

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"¹⁶ 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 "first-author problem" and for all practical purposes to ignore it.

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