History Today, 35 (1985): 32-40

WHAT IS THE HISTORY OF SCIENCE?

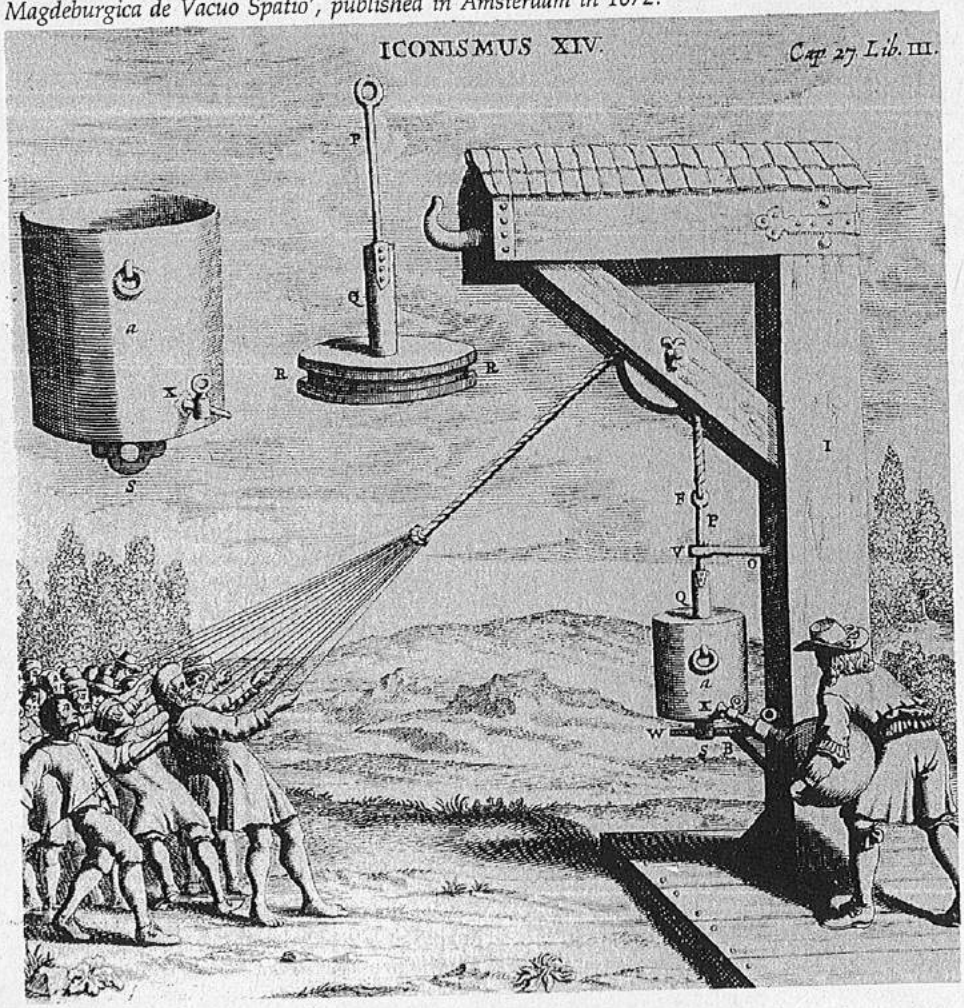
If science is founded in the 'natural world', in entities that are not man-made, is the history of science a history at all? Yet, defined as the study of man's changing understanding of the world of nature, the history of science is so wide-ranging, so profound, that ***History Today*** *has asked twelve practitioners to respond to the question 'What is the history of science?'. Six reply this month, six next.*

Roger Cooter

THE HISTORY OF SCIENCE IS NO longer an isolated discipline inhabited by scientists flattering themselves by ennobling their past. Nor any longer is it a pasture for grazing philosophers treating scientists (or natural philosophers) and their ideas as if they existed in a vacuum, apart from the rest of society. But it would be a mistake to suppose, simply because historical studies of scientific ideas and events now conform better to the norms of scholarship elsewhere in history, that the discipline has become fully a part of history proper. Despite the success of the efforts made since the 1960s to incorporate historical studies of scientific activity into the rest of history, the history of science as a discipline remains separate (presumably, therefore, for reasons other than the body of material upon which it focuses). Arguably, it is the very success of the efforts made since the 1960s that, paradoxically, has caused the history of science to remain unincorporated. In any event, the present state and outlook of, and regard for, the history of science cannot be defined without referring to its recent past.

For the sake of brevity and convenience, let me confine myself here to one of the interests of my own recent past: the study of those bodies of knowledge that historians previously either dismissed as nonsense or endeavoured to exploit for the purpose of benchmarking the progress of scientific truth. As I argued in 1976 (*History of Science*), the coming together of scholars on such issues as alchemy, astrology, mesmerism, phrenology and spiritualism was not a sign of growing antiquarianism, but rather a manifestation of current concern over the location and, in some cases, the existence of legitimate boundaries between science, 'pseudoscience', and society. The examination of the controversies over such practices and bodies of knowledge made it apparent that only in hindsight could one sharply distinguish between science and objective facticity, on the one hand, and 'pseudoscience', 'scientism', ideology and social values and interests on the other. Just as the theoretical elaboration and deployment of some of the so-called pseudosciences could be shown to be inseparable from their producers' and deployers' social interests, so the knowledge and methodologies that established them-

An experiment to show the effect of air pressure, from Guericke's 'Experimenta Nova Magdeburgica de Vacuo Spatio', published in Amsterdam in 1672.

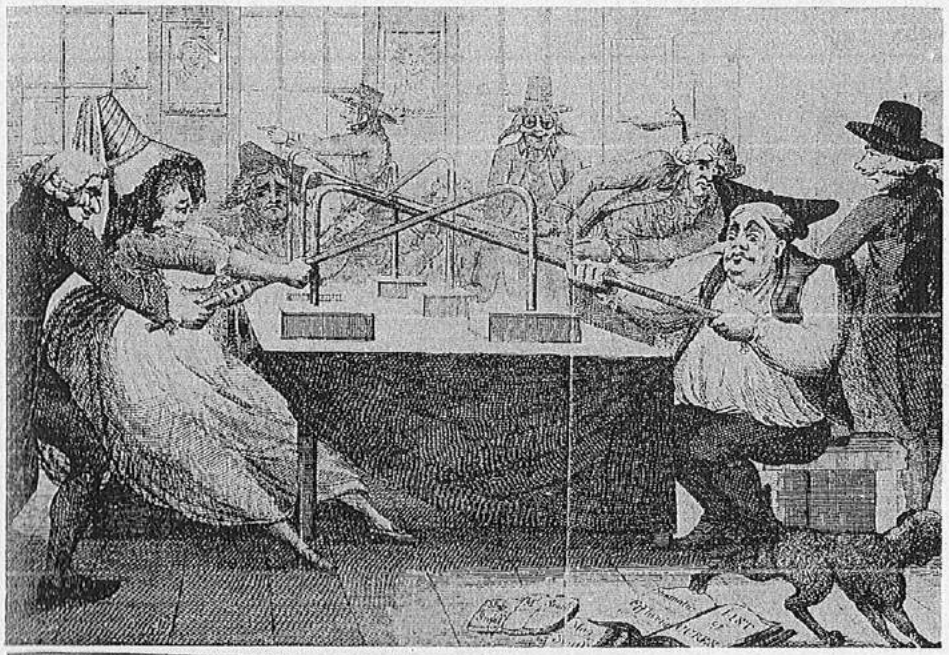


selves as 'scientific' could likewise be shown to be social and ideological. The point made was that science and the distinction between it and non-science was not universal, neutral and eternal as positivist philosophers and historians had implied; what was deemed 'natural' or 'scientific knowledge' and the process by which it was distinguished from 'the social' and 'the cultural' was historically determined, or was the outcome of particular social interests negotiated in particular social contexts.

Quite aside from the fact that studies such as those on rejected scientific knowledge were fundamentally committed to the principal object of history – to explain and account for change – they had a profound implication for a history of science regarded as separate from the rest of history. Because science was shown by its very nature to be social and ideological (in addition to whatever else it is), the history of science could not be rendered other than integral to the total history of social relations and structures.

That this conclusion was not welcomed with open arms by all historians of science is hardly surprising. More interesting, though, is how two decades of hard scholarship have been effectively co-opted through the very act of granting legitimacy to 'social history' of science. Thus labelled and cast (wittingly or unwittingly) merely as the study of science *in relation to external social 'factors'*, the historical studies that had revealed science as integral to the history of society as a whole were opened to marginalisation, whenever and wherever expedient. Moreover, through the same act of acknowledgement, a pardon was given to historical studies of science that were entirely within the history and philosophy of thought.

Thus the history of science today is far from uniform in its historiographical outlook. Instead of having become fully a part of history, the discipline often appears hardly less separate than before. Indeed, it seems in some danger of regressing into isolation as a result of failing to understand and/or to heed its own historical counsel.



