowledge and perspectives of other disciplines – archaeology, art history, media and communication studies, museology—are essential supplements to the scientific, historical, and philosophical training historians of science traditionally receive. These skills are especially important for historians of science seeking to present their work to the general public as well as to other scholars. In modern societies saturated with science and technology, some understanding of the history of these fields is increasingly important for citizens charged with making decisions about future research policies. Museum exhibitions succeed in making the history of science vivid and accessible to a larger and more varied audience than the print media usually reach – a clear opportunity for public outreach. Conversely, museums will increasingly become sites of research for historians of science who have mastered the techniques of extracting information from artifacts as well as from texts. The Max Planck Institute for the History of Science has already been involved in several such exhibitions, such as techniques for assembling scientific information ("Cut and Paste") or the transformation of world pictures ("Albert Einstein, Engineer of the Universe"); a number of the Participating Institutions (Institute and Museum of the History of Science in Florence, the Helmholtz-Zentrum of the Humboldt-Universität Berlin, the Scientific Instrument Collection of Harvard University, the Whipple Museum of the University of Cambridge) have done pioneering work in this area.

Text, Images, and Things

With the widening of the scope of recent history of science to include for example the experimental culture of science, increasing attention has also been paid to images. This widened perspective not only implies the methodological extension to incorporate in particular the methods of the history of art, but also implies a new understanding of scientific knowledge. Paying attention to images increases first of all the awareness of the dependence of scientific knowledge on different external representations and thus deepens the understanding of the historicity of this knowledge. Indeed, external representations such as images are subject to cultural changes and therefore play an important mediatory role between science and its cultural context. Second, the study of images reveals a deeper, more complex structure in scientific knowledge than the analysis of texts alone would suggest. For example, the analysis of the function of images in the early modern period shows that they mediated not only between science and its cultural context, but also between practical knowledge and its theoretical reflection in scientific theories.

The production of images is coincident with the emergence of modern science in Europe during the sixteenth and seventeenth centuries, and has not abated since. Armed with computer graphics and instruments ranging from the electron microscope to MRI imaging, contemporary science produces vast numbers of images that are illustrative, evidentiary, and probative. Of particular interest is the role of film, both as a medium of scientific investigation and illustration and also as a means of documenting scientific activity (roughly analogous to the oral interview) that captures aspects (especially aspects related to the material culture of science) largely omitted by textual accounts. ("Science on Film" was the topic of the most recent MPIWG Berlin Summer Academy.) Images are often more important to scientific argument than the texts that accompany them, posing challenges to their makers and their interpreters that involve both aesthetic and epistemological dimensions. In the past decade, historians of science and historians of art have studied scientific images intensively. Still missing however is an account of the material production of images: the evidentiary weight of an image depends crucially on the processes by which it is made, processes which in turn depend on hypotheses and instruments that map things into images. These connections are obvious in the case of photography, but equally present and important in digital imaging technologies. Because of the division of labor between scientific research and image-making – as old as that between botanist or anatomist and artist in the first illustrated scientific texts of the sixteenth century – scientists themselves may have to take such connections for granted.

This is still more the case for the general public, for whom such images increasingly constitute the main form in which scientific research is presented. As in the case of the museum exhibitions mentioned in the previous section, this aspect of the research network offers opportunities not only for public outreach, but also to link up with the "Dynamics of Science and Society" project conducted by several Max Planck Institutes as part of the Max Planck Society Building Excellence initiative.