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EDITORIAL

Watching science watchers

Can the output of science and scientists be quantitatively measured? Can open-ended scientific research be subjected to 'measurements' that provide reliable indices of the status of scientists and their institutions, including the journals in which the output of science is published? These must have been questions which preyed on the minds of many scientists a few decades ago. Today, the answer is clearly, yes; scientometrics is an established field, concerned with 'the study of the measurement of scientific and technological progress' (Brusilovsky, B. Y. A., *Technol. Forecast. Soc. Change*, 1978, **12**, 193–200; Garfield, E., *Curr. Contents*, 1979, **46**, 313–318). One of the major tools of scientometrics is the Science Citation Index (SCI), which was conceived by Eugene Garfield in the 1950s. Readers of the journal *Science* in the mid-1950s may have paid little attention to an article entitled 'Citation Indexes for Science: A New Dimension in Documentation through Association of Ideas' (Garfield, E., *Science*, 1955, **122**, 108–111). The paper begins with a quote, which is well worth reproducing: 'The uncritical citation of disputed data by a writer, whether it be deliberate or not, is a serious matter. Of course, knowingly propagandizing unsubstantiated claims is particularly abhorrent, but just as many naive students may be swayed by unfounded assertions presented by a writer who is unaware of the criticisms. Buried in scholarly journals, critical notes are increasingly likely to be overlooked with the passage of time, while the studies to which they pertain, having been reported more widely, are apt to be rediscovered' (Thomasson, P. and Stanley, J. C., *Science*, 1955, **121**, 610). Garfield then goes on to say: '... I propose a bibliographic system for science literature that can eliminate the uncritical citation of fraudulent, incomplete, or obsolete data by making it possible for the conscientious scholar to be aware of criticisms of earlier papers. It is too much to expect a research worker to spend an inordinate amount of time searching for the bibliographic descendants of antecedent papers. It would not be excessive to demand that the thorough scholar check all papers that have cited or criticized such papers, if they could be located quickly. The citation index makes this check practicable. Even if there were no other use for a citation

index than that of minimizing the citation of poor data, the index would be well worth the effort required to compile it.' The importance of citation systems was in fact first recognized by lawyers, whose preparations for arguments in court were vastly aided by Shepard's *Citations*, a tool published since 1873, as pointed out by Garfield. In science, as in law, much is based on precedent. Garfield's case for a citation index was compelling and he concluded his 1955 essay with a prophetic comment: 'The new bibliographic tool, like others that already exist, is just a starting point in literature research. It will help in many ways, but one should not expect it to solve all our problems'.

In the early days, few could have anticipated the enormous impact of the SCI. The dramatic advances in data storage, transmission and retrieval have allowed Garfield's creation, the Institute for Scientific Information, to create quite literally a 'Web of Science' whose reach is truly worldwide. It is now possible (and sometimes unfortunately so) for almost anyone to do citation analysis; most often, for purposes quite unintended by the originators of the SCI. The citation index can provide remarkable insights into the lineage of scientific ideas; but science watchers must remember that scientometric analyses require a degree of scholarship that is sometimes no less than that required for the science that is being studied. In his columns in *Current Contents*, Garfield repeatedly demonstrated that highly cited scientists are indeed the pace setters in their chosen fields. His classification of scientists as 'Nobel class', was a provocative reminder to the scientific community that the Royal Swedish Academy cannot always honour all those whose work deserves to be celebrated. But, in looking back on this facet of citation counting, readers might go back to a list of 50 names published over a quarter of a century ago, representing the most cited authors during the period 1961–72 (Garfield, E., *Curr. Contents*, 1973, **40**, 487–488). Fourteen names on the list had already been recognized by Nobel awards; in the ensuing years half a dozen more have been honoured. Almost all others are pre-eminent in their fields, a clear indication that 'high end' citation frequencies are a reliable index of scientific achievement. Both critics and

promoters of citation counting in India often forget that analyses of 'low end' citation frequency data must be approached with care. The most vehement critics of scientometrics are often those who do not wish to learn lessons from hard facts, reminding us of the Bourbons who 'learnt nothing and forgot nothing'. Garfield clearly recognized that citation counting was but one parameter, in a complex equation that governs our judgements about science: 'The numbers used by researchers in the science of science include but are not limited to: the number of people receiving scientific degrees, the number of patents granted to scientists, the number of scientific articles published, the number of scientists who publish papers, the number of references appearing in papers, the number of citations to each paper, the amount of grant money awarded to scientists, and the amount of money budgeted by research agencies for scientific activities. The various numbers may be used in science policy or programme evaluation studies to measure the scientific "strength" of various countries, regions, or a particular university. One can follow the growth or decline of various fields or identify "where the action is". In short, scientometrics is concerned with the demographics of the worldwide scientific

community'. (Garfield, E., *Curr. Contents*, 1979, **46**, 313–318).

In India, scientometrics has much to contribute in analysing our strengths and weaknesses. In a country with limited financial resources for science, policies may be better guided by scholarly analysis of scientific output, with the citation index providing only one of the tools of measurement. The strongest critics amongst our scientists of the discipline of scientometrics would have us believe that old-fashioned 'personal prejudice' is a better guide to assessing scientific activity. Unfortunately, scientometrics is itself a field that is in its infancy in India. Few science watchers in India bring rigour and scholarship to their studies. Most, use statistics, culled in an amateurish way from the SCI, to draw sweeping and often unwarranted conclusions. It is clear that 'science watching' is an important activity, but the 'watchers' must be trained and professional.

In highlighting scientometrics in a special section, this issue of *Current Science* focuses on an area outside traditional science, which will nevertheless dominate our perceptions about scientific activity in the years ahead.

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