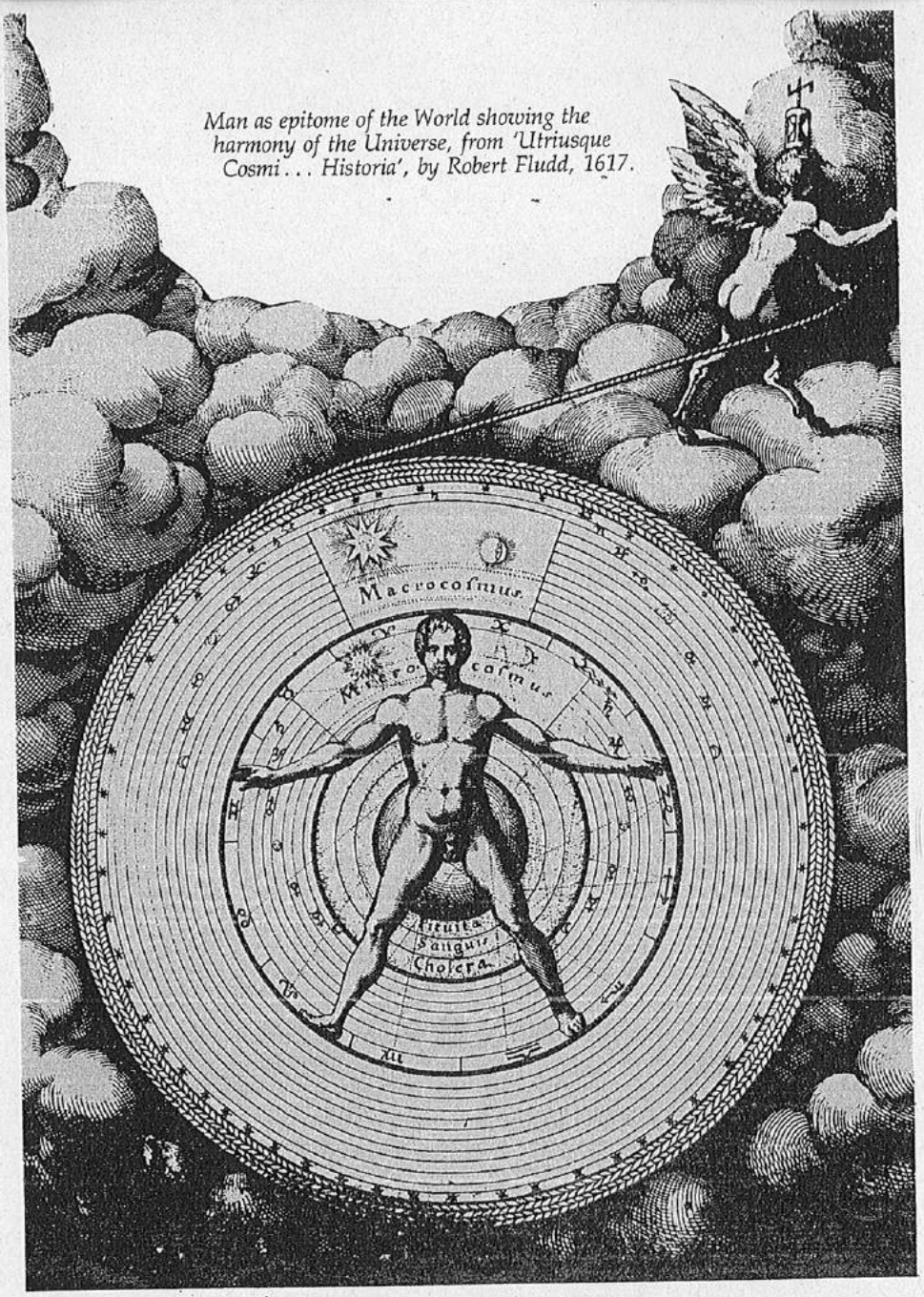
A cartoon of 1790 showing the appeal of mesmerism. 'Animal magnetism' was allegedly running through the metal bars and was transmitted to the patients who clutched them.

Weighing and Mixing Sol and Mercury; the vessel is sealed and placed in the furnace; Sol and Luna unite. From 'Liber Mutus Alchemiae', 1702.

Maurice Crosland

MUCH OF HISTORY HAS UNDERSTANDably been focused on mankind, with little attention being paid to his natural environment. The history of science is related equally to humanity and the natural world. We might consider the history of science as a study of man's changing understanding of the world of nature. Some people, on seeing the word 'science' assume something modern and very technical, probably associated with a laboratory. But science began with a commonsense interpretation of the world around us, which later became more sophisticated and only in the last century became separated from other studies by specialisation.

The ancient and medieval worlds in which man, the microcosm, was influenced by the macrocosm, the old world of harmony, purpose and design was to be transformed in early modern Europe by new ideas in natural philosophy. The natural world continued, however, to provide a model for human society as, for example, in the organisation of the state. In the seventeenth century the



Man as epitome of the World showing the harmony of the Universe, from 'Utriusque Cosmi... Historia', by Robert Fludd, 1617.

institution of the monarchy was upheld both on the analogy of the position of the sun in the 'universe' (solar system) in the heliocentric theory of Copernicus and by analogy with the heart in the body in the physiology of William Harvey. In the eighteenth century interpretations of nature provided a model for a new approach to law, religion and society. In the nineteenth century Darwin's theory of natural selection was seized upon as justification for two extreme but opposite political viewpoints. There can be no doubt about the power of scientific ideas.

There are many different approaches to the history of science but an encouraging feature over the past decade has been the replacement of much of the old 'internalist' (or science-centred) history of science by a broader contextual approach which relates science to the society of the day. One valuable genre in the history of science is the biographical approach, since the researcher is forced to look at the subject's life and surroundings as well as his work.

Joseph-Louis Gay-Lussac, 1778-1850. The French chemist and physicist who enunciated the law of volumes.

A few years ago I chose to study the French scientist, Gay-Lussac, as a prominent example of one of the first generation of professional scientists which emerged in the eventful period immediately after the French revolution, a revolution which had a major influence on the organisation of science and medicine as well as on the social order. Moreover, Gay-Lussac not only became one of France's leading scientists in the early nineteenth century, he also applied science for commercial and industrial purposes and was elected a member of the Chamber of Deputies. The resulting book is therefore a case study of the interaction of science and society in a specific historical context.

A good example of the biographical approach is Richard Westfall's recent study of Isaac Newton. This large book draws on a vast literature and provides an excellent example of the *contextual* approach to the science of the past. Westfall does not make the old mistake of abstracting the physics from the context of theology, philosophy and alchemy which loomed large in Newton's mental world. A political dimension emerges not so much in Newton's own life as in the uses which are alleged to have been made by Church and State in eighteenth-century Britain of the Newtonian system.

But history of science must be more than the study of individuals. Historians of science have recently been increasingly concerned with institutions. From the seventeenth century onwards men organised themselves into societies, of which the most famous were the Royal Society of London (1660) and the Paris Academy of Sciences (1666). State patronage of science raises interesting questions and there is a striking contrast in the relation between science and government in Britain and France. Searching questions are being asked about the membership of scientific societies, whether on an amateur, part-time basis, as in the British Association, or in a more élitist and professional way, as in the French Academy.

If ladies and gentlemen in nineteenth-century Britain turned to science for recreation, what did they expect to find? Was it a reassuring picture buttressing the existing social order and the established church? And what of the Mechanics Institutes? Here, as elsewhere, there are so many interesting questions to ask and

Seventeenth-century gentlemen of learning showing great interest in the sciences. A detail from 'Cognoscenti in a Room hung with Pictures', Flemish School, circa 1620.

only a handful of specialists engaged in finding answers. Unlike political history, history of science is a comparatively new field. It needs more people with some training in history and an interest in the history of ideas and the applications of science.

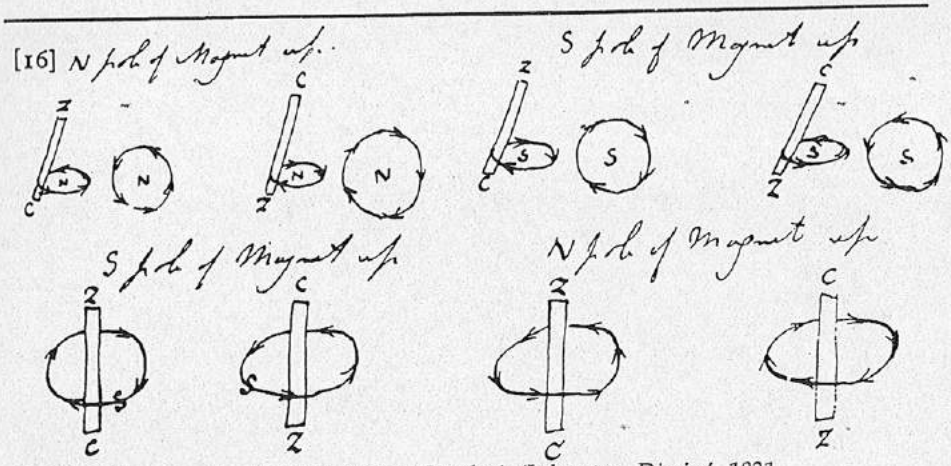
History of science can be studied at undergraduate level as part of a history course at several British universities and polytechnics. At the University of Kent it can be studied together with History or English or certain other arts subjects. For postgraduate students there is a fascinating range of problems to study and the field is still fresh enough for researchers to be cultivating virgin soil.

Brian Easlea

FOR ME, THE PRINCIPAL REASON for studying history is to try to understand human behaviour from the perspective of attempting to contribute towards the achievement of a less inhumane world. Although other perspectives are certainly possible, I believe that many historians do pursue their research either explicitly or implicitly informed by an overall concern for human well-being. Conversely, I believe that no serious attempt to realise a better future can afford to neglect the contributions historians are able to offer.

What can be the special contributions of historians of science? From the above perspective, the answer is obvious: the scientific revolution, Herbert Butterfield has claimed, outshines everything since the rise of Christianity. Indeed, very broadly speaking, spokesmen for science claim that for over three centuries competent scientific practitioners have pursued an identifiable methodology that has generated knowledge about the natural world as opposed to mere belief; that an important measure of the truth content of scientific claims is (ever-increasing) technological power; that scientific practice underwrites medical, industrial and military innovation and is the principal driving force promoting our civilisation's extraordinary dynamism. No need exists from my general perspective to justify the study of the history of science.

Questions emerge immediately. How is scientific activity to be defined and identified? What have been the principal conceptions of Nature advanced by natural philosphers? How are they to be evaluated, how have they changed and why? Have practitioners of science successfully promulgated manifestly 'false' conceptions of Nature and with what implications? What kinds of people and from what social classes have tended to become scientists? How and why has it hap-



Sketch of the properties of electricity from Faraday's 'Laboratory Diaries', 1821.

