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Where the Action Is, Was, and Will Be--For First and Secondary Authors

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About a year ago, I published a paper¹ which was summed up as follows: "By revealing who has really influenced the course of science, the Science Citation Index ® seems to be a valuable sociometric tool for historians and sociologists." In the paper, I made this observation: "Proper analysis of this information [a list of the 20,000 papers most cited in a given year], could be a giant step forward in identifying 'where the action is' (or should be) in the area of scientific research."

The article in Nature was followed by several letters2-7 as well as an editorial.8 Comment and controversy are, of course, one measurement of impact, but in this case most it of came down to elaboration of my own caveat against injudicious, particularly simplistic use-with talk of numbers games and Nobel Golden Disks, scientific Pop Charts, super-cited Lysenkos, and undetectable conglomeration of likenamed scientists into impossibly competent and super-cited neo-Renaissancemen. The uncitedness of Jesus was even put forward, which I find a rather imaginative extreme among sporadic attempts to discredit the value of citation indexing in measuring impact.

However, the most serious error made by the ubiquitous, always anonymous (and, therefore, in my opinion irresponsible) editorialist in *Nature* was a downright distortion of science history to support a dubious argument. As

I wrote in a letter⁹ which he refused to publish, the work of Onsager on order-disorder phenomena¹⁰ was not ignored nor, according to Professor Onsager himself,¹¹ was its significance unappreciated by scientists.

There is little doubt that different papers are cited for different reasons. A "method" paper ordinarily is cited for a different "reason" than a theoretical work like that of Onsager on order-disorder, or that of Einstein on the stimulated emission of radiation.12 But for whatever "reason", these quite different types of papers are cited, and their citation indicates some sort of impact. In the one case, the impact may be impractical, even "econmediate and omic"; in the other, the impact may be intellectually, at least, more far-reaching. In either case, it is absurd to assume that the SCI® attempts to, and downright fatuous to criticize it because it can't, explicate such differences. How, then to judge the criticism of Nature's editorialist, who remarked that "radically innovative papers are often neglected for several years until they have somehow become absorbed into the mainstream of development, . . . crucial papers that would hardly have shown up [on highly-cited lists] ... when their importance was most in need of recognition."

Now, as I have discussed in another editorial recently, 13 the SCI is indeed

a powerful tool. But it is not some sort of oracular Sibylline book that will reveal the true and eventual importance of "premature ideas" and "innovative papers" still neglected by the scientific community, or by society as a whole for that matter. But, perhaps more quickly than anything else, the SCI will show, once neglect begins to give way to understanding and appreciation, just where the action should have been, where it now finally is, and where likely it may further develop.

Citation analysis can, therefore, measure impact or lack of it. And as shown again recently in the field of psychology, ¹⁴ journal citations can without doubt be correlated with scientific eminence.

In discussion of this correlation, it has frequently been objected that the citation method is basically unfair because of the "first-author problem". It is time, I think, to lay that bugaboo to rest. The "first-author problem" is, to use an apt term from the vocabulary of youth, a hang-up. As stated repeatedly, for the SCI's original purpose of retrieving scientific information, it is not essential to the index that authors' names be used at all. A citation consisting of only journal title, volume, page, and year will do perfectly well to identify almost any paper uniquely, and to permit the index user to locate all subsequent papers that have cited this earlier work.

However, our studies prior to the initial publication of the SCI showed that most users preferred or required the convenient redundancy of the first author's name in the citation. Consequently, to simplify location of a particular reference in the SCI, we followed the general practice of using the first author's name as the initial entry point.

It makes no difference, by the way, whether or not this "heading" is unique to a particular person. Quite often it isn't. There may be more than one J. Smith, but that doesn't affect retrieval of precise information, because the SCI also provides the cited year, journal, volume, and page.

We realized, when we first published papers on the SCI,15 that the index might be used for the purpose of evaluating scientific work. But we could not justify the cost of repeating the citation record of an article under every secondary author's name. To do so would have more than doubled the size and cost of the SCI. But this artifact does not in any way affect the validity of citation analysis.

The order in which authors name themselves in published material must certainly be taken into account. There has been some discussion, not entirely lacking in seriousness, of the "alphabetic syndrome" induced in people with names like Xavier, Young, and Ziegler, who are condemned forever to be at the end of lists, queues, and joint-author by-lines.

The "first-author problem" has been examined by Creager¹⁷ in an extensive study involving the evaluation of post-doctoral work in biochemistry. Citation analysis proved to be a valid technique for forecasting research potential. Price¹⁸ has done some studies that tend to confirm an adverse effect of obligatory alphabetic arrangement of authors' names in physics journals, but he has shown also, however, that the "first author problem" is of significance for only 3% of authors as far as citation analysis is concerned.

The example of Nobelist Hargovind Khorana is a case in point. Using the SCI, G.B. Weiss¹⁹ has shown that Khorana published 21 papers in 1967, 11 in 1966, and 18 in 1965. He was first author on only five of them. These 50 papers were cited 383 times in 1967, but the five on which he was first author accounted for only 35 citations. In this same period the ten most-cited scientists published, as a group, about 300 papers, and were first authors on about 200 of them. Khorana did not show up in my list of 50 most-cited authors, as published in Nature, 1 since only first authors were considered. But as Weiss clearly demonstrated in using the SCI himself, one can count all the citations to the work of Khorana, or anyone else. If one wishes to evaluate the impact of a particular man, you simply look up the entries for each of the pertinent papers using the Source Index to identify first and secondary authors. The SCI should not be accused of doing "disservice" to the reputation of younger scientists whose "senior" coauthors may not display the same undue bibliographical modesty as Dr. Khorana. As far as the SCI is concerned, there is no "first-author problem." Just as the printed SCI cannot be expected to provide oracular insights, so it cannot be expected either to compensate bibliographically for unresolved problems of courtesy and ethics in publishing. As in other cases (language, terminology, subject heading, etc.),20,21 the SCI allows you to work around the "firstauthor problem" and for all practical purposes to ignore it.

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