How Many Angels Can Sit On the Head of a Pin?

RANDALL C. BROOKS

Since attending the 1991 conference of the Scientific Instrument Commission (SIC) of the International Union for the History and Philosophy of Science I have been contemplating the manner in which history of science is researched. Returning from the combined conference of the American, British and Canadian history of science societies in Toronto (July, 1992), I am even more frustrated and disillusioned. One of the objectives of *Material History Review* is to provide a means of communicating knowledge pertinent to material history, including scientific apparatus, such as is found in our museums. The SIC conference should have been largely concerned with the material history of science and in particular the instruments themselves and the insights that studying these objects provides. I had hoped that a few of the almost 200 papers delivered at the Toronto conference (the primary theme was scientific laboratories) would include some presentations dealing with analysis of scientific instruments and that a report on those papers would be of interest to *MHR* readers. How wrong I was!

The history of science may be broken down into four distinct topics: the theoretical framework, the equipment employed, the details of the experimental techniques including the results and, finally, the impact. To me, as a scientist turned historian, the most important aspects of an historical assessment of scientific activities are the origins and evolution of the theoretical framework or context and the development and characteristics of the equipment and apparatus employed. Once you understand where the scientist was coming from intellectually and how he was limited by his instruments, one can, after the fact, readily explain the experimental results.

The impact of scientific and technical progress is important for what it tells us about nature and how we have grown to understand the relationships between its various branches (e.g., biology and chemistry) and how we have learned to harness natural phenomena to our advantage. It is also important to understand how progress provided feedback to contemporary scientists as they sought to explain various phenomena. The impact of scientific discoveries on society is completely secondary to the study of the history of science. Yet a majority of historians of this discipline today seem to concentrate on this latter secondary theme in a modern day parallel of the philosophical debate regarding the number of angels that can sit on the head of a pin.

I am not the first to voice such reservations. Gerard Turner, in his 1972 Quekett Lecture to the Royal Microscopical Society, criticized historians of science thus:

> *Some historians of science like to describe themselves as intellectual historians, seeing as their proper study the development of concepts in man's attempt to explain the material universe. I do not, of course, dispute the value of this study. What is unfortunate is the imbalance that I see in the history of science brought about through the failure to recognize the potential of the study of scientific instruments, which are, after all, ideas made brass. To take an example: the author of a recent book on the history of spectroscopy deliberately omits any consideration of the instruments concerned. This omission cripples the book because, particularly in this subject, the development of the concepts is so intimately connected with the instrumentation. Another case where the development of theory cannot be considered apart from the design, manufacture and use of instruments, is in the study of the 18th century 'electricians,' as they were called. Here the conceptual framework had to be teased out empirically from extensive experiments.*

To date, the melding of traditional arts subjects with the study of science history, and by extension the technology of science, has negatively impinged on its progress. This is largely the result of poorly designed and taught university programmes with inappropriate prerequisites for the students. This is forcibly driven home in Michael J. Crowe's booklet, *History of Science, A Guide for Undergraduates,* in which he states, "Most introductory courses in history of science require no greater knowledge of science than is required for admission to the college ..." (p. 6). How, in the twentieth century, is someone so inappropriately educated to understand the complexities of nuclear physics, genetics or, more relevant to *MHR* readers, the design and function of a laser or spectrophotometer, going to write a coherent history of the subject? Clearly one cannot.

Current history of science conferences and journals have an overwhelming number of marginally topical papers to the primary themes noted above and those that are relevant are all too often concerned with the seventeenth- or eighteenth-century luminaries such as Galileo, Newton or LaPlace! If we are lucky, we may have a foray into nineteenth century Darwinism but rarely do we have an illuminating contribution on twentieth century science or the technology (of any period!) on which progress was based. Without scientific training and experience, how can a person understand the intricacies of a complex theory or appreciate the delight a researcher feels when a theory is born out by experimental results after months of "tweaking" temperamental state-of-the-art apparatus? They can't and the result is history that concentrates on the social impact of science. Few social historians of science will admit that a scientist's primary driving force is just plain, simple curiosity; they feel compelled to create a fictional image of deep philosophical and psychological motivations that are off the mark and irrelevant to the progress of science and technology.