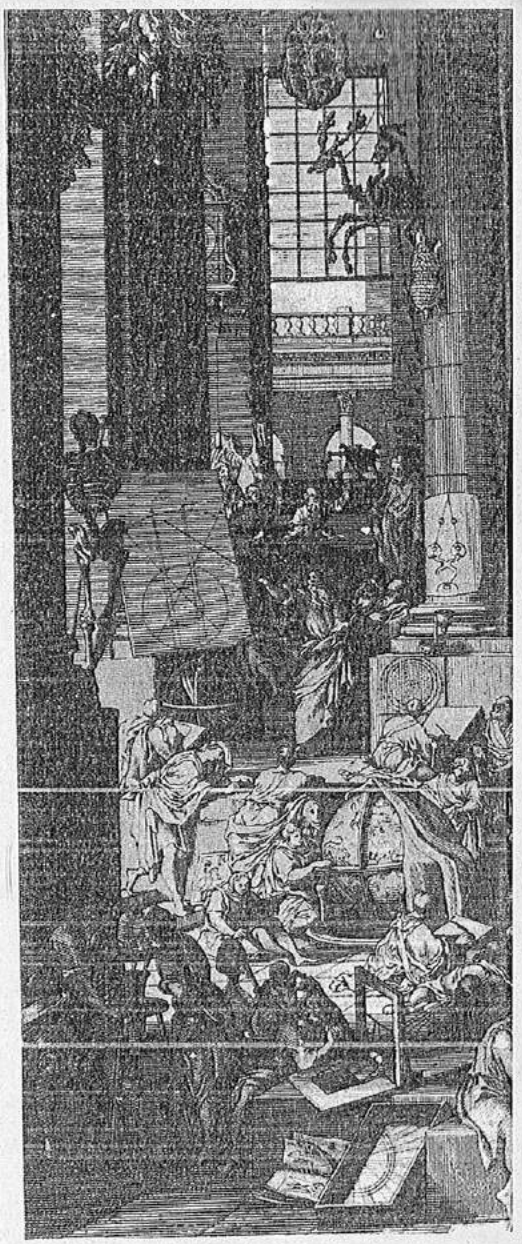
pened that a large fraction of the world's scientists work today on the development of weapons systems, and what might be done to promote socially constructive applications of science? There is no shortage of questions.

From this perspective, my own research programme explores possible ramifications of the 'maleness' of science. The subject is not an insignificant one. For example, in her book *The Gestalts of War* the military historian Sue Mansfield has claimed that the scientific mentality 'has carried from its beginnings in the seventeenth century the burden of an essential hostility to the body, the feminine, and the natural environment,' that the scientific mentality has not only produced atomic and thermonuclear weapons but informs current nuclear strategic thought, and that 'though the re-enslavement of women and the destruction of nature are not conscious goals of our nuclear stance, the language of our bodies, our posture, and our acts is a critical clue to our unexamined motives'.

From the perspective of contributing towards a less inhumane world, historical and psychological claims such as Mansfield's need detailed exploration and evaluation. They imply that Western culture has maintained a man-mind-science/woman-body-Nature dualism and that within this dualistic tradition modern science is underwriting an unconscious drive towards the destruction of Nature and the re-enslavement of women. Stated this baldly, the implications seem somewhat improbable, if not absurd. However, given the absurd military situation produced by scientifically advanced nations in which even a 'limited' nuclear war could bring about 'unthinkable' destruction, it is prudent not to dismiss Mansfield's claims out of hand.

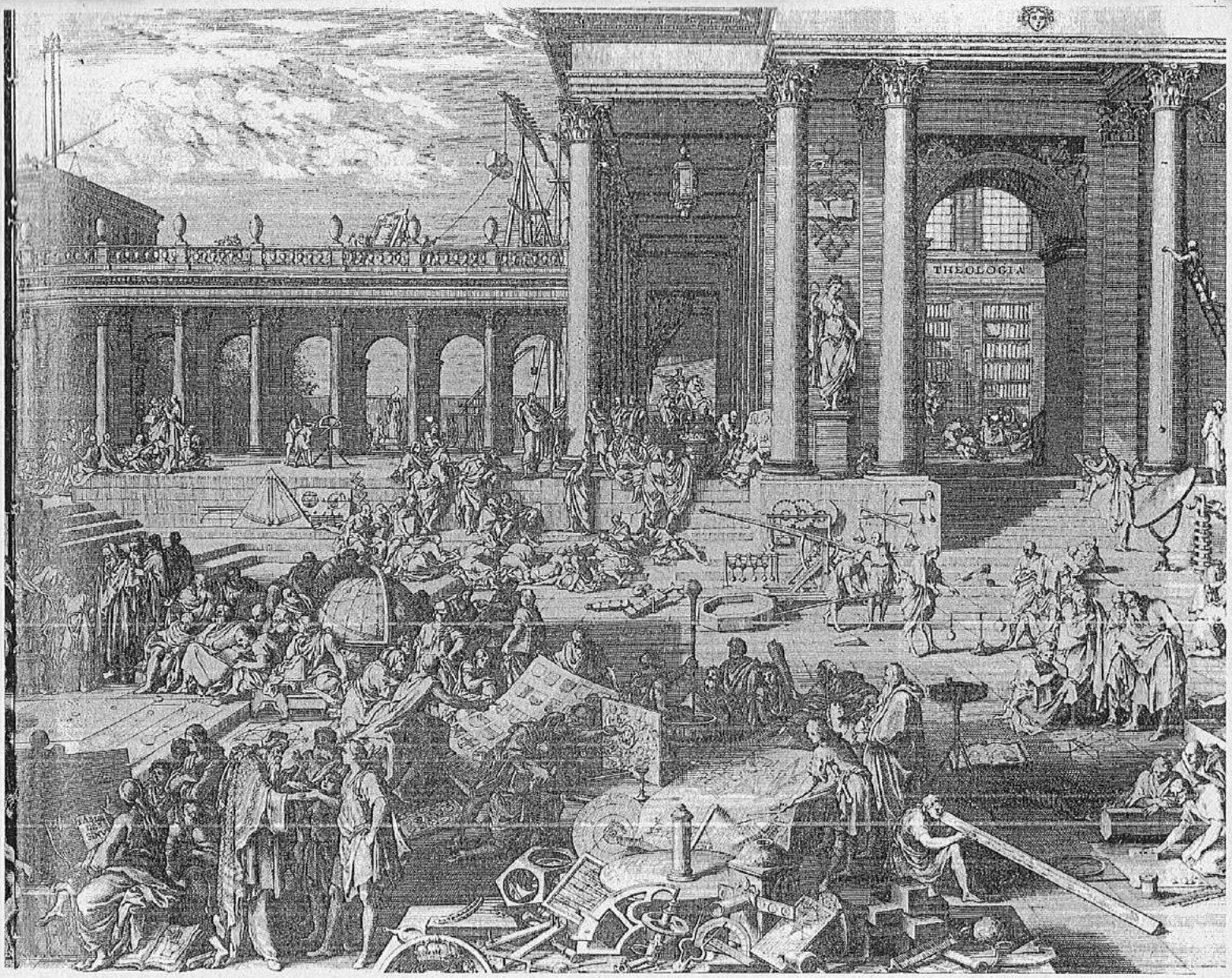
Again, an abundance of questions springs to mind. Is misogyny characteristic of Western civilisation? How is misogyny to be defined and identified? Is it true, as H.C.E. Midelfort stated in *History Today* (February 1981), that the witch-craze of early modern Europe 'displayed a burst of misogyny without parallel in Western history? If so, is it coincidental that modern science originated in a period of intense misogyny or can causal connections be identified? How have the development of science and changing misogynistic attitudes and practice reciprocally interacted? Is Western society still misogynistic? Dorothy Dinnerstein, Professor of Psychology at Rutgers University, writes that 'the hate, fear, loathing, contempt, and greed that men express toward women so pervade the human atmosphere that we breathe them as casually as the city child breathes smog'. If this is true, is twentieth-century science deeply misogynistic? Is military science even more so? Does an unconscious desire exist for the destruction of 'female' Nature and the re-enslavement of women?

These kinds of questions crudely serve to outline a complex historical research programme. There already exists, for example, the work of H.C.E. Midelfort on the history of the witchcraze, Carolyn Merchant's work on the seventeenth-century scientific revolution, the work of feminist historians on Darwin's revolution and modern biology, my own preliminary work on the sexual metaphors used by nuclear scientists and weapons physicists, and the work of philosophers such as Evelyn Fox Keller and Sandra Harding on the social construction of gender and science. Underlying this work is the larger question of the possibility of a major transformation in *weltanschauung* and practice, such as that described in Fritjof Capra's *The Turning Point*. Sandra Harding has explicitly asked: How does the 'super-masculinization of desirable belief . . . limit the ability of the kind of science we have to contribute to truly human progress'? One of the tasks of historians of science, I suggest, is to help explore this kind of question and to attempt to answer it.



David Gooding

HISTORY OF SCIENCE DEALS WITH an influential and very specialised form of culture: the production, study, and use of natural phenomena. Historians of science are interested in the activities of scientific practitioners, in the instruments and techniques they devised to investigate nature, the ways they represented and communicated their results to others, the institutional arrangements made to promote science, and in the development of their ideas and arguments, as recorded in manuscripts and papers. There has been a growing



Académie Royale des Sciences, Paris. Engraving after le Clerc, 1698. The activities depicted range from astronomy and cosmology to physics and mathematics.

recognition that scientists drew verbal, visual and symbolic representations from images, practices, and technologies of the world in which they lived. The has renewed our interest in artefacts and procedures as sources which complement the interpretation of the written word. Historians are studying how these practitioners drew upon their milieux and how they were in turn affected by them. They are finding that, whether scientists were inventing a new intepretation or defending an established one, they drew on a far wider range of resources than the familiar material and financial ones.

