

Would Mendel's Work Have Been Ignored
If The *Science Citation Index*[®]
Was Available 100 Years Ago?

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Critics of citation indexes sometime question their utility because many great discoveries were unnoticed by contemporaries and, therefore, were uncited. The case of Gregor Mendel is invariably mentioned. My purpose is to show that the Mendel case (or any similar example) is a *non-sequitur*, as regards the *raison d'etre* for the *Science Citation Index*. As most geneticists know, the common notion that Mendel's work was *never* cited until it was re-discovered, is a myth. Prof. Conway Zirkle has completely documented the story(1).

Not only was Mendel's work cited before it was re-discovered about 1900, but it was cited several times including the *Encyclopedia Britannica*! Much earlier Wm. Bateson had implied(2) that the only reference to Mendel's work was made by Focke(3) in 1881. It is doubtful that Focke did not know about Mendel's work even earlier because they were contemporaries (4) and worked close-by in Austria. Zirkle states that Mendel's work was, in fact, cited by Herrmann Hoffmann in 1869 but does not give the bibliographic citation. Someday I shall allow myself the luxury of doing the research necessary to compile the citation history of Mendel's work along the lines I have pursued on DNA(5).

So much for the myth that Mendel's work was never cited! Let me now establish why such discussions are *non-sequiturs* when considering the utility of the *Science Citation Index*. Even if a given paper is *never* cited, we would need to

compile the *SCI*[®] to establish that fact! Surely any scientist can recall an instance when he wished to be certain that a given work had never been cited in some *subsequent* paper.

Various estimates have been made as to the number of papers that are never cited. Kessler(6) found that 10% of physics papers are never cited. When we compiled the *Genetics Citation Index* (7)(8) our NIH grant was terminated just when we were going to investigate the character of the papers we identified in the *GCI* as *never* having been cited in a core list of genetics journals. We may yet publish this list of uncited papers. The subject of uncited papers will be discussed in a separate report.

In discussing the value of the *Science Citation Index* for information retrieval, it is absurd to place the emphasis on the uncited work because over 90% of all papers *are* cited. The evidence is quite clear, in spite of the Mendel example—important work is *frequently* cited long before the Nobel prize committees discover their importance(9). In fact, we recently reported on the ability to forecast prize winners with the *SCI*(10).

Let us suppose, however, that it were true that Mendel's discovery was neglected because it was published in a relatively obscure journal. Consider what might have happened if there had been a *Science Citation Index* 100 years ago! I will not make the claim that Mendel's work would not have been neglected. His contemporaries may not have been pre-

pared psychologically or otherwise to accept or to recognize the importance of his work, as Zirkle has shown. However, with an *SCI* available, his work could only have escaped their notice by deliberate negligence. Had they used the *SCI* in a routine fashion, as is the frequent practice today, Mendel's work could not have gone unnoticed even though, as Zirkle indicates, copies of Mendel's papers were received by no less than 120 libraries including a dozen in the U.S.

It would not have mattered whether or not anyone ever cited his work. Why would they if they chose to ignore it? What would have mattered is whether or not Mendel cited those authors which were known to him and his contemporaries. This Mendel did. In 1865 he refers(11) to the works of Koelreuter, Gaertner, Herbert, Lecoq and Wichura. In 1869 he refers(12) to Fries, Naegeli, and Darwin. Had the *SCI* been available, anyone who had looked up any of these cited authors would have learned about Mendel's papers. Furthermore, they might then have seen the relationship between his works and those of contemporaries like Naudin, Godron, Crampe, Laxton, Bentham, etc. -all mentioned by Bateson- as well as predecessors like Knight(13).

Thus from the viewpoint of successful information retrieval, the *Science Citation Index* is primarily dependent upon the number of items cited by any particular paper and not whether it is cited. The probability that not one earlier relevant work is cited in any given current paper is very low. Most papers contain a bibliography. Only a small percentage do not and most of these are not worth worrying about. Any well refereed journal today prevents the loss of important information by insisting upon good titles and useful bibliographies.

There are times when the linkages established through the *SCI* between two or more citing works seems at first glance (from titles) to be hard to comprehend. Examination of the two papers will, however, invariably show that methodologically or otherwise they do share a common heritage. Smith(14) called this "systematic serendipity" but only a prepared mind can take advantage of this "fortuitous" marriage of two seemingly unrelated events. One wonders how genetics might have developed had the *Science Citation Index* been available in Mendel's time. I like to think that *SCI* will not only prevent inadvertent neglect

of useful work but, feel confident it will prevent much unwitting duplication of research and publication.

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3. Focke, W.O., "Pflanzen-Mischlinge", Born-Träger, Berlin, 1881, p. 109.
4. Focke, W.O., "Ueber Dichtotype Gewaechse", *Oesterr. Bot. Zeit.* 18, 139, (1868)
5. Garfield, E., Sher, I.H., Torpie, R.J., "The Use of Citation Data in Writing the History of Science", Philadelphia, Pa., Institute for Scientific Information, December 1964, 86 pp.
6. Kessler, M.M., Heart, F.E., "Concerning the Probability that a Given Paper will be Cited", November 1962, 19 pp., M.I.T., Cambridge, Mass.
7. Garfield, E. and Sher, I.H., *Genetics Citation Index*, Philadelphia, Pa., Institute for Scientific Information, July 1963, 864 pp.
8. Garfield, E. and Sher, I.H., "Dissemination and Retrieval of Genetics Information Through Interdisciplinary Citation Indexing", 11th International Congress of Genetics, The Hague, September 1963, *Proceedings* Volume I, p. 321.
9. Sher, I.H., and Garfield, E., "New Tools for Improving and Evaluating the Effectiveness of Research", Yovits, M.C. et al, Eds., *Research Program Effectiveness*, (New York: Gordon and Breach, 1966), pp. 135-146.
10. Garfield, E. and Malin, M.V., "Can Nobel Prize Winners Be Predicted?", 135th Meeting, AAAS, Dallas, Texas, December 1968.
11. Mendel, G., "Experiments in Plant Hybridisation", *Verh. Naturf. Ver. Brünn*, Vol. 4, 1, (1865) - as cited in (12) and translated in (2), pp. 40-94.
12. Mendel, G., "On Hieracium-Hybrids Obtained by Artificial Fertilization", *Verh. Naturf. Ver. Brünn*, Vol. 8, 26, (1869).
13. Knight, T.A., "An Account of some Experiments on the Fecundation of Vegetables", *Phil. Trans.* 1799, II, p. 195 - as cited by Bateson.
14. Smith, J.F., "Systematic Serendipity", *Chem. Eng. News*, 42(35), pp. 55-56, (1964).