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7. R. C. Axtmann, "Chemical aspects of the environmental impact of geothermal power," paper IV-2 presented at the Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, Calif., May 1975.
8. H. P. Rothbaum and B. H. Anderton, "Removal of silica and arsenic from geothermal discharge waters by precipitation of useful calcium silicates" *ibid.*, paper IV-13.
9. Japan Geothermal Energy Association, *Geothermics* 3, 122 (1974).

## Citation Analysis Studies

Citation analysis reflects the real world of science, not a fantasyland where all scientists' work is equally valuable, where there is no scientific elite and no mediocrity, or where scientific results are directly proportional to money spent.

It is ironic that Nicholas Wade, in his otherwise excellent article on citation analysis (News and Comment, 2 May, p. 429), neglected to cite any of the relevant literature. It is equally ironic—and significant—that subsequent critics of citation analysis (Letters, 13 June, p. 1064) ignore the wealth of published information on citation analysis (*1*), in which each of their points has already been assessed.

Those who read this literature will find that citation analysis is not without its pitfalls, but that anomalies or abuses have a very small effect. Statistical routines have been developed to deal with derogatory and self-citations, multiple authorships, the stature of the journal in which an article appears, and unusual techniques papers. In addition, a confidence statement appropriate to statistical indicators is usually included in citation analyses.

Original, informed criticism of citation analysis is welcome.

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### References

1. D. J. de Solla Price, *Science* **149**, 510 (1965); A. E. Bayer and J. Folger, *Sociol. Educ.* **39**, 382 (1966); J. Margolis, *Science* **155**, 1213 (1967); C. R. Myers, *Am. Psychol.* **25**, 1041 (1970); A. M. Hall, *The Use and Value of Citations—A State of the Art Report* (Report R70/4, Institution of Electrical Engineers, London, 1970); W. O. Hagstrom, *Sociol. Educ.* **44**, 375 (1971); J. P. Martino, *IEEE (Inst. Electr. Electron. Eng.) Trans. Eng. Manage.* **EM-18**, 146 (1971); A. J. Meadows and J. G. O. O'Connor, *Sci. Stud.* **1**, 95 (1971); J. R. Cole and S. Cole, *Social Stratification in Science* (Univ. of Chicago Press, Chicago, 1973); A. J. Meadows, *Communication in Science* (Butterworths, London, 1974); J. R. Cole and S. Cole, *Science* **183**, 32 (1974); H. Small and B. C. Griffith, *Sci. Stud.* **4**, 17 (1974); B. C. Griffith, S. Dey, J. Stonehill, *ibid.*, p. 339; J. A. Virgo, thesis, Graduate Library School, University of Chicago (1974).