Historians of science also want to show how scientists made use of the literary, technical, financial, and institutional resources of their culture while maintaining the power to influence and change it. This work suggests that influential discoveries and ideas are not given in nature or by genius. Nor are they extracted and distilled from nature, for application to technical or social ends. Natural knowledge is invented and constructed by making information from nature intelligible, interesting and useful. It can then be influential. So we no longer see science as having been insulated from the wider social and cultural environment. We now see laboratories and research institutes as places where scientists bring nature into the crucible of western culture. What they get out has often reflected that culture as much as it reflected nature. This suggests that scientists' success – their ability to explain and control aspects of nature – depends as much upon their mastery of culture as upon their study of nature.

Historians are now moving away from the familiar trilogy of sources: ideas embodied in texts, applications embodied in technologies, and consequences such as industrialisation or secularisation. Like other students of science, historians are paying particular attention to what scientists did as well as what they said and wrote. If science is not preeminently theoretical or literary, we can look beyond texts for the concrete and practical sources of evidence about the day-to-day activity in which scientists have constructed new views of the world. An exciting example of this is the attention now given to experimentation. Some historians now present this as a process of making and remaking our experience of the world as the basis for more general views about nature, ourselves, and our societies.

We all believe that what distinguishes science from other pursuits is the fact that scientists test their theories by making experiments whose results are often decisive. Our beliefs are reinforced by the way we learned to think about experiments. Most of us came to know experiment second- or third-hand, through classroom demonstrations or through media coverage of spectacular 'crucial' tests of major theories. Both make it seem that experiment makes the natural world speak directly to the intellect. But empirical studies of experimental practices suggest that

'Scientifc Researches! New Discoveries in Pneumaticks! or an Experimental lecture on the Powers of Air' at the Royal Institution, 1802. Cartoon by Gillray.

this is a caricature. This mini 'Copernican Revolution' has led many historians to look beyond the didactic and demonstrative uses of experiment, to see how experiments were made and used and how their results came to be accepted or discredited. When scientific practice is not idealised as the handmaiden of theory (as it was, for example, by Sir Karl Popper) or as the handmaiden of politics (as it was more recently, for example, by Sir Keith Joseph) a multiplicity of experimental strategies comes to light. Most of these were used to make results intelligible, easy to communicate and to experience. We find that, though their techniques and arguments vary, scientists have always been concerned to make their results self-evident and real. They do not want their results dismissed as artefacts that owe their existence to the ingenuity of a few practitioners. Much of their time and ingenuity is devoted to solving practical problems of presentation and communication. Such problems have aesthetic, cognitive, social, institutional and political dimensions as well as the more abstruse intellectual and technical dimensions. Here case studies suggest that in the exploratory, innovative stages of research, interactions between scientists (as persons) are often more important than their interactions with nature (as observers).

This means that the history of science cannot be written on its own. Historians no longer take the cognitive or moral priority of science for granted, or the existence of nature as an objective source of information. If scientists' learning about nature is not as distinct from other, more familiar forms of learning, invention and expression as we used to think, then we may be close to writing a history of science which explains why science has been so successful as a way of learning about nature and so powerful an influence upon the way we live and think. Many historians of science now have training in both history and a natural science and can combine interpretative and empirical modes of investigating history. Their explanations should be more accessible to scientists and humanists, than earlier histories that placed science above and apart from the rest of culture.

A. Rupert Hall

THE ESSENTIAL OF BEING AN historian, like the essential of being a poet or a musician, is to follow one's craft rather than to try to explain it to non-practitioners. For this reason among others it is, I think, appropriate to conceive of history operationally: as being the telling of a tale or the analytical dissection of recorded data, or something lying between these extremes. It is both qualitative and quantitative. The history that attracts the majority of readers is the history of tales; the best-known, perhaps the best, historical writers have been superb tale-tellers, from G.M. Trevelyan and Sir Arthur Bryant to Sir John Plumb and Antonia Fraser. Tale-telling of the highest order requires no less formidable a bulk of knowledge, no less ardour in research (even if it eschews computers!) than does the analytical history which, on the whole, academics prefer. There is this difference, however, that analytical history uses procedures that are, in principle, universal; a tale is necessarily unique. Does anyone doubt that irrespective of historical weight the story of Garibaldi is more exciting than that of Cavour? Who would not rather write the life of Samuel Pepys than that of Edward Cardwell?

By contrast, analysis of the role of the Cavendish Laboratory at Cambridge in the history of modern physics is not, methodologically, very different from analysis of that of the Star

Chamber in the governance of Tudor England. An historical study of MPs can be easily paralleled by another of FRSs. Again, analysis of the work of a poet or novelist may find analogy as to method in the study of a mathematician, indeed, some literary scholars have made notable contributions to the history of science, like Majorie Nicolson. Where an economic historian examines figures for the export of commodities, the historian of science can examine statistics relating to expenditure on scientific education and research.

Analytical studies of the development of the natural sciences in their manifold aspects – organisational, textual, educational, prosopographical, social, and economic – have flourished enormously during the last forty years. Nearly all the historians of science in the world are academics or para-academics – not least in the USSR and Japan – and most of them are engaged upon properly analytic academic researches. Teaching of historical methodology is almost *de rigueur*, and not a few believe that historical writing should follow some formal methodological model, for example that of Thomas S. Kuhn or Mary Douglas. And since analytical history can only work with certain kinds of questions – though these may be linear in type as well as cross-sectional – just as quantitative history (*sensu strictu*) can only work with things that can be counted, these are the questions that most historians of science today are concerned with.

They are not, therefore, tale-tellers. Pioneers of the history of science indeed strove to tell 'The Story of Astronomy' (as it might be) and in trying to paint in simple colours too large a canvas they were often guilty of superficiality and, what some hold to be worse, 'Whiggishness'. Their stories had happy endings. They found that progress in human knowledge had occurred, was occurring, and was likely to occur in the future; that later ideas of the natural world were almost invariably more rational and better supported by evidence than earlier ones. When Karl Sudhoff (and many others) examined the history of anatomical illustration, for example, they discovered it to be non-existent in antiquity, crude and imaginative in the Middle Ages, first achieving pictorial realism with the artists and engravers of the Renaissance, and advancing to fully scientific, ultimately photographic, realism in recent times. Again, historians of cosmology found a progression from crude speculations to the sophisticated anthropocentric universe of antiquity and the Middle Ages, followed by the notion of an infinite and isostatic cosmos brought into close correspondence with an ever more exact astronomy, which was in turn modified during the late eighteenth century by the concept of cosmic evolution. No one could fail to see that the theories of each stage – though none was final – were buttressed by more numerous and more precise observations than had been the case before, and that the later understanding invoked and depended upon a far more rich and detailed range of integration with other branches of science than was previously possible.

Thus, until well into the present century, the main story-line of the history of science, by no means uniquely, was that of intellectual progress. Of course, there are also many excellent special tales in the history of science like that of the 'crime' and trial of Galileo, so well told (in English) by Giorgio de Santillana (1955). But even these have tended to lose interest in the general discredit of the idea of progress. This has had far more effect upon the nature of the subject, history of science, than has the character of science itself. The forbidding appearance of some work on the history of science has, of course, had its effect and it is no accident that the most widely discussed book in this field in recent years was by Arthur Koestler, *The Sleepwalkers* (1959), a book which though analytical in spirit has many attractive tale-telling qualities.

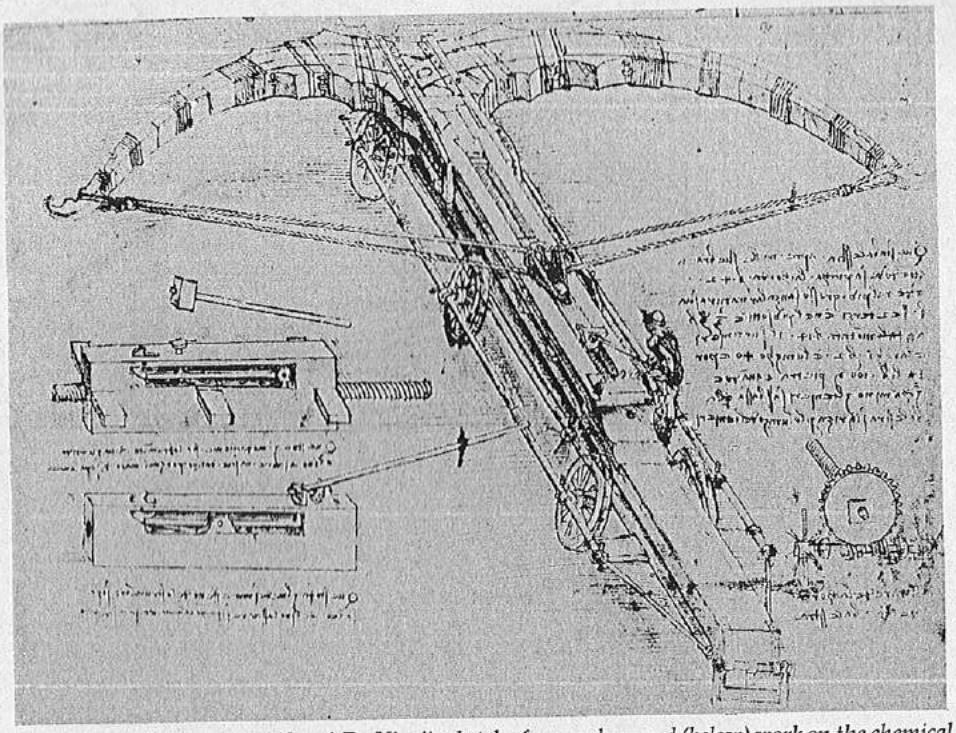
Historians of science pride themselves, rightly, on their post-war creation of an academic profession (a 'discipline', indeed, since it is taught to students) and less justifiably on writing only for members of their own profession (thus, hopefully, gaining 'peer-approval'). On the other hand, it would be a dubious proposition that either scientists or general historians are now more interested in the history of science than they were half a century ago, nor has it yet been satisfactorily demonstrated that there is any inevitable antithesis here: that an historian of science must appeal *either* to scientists *or* to general historians. The perfection and extension of analysis has done great things for the history of science, but a return to narrative history is long overdue.