I will admit that we all have our biases and, as Victor Torrens, past President of the British Society for the History of Science, suggested at the Toronto conference, there are two ways to look through a telescope and the views are very different. But one can carry the analogy further. Astronomers have for many decades used a variety of filters with their telescopes; these may be coloured or broad or narrow band interference filters chosen to sharpen their vision of a specific phenomena. Every historian, myself included, is saddled with such a set of filters defined by one's education, experience, interests, etc. But to start off your career with welders glass in front of your eyes (as a young intending historian of science or materials does on this continent), one has little chance of making a significant contribution.

What I have had to say thus far primarily relates to the material history of science but the following, I believe, applies to the material history of any discipline. Clearly we cannot all obtain a Ph.D. in a specialist technique before tackling a research programme, but there are some technical skills and knowledge with which all historians of material history should be provided. I see little evidence that university programmes are providing those skills though in the UK, cooperation between Imperial College and the Science Museum appears to be paying some dividends in this direction. In Canada, some of the more relevant technical skills are provided by the Canadian Conservation Institute but these are primarily aimed at preservation and restoration although they also learn much of manufacturing techniques during their work. Researchers with these skills could add an important dimension to one's understanding of our material history. One could envision a cooperative effort between CCI, the National Museum of Science and Technology and universities in Ottawa to address this shortcoming in the way we instruct students to study the history of science and technology and material history in general.

Canada has tens of millions of artifacts sitting in museums begging to be researched. Few historians have tackled the problem of carrying out detailed physical studies of those artifacts using the most sophisticated apparatus and techniques available. Yet, as Gerard Turner points out, there is much to be learned from artifacts. But to take full advantage of this resource, scholars must have the necessary knowledge and experience to intelligently design a research programme employing specialized, state-of-the-art, and often purpose-built equipment. What we need are research programmes aimed at late nineteenth- and twentieth- century topics and involving integrated groups of specialists that meld interests in history with a detailed knowledge of modern analytical methods and equipment.

To advance the progress of material history studies we, as historians and curators, should be cultivating working relationships with specialists from other disciplines so that their specialist knowledge and our historiographic skills can be combined to deal with topics that individually we may be incapable of handling. The twentieth century has brought the most rapid increase in our knowledge of science and technology and, indeed, of all the scientists and technologists who have ever worked, 80 per cent are now living. Many are now approaching retirement age and are eager to continue with related intellectual pursuits. It is time that we develop relationships with specialists who can offer scientific or technical skills we may lack. A few of them are now working on historical projects but combined efforts aimed specifically at analysis of preserved artifacts could be even more fruitful. The trick will be to find a means of matching their interests and skills with the projects we would like to carry out.

Granting agencies such as SSHRC and NSERC must be sensitized to the special conditions and requirements for material history studies if we are to successfully employ the material and human resources available in this country. SSHRC's requirement that principal investigators be associated with a university is a significant, inappropriate obstacle and deterrent to the type of studies that I am advocating. Those with access to the collections and who are in the most advantageous positions to initiate such material history studies – and indeed who know what studies are most critical – are rarely university professors.

So, how many angels can sit on the head of a pin? In the 1990s the informed scientist's or technologist's answer would probably be many hundreds or thousands – at least if you have an atomic force microscope and a patient technician capable of shuffling the atoms on a pinhead atom by atom to create images of angels! But without the requisite skills, knowledge and objectives, historians of science, technology or material history will never know how many let alone what advances made this possible!

REFERENCES

Crowe, Michael J. *History of Science, A Guide for Undergraduates.* History of Science Society, 1991.

Turner, Gerard L'E. "Micrographia Historica: The Study of the History of the Microscope." *Proceedings of the Royal Microscopical Society* 7 (1972): 1220–49.