John Hendry

PEOPLE LIKE CLASSIFICATIONS. Even if the phrase means nothing to them, I find on the whole that the people I meet feel comforted to know that I am an historian of science – or an historian of philosophy, *or* of technology, *or* of industry. If, on the other hand, I admit to being more than one of these, however partially or inadequately, they become suspicious and uncomfortable. They cannot place me, so they cannot trust me. In much the same way my fellow historians of science, as they class themselves, are happy to accept me as, let us say, an historian of twentieth-century physics, but ill at ease should I appear to stray into such distant disciplines as the history of astronomy, or that of not quite so modern physics. And at the other end of the spectrum there are people who are quite content to class me as an historian with no further qualification – providing of course that I do not admit to indulging in philosophy, policy studies, or, worst of all, fiction. Sometimes, I have no doubt, my statements of activities are mistaken for claims of expertise. Sometimes, I suspect, there is an element of resentment that I should be able to earn a living indulging and enjoying myself as much as I do. In general, though, these reactions probably reflect no more than a natural and universal desire to classify and categorise our environment, the very same desire, indeed, that underlies that science of which I am, or try to be, an historian.

This observation may seem commonplace, but it does have a particular relevance for the history of science today. For it is a curious and somewhat ironic circumstance that the desire for classification that is central to the subject matter, and thus to the growth, of the history of science, is also central to its isolation and current decline. The pioneers of the discipline were all people with unusually broad interests and learning who sought to develop what was once a sadly neglected subject. In the process of establishing and defending their new field, however, they unwittingly isolated it both from science and from history. A subject that originally grew out of a rebellion against specialism thus became a speciality in its own right, has remained one ever since, and has now begun to suffer the consequences. In most history faculties the historian of science is no more welcome than is the historian of art or philosophy. But nor is he welcome either in the faculties of science, where experiment and calculation, not literature, reign.

For the historian of science today this situation is an irritation, to say the least, but it is also a challenge. For



The Science of Weaponry. (Above) Da Vinci's sketch of a cross bow and (below) work on the chemical separation process by which plutonium is produced, at the Windscale Atomic Plant in 1954.

somehow the history of science has to be brought back into the mainstreams of its parent disciplines, and this has to be done without sacrificing in the process everything that it has gained over the years. It is easy enough to communicate with social historians by restricting one's attention to the history of scientific institutions, or with scientists by restricting oneself to the narrowly internalist pre-history of current scientific theories. It is much harder to convince scientists of the value of historical perspective, context and analysis, or historians of the relevance of scientific theories and experiments. We must, however, try.

The aims of history, as of any other study, are largely personal. My own view, for what its worth, is that history is a literary genre, subject to strict rules of evidence and cross-examination, the purpose of which is extremely practical. Much of my history of science and philosophy is aimed explicitly at scientists, and much of my history of technology and industry at policy makers. But the history of science must also be directed at the wider historical community. And it must be so not only for its own sake but, far more importantly, for the sake of that community.

History is the study of man. And there is surely nothing that has been more central to man's development in the modern era than has science. It has been central both to man's psychology and to his society, and central in both its ideas and its consequences. The world we live in has been moulded by the ideas of evolution and relativity, psychoanalysis, even non-local quantum mechanics, every bit as much as it has by those of political or economic thought. The impact of science-based technologies, from electric power to genetic engineering, from plastics to nuclear weapons, and from antibiotics to aircraft, has surely been even greater than that of wars and revolutions.

Given this situation, it seems obvious that if history is to be taken seriously at all, then the history of science must play an important part in it. But there appears to be no sign of this happening. The historians of science complain, quite rightly, that they and their subject are left out in the cold. The mainstream historians retort, quite rightly, that this is not entirely their fault. What they need are textbooks. What they have is nothing between the distortions of popular science writers and the inaccessible scholarship of the historians of science. Both sides blame the other and neither does anything about it.

One day, if historians of science can get off their high horses and write books that can be read, and if mainstream historians can get off their high horses, accept that science really is an important part of their domain, and make an effort to understand it, the history of science may become genuinely part of history. If not, it may just become part of history in the other, less vital sense, and it is history itself that will be the loser.

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Brian Easlea is lecturer in Science Studies at the University of Sussex and author of *Fathering the Unthinkable* (Pluto Press, 1983).

David Gooding is a lecturer in the History and Philosophy of Science at the University of Bath and co-editor of *Faraday Rediscovered* (Macmillan, forthcoming).

A. Rupert Hall is Professor Emeritus of the History of Science and Technology at London University. His latest book is *The Revolution in Science* (Longman, 1983).

John Hendry is GSRC Fellow in Business History at the London Business School and author of *The Bohr-Pauli Dialogue and the Creation of Quantum Mechanics* (Rydell Press, 1984).

History Today, 35 (1985): 46-53.

WHAT IS THE HISTORY OF SCIENCE?

*In its quest to understand man's changing perception of the world of nature, **History Today** asks six further historians, What is the history of science?*

John Pickstone

FOR ME AND SEVERAL OF MY generation it has been a progression, from science, to history and philosophy of science, to a broader form of history which includes social as well as intellectual aspects of science. The broader picture is not restricted to knowledge, it includes practice – the crafts of science and especially the practices of technology, agriculture and medicine. Thus we come to deal with a large and central area of social and economic history – the continuing and ever-changing interplay between more or less cumulative knowledge and more or less effective practices.

The 'intellectual' side remains important and stimulating. Popper – Kuhn – Lakatos – Fyerabend have become staples of philosophy of science and are all very much historical. The debates about rationality and shifting frames of reference remain stimulating. Recent French analysis, especially by the late Michel Foucault, has still to be properly explored by Anglo-American historians, though almost twenty years have passed since *The Order of Things* was first published. We still lack criteria for judging the depth and extent of 'structural shifts' in scientific understanding, e.g. around 1800. Shall we continue to explain such shifts as the putative sum of more particular changes linked to patterns of group advancement; or do more general links between social structures and understanding have some purchase here?

But 'scientific knowledge' is not all, and may often not be primary. Historians of technology and medicine especially, are concerned with patterns of practice that have their own traditions – moulded by social and economic forces, they are as often fields for scientific exploration as for scientific application. The nineteenth-century hospital was a social and professional invention which made a certain kind of medicine possible. As De Solla Price has noted, we need to pay more attention to such *instrumentalities* whether they be largely social, like a hospital; physical, like a telescope; or simply conceptual, like the differential calculus. Such instrumentalities, in many fields, helped create theory though they required little.

So the emphasis shifts to science-practice relations, and to contexts where the social and economic is not mediated only through scientific or religious ideologies – to Pasteur, as well as Darwin, a Pasteur concerned with French economy, not just with problems in scientific method. This kind of approach brings history of science closer to the economic and social history practised in history departments. It also links closely with studies of policy for science, industry and medicine.

Discussion of policy becomes more important as public concern grows and resources do not; practitioners of 'science policy' become more historically-minded as they grow older in such studies. Twenty years ago, history was little more than a gloss in 'social studies of science'; now synthesis is evident; there is opportunity and need for much more. Historians privileged to spend their time in the study of scientific and technical change should welcome engagement in discussions of policy, for all its difficulties. No one concerned with policy in rapidly changing areas can afford the parochialism of a narrow present. Some months

A ward of the London Hospital in 1888.

Chemical lecture by Sir Humphrey Davy at the Surrey Institute; engraving by Thomas Rowlandson, 1810.

ago *The Times* called for a British Institute of Contemporary History. Such enterprises are better conducted in the plural, but whether one or many, such institutes must surely contain specialists in science history. How else can we 'debrief' the influential (or the scientific rank and file); how else can we learn from the archives about critical areas of our present?

Historians of science, technology and medicine straddle major divides in our culture; it is a privileged position, if sometimes an uncomfortable one. They must meet in full the standards of professional historians, but should not lose contact with the students and professionals whose disciplines and occupations they address. Above all they must help provide a framework in which the key issues of technical and social development can be considered by a broad and informed public.

Roy Porter

A GREAT TRANSFORMATION IS UNDER way in how we view the history of science.

When, at the turn of this century, J.B. Bury proclaimed, 'history is a science, no less and no more', he was giving science his vote of confidence. Bury's confidence was widespread. For Victorian minds like his, science was an engine in the intellectual world no less mighty than the steam engine in the industrial. Honest doubters of course voiced their fears (was not science eroding faith and killing poetry?), but science's success in unveiling Nature's laws and transforming material life seemed beyond cavil. As Macaulay sang the praises of Baconian science:

> It has lengthened life, it has mitigated pain, it has extinguished diseases, . . . these are but a part of its fruits and of its first fruits. For it is a philosophy which never rests, which has never attained, which is never perfect. Its law is progress.

Thus to our grandfathers, science was the epitome both of objectivity and utility. It was right that primitive thought-forms like magic were crumbling before science's hard facts and conclusive experiments; good that the humanities themselves were becoming scientific (as Bury thought was happening to history). Not surprisingly then the aim of traditional history of science was clear-cut. It was to trace the march of mind, to show, for instance, how in astronomy Ptolemy had yielded to Copernicus, how in physics Newton had superseded Descartes. For, ultimately, Ptolemy and Descartes had been wrong, Copernicus and Newton right.

This conception of writing the history of science by plotting its progress towards truth has continued to be influential this century, and it has been reinforced by growing acknowledgement of the role played by science in making Western civilisation unique. Thus, as Herbert Butterfield put it, the Scientific Revolution from Copernicus to Newton wrought such changes as to put both the Renaissance and the Reformation in the shade. It remains the creed of popularisers such as Carl Sagan and Isaac Asimov, and is central to Daniel Boorstin's new survey of *The Discoverers*.

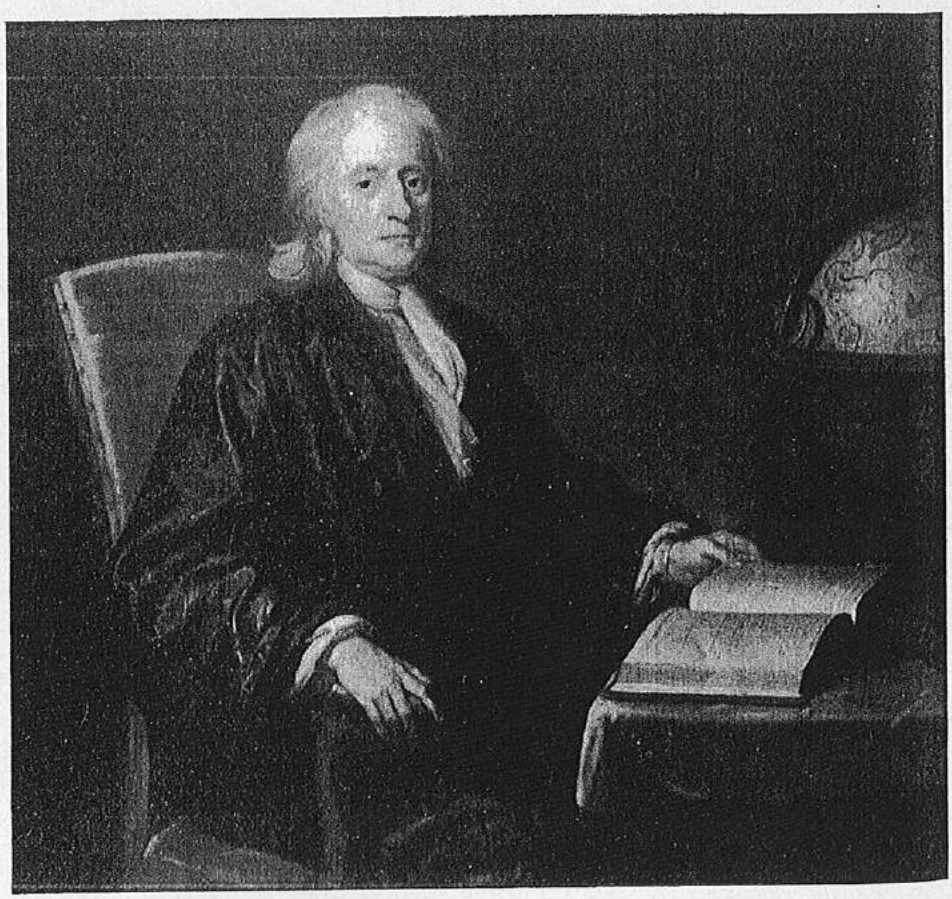
Yet it is being overturned. Revisionist historians of science have reminded us how general history freed itself long ago from religious or political bias, concluding that judging the past by the present produces bad

history. But aren't we making the same mistake if we tell the history of science, using hindsight, from the viewpoint of today's astronomy or physics? Too often this approach ('Whig history') paints a canvas depicting, on the one hand, heroic precursors, passing down the baton of truth in the relay race of discovery; and, on the other hand, knaves and fools (such as anti-evolutionists) who got it all wrong. In such Manichee history, the errors of the also-rans get attributed to their psychology and prejudices (e.g. religious dogma), whereas, by contrast, the triumphs of the winners are explained by genius. Theirs are the minds which soar into the stratosphere of intellect, thinking higher, purer thoughts.

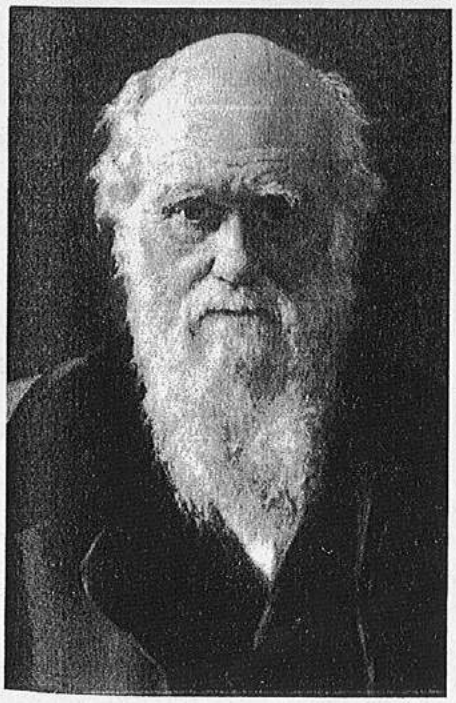
But we must reject these 'saints and sinners' caricatures. We shouldn't take sides. Losers need study as much as winners. For example, don't neglect Descartes (as Asimov does) merely because it was the Newtonian not the Cartesian laws of mechanics that ultimately triumphed. For Descartes was a key figure in his own day and immensely influential.

Furthermore, the historian mustn't just stand back and admire genius; he must anatomise the thought-worlds of the 'discoverers'. It begs too many questions to see Newton as 'discovering' the law of gravity merely by dint of the exercise of his towering rationality. Indeed, put his mind under the microscope, and does he even look so rational? For Newton was deeply absorbed in alchemy, in Neo-Platonic philosophy, and in millennialist theology. Nor were these mere hobbies; more likely they were integral to his scientific achievements. Alchemy's doctrine of sympathies probably attuned Newton to the notion of attraction, so vital to universal gravitation; while Neo-Platonism's quest for the immaterial probably persuaded him that the universe was almost entirely pure space, a void. So the inspirations of science turn out to be varied and complex, and include outlooks we'd nowadays see as unscientific.

Above all, the new history of science is on its guard against interpreting science's past by present scientific orthodoxy. Take the history of evolutionism. For the last half century the Darwinian theory (evolution works chiefly through natural selection) has been in the driving-seat. So historians



(Above) Ptolemy, astronomer, mathematician and geographer of Alexandria, second century AD.
(Right) Sir Isaac Newton, 1642-1727, author of "Principia" (1687).



have heaped their attentions on Darwin, to the neglect of other evolutionists such as Lamarck. And there have been strenuous efforts to prove that Darwin 'discovered' natural selection 'scientifically', rather than through extraneous stimuli, e.g. after reading Malthus' account of the struggle for survival. But right now biologists are again having grave doubts about the part played by natural selection, stressing instead the role of random variation. Must we therefore start rewriting our histories? That would turn history into a service industry for science itself, which would be akin to intellectual treason.

We live in paradoxical times. Science flourishes as never before. But we are becoming less sure whether it is a blessing or a bane. And, not least, following Einstein and Heisenberg, even the very notion of scientific truth is in the melting pot. In this situation, the job of the historian of science is not to play historiographer royal to science, but to undertake detached analysis of how science really operates, and to examine its place within the wider spheres of thought, culture and society.

Simon Schaffer

ONE OF THE EARLIEST ATTEMPTS to define the scope of the history of science – and, at the same time, to recommend it to a wide popular readership – was that of the radical Dissenter and heroic chemist Joseph Priestley. By 1767, he had completed a lengthy survey of discoveries in the science of electricity made since the earliest times. While his book aimed to cover the whole history of this science, more than one half of the book was needed to deal with the mass of work done in electricity in just the past twenty years. This striking demonstration of cumulative and accelerating progress was Priestley's main concern. It has been the main concern of historians of science ever since. The doyens of twentieth-century history of science, such as George Sarton in the 1930s, made this kind of history the noblest and the most virtuous work any chronicler could perform, just because this was the only activity which the human race had developed which was always progressive, always successful, and increasingly revealing of truth.

(Top) Descartes, 1596-1650; painting by Frans Hals.
(Centre) Copernicus, 1473-1543; a sixteenth-century woodcut.
(Left) Charles Darwin, 1809-82; painting by John Collier.

Priestley put it bluntly: 'civil history', the story of politics and statecraft, 'presents nothing but a tedious uniformity', and any sensitive reader could not 'help being shocked with a view of the vices and miseries of mankind'. By contrast, science itself while virtuous, could not engage our interest because it lacked the human angle. Thus history of science was the best of all forms of history, since it was 'relieved from what is most tedious and disgusting' and at the same time presented 'the human understanding grasping at the noblest objects'. This sales pitch made history of science the best reading matter for an enlightened market.

But in the 1960s something started to go very wrong with this splendid vision. History of science has increasingly turned dirty. 'The vices and miseries of mankind' are now more visible in the stories historians tell about science than almost anywhere else. We were told that Isaac Newton was an autocrat, deeply disturbed by radical critics, Roman Catholicism, and continental operators. Louis Pasteur, cynosure of pure experimenters, suppressed his data, organised campaigns of slander against scientific rivals, and engineered wholescale coups in the polity of nineteenth-century France. More recently, even apparently 'hard' areas of scientific knowledge, such as mathematical statistics, quantum theory, or observational geology, have proved accessible to ingenious historians who have displayed the social interests which sustained claims to truth, and have analysed the cultural wiles which scientists use to make their views stick. Simultaneously, areas of knowledge hitherto quite outside the accepted boundaries of real science, such as phrenology, astrology or mesmerism, have been treated in just the same way as historians treat our own favoured forms of truth. In the conditions of the seventeenth century, the contest between the Society of Astrologers and the critics of judicial astrology is not to be understood as the obvious and inevitable triumph of reason over obscurantism. Historians have become so suspicious of this obviousness that they have begun to avoid using it as an explanatory principle.

The loss of the obvious is probably the most striking aspect of this change in historiography. In Priestley's time, European culture encountered fresh evidence of the enormous cultural diversity of human experience, whether in the South Seas or in the streets of Paris. It is as though this

clash has at last reached the final haven of western European culture – natural science itself. For the principal resources on which the historians of science rely are those developed in the fields of cultural anthropology and comparative sociology. Just as in New Guinea a cassowary is, for some people, not a bird at all, so, in Wiltshire in 1774, the air generated when calcined lead was heated was just not oxygen. It is, of course, quite possible to say that the culture of the New Guinea hill tribes and that of Wiltshire chemists were both mistaken. We know that the cassowary is a bird; we know that calcined lead yields oxygen. But to say as much scarcely allows space for history. The priority has been changed, and the demand is that a space be made where historians can work. It turns out that making that space means getting rid of our obvious assumptions about what is the case in nature. Then historians of science can freely exploit the tools which all other historians have themselves taken for granted. This necessary act of jungle clearance has deep institutional consequences: it brings historians of science closer to other analysts of culture, further from the scientific institutions in which they find themselves. But a more profound understanding of the way science works is a rich reward: it ought to provide science with better means of explaining itself. Priestley agreed:

> These histories are evidently much more necessary in an advanced state of science than in the infancy of it.

Joseph Priestley, 1733-1804. Medallion by Phipson.

Steven Shapin

AMONGST HISTORICAL SPECIALITIES, the history of science has a unique problem. Is it history at all? We take history to be the record of human affairs and actions. Yet the received view of science is that it is founded upon entities which are not man-made: science is based not upon artefacts but upon facts. Scientific matters of fact, along with certain privileged ways of accounting for them (laws, theories), are widely held to be discovered rather than invented. In this received view, we can record the history of discoverers, but that which they discover (objective scientific knowledge) must lie outwith the scope of historical inquiry.

It follows from the received view that science, considered as the corpus of objective knowledge and as an activity governed by a special method, is not a typical form of culture or a typical human pursuit. Thus the history of science is fundamentally different from the history of art, religion, philosophy or politics. Perhaps the history of scientific errors, delusions and by-ways belongs to history proper, but not the history of *science*.

Over the past fifteen or twenty years, this received view of science and its historical study has been systematically challenged. It is now widely, if not universally, maintained that science is a social activity and a form of culture like any other, and that it may be studied and understood accordingly. The challenge has come from three main sources: from the professionalisation of the academic discipline called the history of science and the consequent loosening of its ties to the scientific community as a constituency for its products; from the development of a significant anti-realist and anti-rationalist strand in the philosophy of science; and, perhaps most importantly, from the growth (especially in Britain and on the Continent) of a serious sociology of scientific knowledge, and from increasing contacts between sociologists and historians equally concerned to understand the realities of scientific practice.

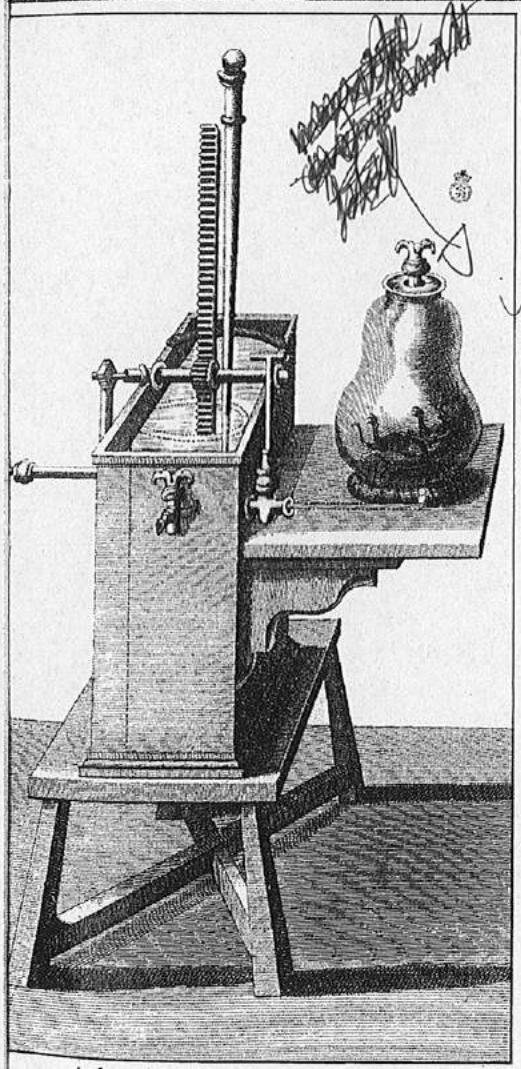
Understanding science as a social activity and as a typical form of culture means that we treat it as goal-directed: we move beyond asking what scientists believe to asking what they are trying to do; it means that we understand beliefs in terms of the inherited and socially-transmitted stock of knowledge available to scientists in their particular settings and in terms of their purposes; it entails understanding the meaning of scientific propositions by referring to their context of use; and it allows us to seek to *explain* scientists' beliefs, whether 'true' or 'false', using the full range of resources available to the historian.

The history of science is a predominantly empirical discipline, and its practitioners have engaged with these projects at a concrete and particular level, generally neglecting the abstract and programmatic arguments of philosophical and sociological theorists. Nevertheless, the body of empirical work which implicitly rejects the received view of science and its history is already impressively large; and existing empirical work has precipitated research programmes of its own. For example, historians have recently shown that in the seventeenth century scientific propositions (including Boyle's and Newton's) were evaluated not only according to their adequacy in technical contexts of use but also according to their value in justifying particular conceptions of God's attributes and the correct moral order of society. Nature was available for such usages because it was conceived to be divine, a theatre for God's activity, a reservoir of moral meaning that might be drawn upon as required to comment upon human conduct.

Suppose it were objected that only past science, pre-professionalised science, can be understood as a typical form of culture. Once, by the end of the nineteenth century, science became properly professionalised, it ceased to be a part of society and a part of the general culture. It would follow that at that moment science ceases to be amenable to truly historical inquiry. The point is an important one for the academic study of science: the sorts of 'social influences' upon science which historians have documented in the seventeenth and eighteenth centuries become much more difficult to trace in the science of modern times. Here is a potential programme for historical research: what were the connections between the professionalisation and differentiation of scientific culture and the development of secular views of nature?

As it happens, modern physical science has been one of the most vigorously worked seams of recent social studies of science. This is where the history of science and the microsociology of scientific knowledge approach each other so closely as to be indistinguishable. The goals of present-day high-energy physicists may no longer include comment upon the order of the wider society, but modern science is no less goal-directed, no less socially transmitted, and scientific statements are no less dependent for their meaning upon the context of practical activity.

'The Cow Pock-or-the-wonderful effects of the new innoculation.' Dr Edward Jenner tests his new vaccine with dramatic results. Cartoon by Gillray, June 1802.



A drawing of Boyle's second air-pump experiment to demonstrate the necessity of air to living creatures.

The programme for the history of science is, therefore, to be *history* everywhere in its domain. This programme entails understanding scientific knowledge as the product of human activity. To paraphrase Marx on history:

> Nature does nothing... It is rather man, real living man who does everything.

Robert M. Young

IF SCIENCE IS SO IMPORTANT, WHY is its history so badly served? Most people who read and write history would readily acknowledge tht 'science' – broadly conceived as science, technology and medicine – has been crucial in every era and is at the heart of our own. Yet books and articles about the Protestant and Capitalist Revolutions of the seventeenth century manage to be silent about the Scientific Revolution, even though those three fundamental changes were arguably part of a single set of alterations leading to the modern world and world view. Simlarly, historians of the Victorian era manage to say little about basic changes of view about 'man's place in nature'.

You can look in vain through many standard histories of these periods for serious coverage of the fundamental alterations in theory and practice which were afoot and which had scientific ideas at their centre. In the seventeenth century example, the earth was being displaced from the centre of the universe, and our sun was seen as the centre of our system of planets, while the 'perfect' circles travelled by the planets were being replaced by ellipses. This and other scientific changes, e.g. in the study of physics, were closely interwoven with developments in theology, mining, ballistics and navigation. Yet they get sequestered into specialist books on the history of science and technology. Why should a new view of our world and how we know it be so isolated?

The Victorian example, is, if anything, even odder. If you look at the contemporary periodicals, magazines and novels which were being read by an increasingly literate public, they are full of the topics which historians of our own day tend to ignore when writing Victorian history. Darwin's theory of evolution by natural selection brought humanity into the world of other animals and fundamentally challenged the special status of 'man' and 'mind'. The writings of the time were full of debates on the concepts which were part of Darwinism, just as Darwinism was part of a wider movement of naturalism and secularisation. Natural laws were applied, for example, to human population growth: T.R. Malthus argued that famine, war, pestilence and death were as much the function of scientific laws as the movements of the planets. The history of the earth and of the coming and going of plant and animal species was seen as a natural process, not a result of separate acts of Divine creation and extinction. The mind was increasingly seen as obeying natural laws, based on the functions of the brain, and this challenged traditional ideas of free will and responsibility.

You can find these matters seriously considered in the novels of George Eliot and Benjamin Disraeli and in the Penny Magazines, but not much in our own period's historical works, except those specialising in the history of science.

A similar story could be told about most periods, e.g. ancient, medieval and Renaissance, Chinese, Arab and American histories. In each case science and other branches of expert knowledge tend to be treated in relative isolation from social, political and other parts of intellectual history. The result is that the academic history of science is in most cases seen as a highly specialised field of esoteric knowledge, while the actual history of science was and is important in social and cultural change.

What forces keep it that way? I would say that our education system is doubly daunting in separating off scientific schooling. Pupils stop doing

either science or the arts at an early age and are *taught* to split off scientific knowledge from social, political, economic and cultural knowledge. Arts people end up in awe of science, and scientists end up defensively arrogant about the arts.

In our own time, science, technology and medicine are transforming the conception of babies, education, work, leisure. Think of 'test tube babies', microelectronics, genetic engineering and biotechnology, video, high-technology medicine. If we can't learn to think of science and technology as part of culture in the present, as well as in the past, we will continue to separate them off from debates abut social values and goals. We have paid a high price for making this separation, and are in the process of beginning to pay an even higher one. Politics is the setting of priorities – values and goals in action – to shape social policy. This goal-setting determines what priorities are set in science, what research gets done, what theories, therapies and things are available to us. These play a significant role in determining the new technologies that embody the social forces that shape our lives. This was true in the great era of exploration at the end of the Renaissance; it was true in creating manufacture and machinofacture, mass production and automation.

In thinking about this urgent set of issues, I would say that the historian of science should not be an abstruse specialist. She or he belongs in the mainstream of social and cultural debate. If we can't get science integrated into history, we won't see how our own history is being made, and, more importantly, we won't give the public access to how we decide it should be made.

History of science now sits in an uneasy niche as a cultural ornament to science or as a tiny sub-speciality within history. It needs to be treated by historians as the fundamental part of culture that it has always been in practice.

John Ziman

THE HISTORY OF SCIENCE IS WHAT is made of it by scientists, metascientists, non-scientists and – historians of science. Each of these audiences expects to hear different things about science.

The scientists want a chronicle of the advance of knowledge. They want 'the record put straight' on every 'discovery' that is now thought to be valid. Scientific discoveries are claimed in precisely dated, definitively authored, publicly communicated and systematically archived documents. The job of the historian of science is to sift through the books and journal articles that have accumulated in total scientific libraries and reassure scientists that they will eventually get the credit for their work. Since the formal literature of science is immense, and not as well-ordered as it pretends, this Whiggish project has its rewards. It is just conceivable that the *Proceedings of the Natural Philosophy Society of Obersteindorf* might contain an article, dated December 1904, by Dr. B. Zweistein, in which there occurred the equation $U=WV^2$ (where U stands for energy, W for mass, and V for the velocity of light). Then A. Einstein's paper of 1905 would have been pipped at the post, and Zweistein is the one who should have been given the Nobel Prize for discovering Relativity. What a pity the poor fellow died as he lived, a clerk in the Patent Office of Unterschwabia! At least we can celebrate the centenary of his death, in 2023.

Albert Einstein, 1879-1955, author of "The Meaning of Relativity" (1923).

Scientists commit themselves objectively to the history of science through their individual claims to priority of discovery. But this individualism flows over subjectively into anecdote. In their reminiscences they live again the human delights of their craft, and reflect upon themselves the glory of once having associated with geniuses. 'Did you ever meet Zweistein?' 'Not that I can recall, but, you know, Einstein really didn't wear socks.'

Unfortunately, the anecdotes recorded in autobiographies and obituaries sometimes upset the record. It is not only that it has to be admitted that the late Professor Dreistein was a bit of a *schwein* to his students ('but it was good for us, of course'). Didn't Zweistein get a letter from Einstein, in 1903, answering some little question – or was it the other way round? So there is another history to be written, the *real* chronicle of priorities, where justice will be done to all such informal influences on the advancement of knowledge. For a scientist, the ideal biographer searches letters, laboratory notebooks and accumulated scribbling to maximise its human subject as a progenitor or unacknowledged precursor of all the best scientific ideas of the future.

Metascientific history ignores mere people. A philosopher will want to know whether Zweistein's symbols U, W and V mean quite the same as Einstein's E, M and C: perhaps one should say that, strictly speaking, there were two distinct discovery events, relating to incommensurable theories. A sociologist might investigate the social composition of the membership of the Obersteindorf Natural Philosophy Society, demonstrating its subservience to the proprietor of the local gunpowder factory, thus indicating the true class interest in this pregnant invention. The economic history of science is still in its infancy, but there might be a lesson for contemporary science policy from an estimate of the resources then available to patent officers with a yen for theoretical physics. And so on.

None of these metascientific questions would, of course, be of the slightest interest to scientists or to most non-scientists. Until recently, these two audiences agreed that the history of science should celebrate the achievements of science, and of scientists, in no uncertain terms. The hagiography of science is still not

dead, although it was dealt a shrewd blow by James Watson's immensely readable version of the discovery of DNA, which kicked all the participants off their pedestals – including the author himself. Nowadays, indeed, the academic debunking of the official history of science by zealous meta-scientists can be popularised for non-scientists, especially if thoroughly personalised and sensationalised: witness Broad and Wade's highly publicised account of scientific fraud in high places, not excluding Newton and Mendel, for real kicks.

The history of science has to accommodate all these diverse interests and insights. The genuine professionals know this, but to an outsider they seem to write a little too much for each other. Perhaps they discover that their concern for what really happened to a person, or a period, or a movement of thought, or a technique, or an institution is not shared by many other people, in academia or elsewhere, and they withdraw into their own scholarly communities where they feel that such matters are properly appreciated.

Let me reassure them. History is an indispensable competent of Science Studies, at every level of sophistication. Whether considered individually or communally, psychologically or philosophically, intellectually or technologically, science is an historical process, which cannot be understood by anyone – particularly its own practitioners – without a reliable account of its evolution in time.

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Book Reviews

The story of a Hebridean island

Canna: the story of a Hebridean island, by J.L. Campbell. 301pp. (*Oxford University Press for The National Trust for Scotland,* hardback, £25)

Canna is a small island in the Inner Hebrides, about six miles long by half a mile across. In 1938 it was bought by John Lorne Campbell, who had met and married his talented, musical wife, Margaret Fay Shaw, whilst they had both been collecting and recording Gaelic songs – he on Barra and she on South Uist. Since 1938 they have lived on Canna and made it into an oasis of civilisation fourteen miles out in the Minch.

The population of Canna, together with the small crofting community on adjoining Sanday, is Catholic and Gaelic-speaking and today numbers eighteen (in 1821 it was 436). There is an astonishing range and variety of flora and fauna, which the careful stewardship of Dr Campbell has done much to promote. The tree and birds, the butterflies, plants and moths, as well as the 'learned, happy accumulation' at Canna House – celebrated in some of her poems by Kathleen Raine – represent an intensity of life which is unique in the Hebrides. In 1981 responsibility for the future nurture of this diversity of life passed to the National Trust for Scotland and Dr Campbell was asked to utilise his unrivalled knowledge of the island and of its place in Hebridean history in writing this book.

The result is that rare thing, a 'total' history. There are nineteen chapters which proceed chronologically, and necessarily episodically, to relate what is known of the island's history from the time of St Columba to the present day. There are then seventeen fascinating appendices which cover everything else about the island from its geology and place-names through its flora and fauna to its population statistics, charters, rentals, lists of clergy, and its local traditions.

Dr Campbell has been well-known as a Gaelic scholar for half a century, and a long list of books, on many subjects to do with the Gaelic-speaking area of Scotland, came from his pen between his *Highland Songs of the Forty-Five* (1933) and the three volumes of *Hebridean Folksongs* published with Francis Collinson (1969, 1977, 1981). Margaret Campbell also has published articles and a book of the *Folksongs and Folklore of South Uist* (1955) which she was recording long before the importance of such things was widely recognised. Together, their life-work of farming and scholarship on Canna, as Gaelic-speaking residents committed to the welfare of island communities such as their own, stands out as a beacon of light in the dark, grim history of Highland landlordism during the past two centuries.

The viewpoint of Dr Campbell is that of a Catholic Gaelic-speaking Scotsman, who has spent all his adult life in the Hebrides and who has come to believe that the early Irish and Norse associations of St Columba and the Lords of the Isles promised a better and a more independent future for the Hebrides than the domination under first the Scottish and then the British Crown which has been their lot. 'It is part of the thesis of this book', he declares, 'that historically the Hebrides were integrated with the mainland against their will'. That integration has meant domination, repression of the Gaelic language, the imposition of Protestantism – 'the Isles had had no part in the Scottish Reformation' – and the ill-informed attentions of government bureaucrats and Scottish historians who 'have never felt knowledge of Gaelic to be indispensable when writing about the Highlands and Islands'. This is a refreshing, anti-Establishment viewpoint which, though it may ruffle some sensibilities, is not without truth and is too seldom heard. For all those brought up on the self-indulgent sentimentality of the Skye boat-song school of writing about the Scottish Highlands, this book will make challenging and stimulating reading.

From the time of St Columba at Iona (AD 563-597) to the arrival to the Irish Franciscans in the seventeenth century, Dr Campbell rightly emphasises the importance of the Irish and Catholic connections for Canna, as for the Hebrides generally. He brings to light some fascinating sources in support of his case, amongst them an intriguing letter of 1626 from the Chief of Clanranald to Pope Urban VIII offering, if given military assistance, to 'reduce the whole of Scotland to obedience to the faith of Christ and of your Holiness'. The links between this historical tradition and the anti-Covenanter stance in the seventeenth century and the pro-Jacobite sympathies after 1688 are well brought out. With the 'unequal incorporating Union' of Scotland with England in 1707, the Presbyterian Establishment gained a permanent ascendancy and bodies such as The Society in Scotland for Propagating Christian Knowledge (1709) came into being to spread the Presbyterian religion and the English language to the Highlands. Dr Campbell utilises the Minutes of the SPCK to show that 'what the majority of the Highlanders were rebelling against in 1715 and again in 1745 (was) a calculated, well-financed attempt, backed by constant political pressure, to destroy their language and their religion'. Only in the nineteenth century, with the Gaelic Schools Society, was the Gaelic language promoted in the Gaelic-speaking areas. In the light of Dr