Editorial Statements

The quantitative evaluation and intercomparison of scientific activity, productivity and progress seems to be sheer nonsense for many, perhaps for the majority of active scientists. This attitude is quite natural, but its source is mainly prejudice, ignorance and/or misunderstanding of the basic ideas of scientometrics. The skeptics are scornful of the hopeless aim of measuring the unmeasurable.

The tremendous increase of the scientific production over the last decades has made the emergence of this new field of science both necessary and possible.

The necessity follows from the industrialization of scientific research (which by no means diminishes the importance of the individual): the heavily needed and substantial financial support cannot be based solely upon subjective judgement. This is of particular importance at present when the extensive evolution of scientific research has just about ended. Scientometrics may help in the more economical and balanced utilization of the available funds, thus increasing the efficiency of research.

The possibility is provided by the development of computerized systems for the cataloguing and processing of information concerning the results of scientific research, as well as by the accumulation of a huge amount of such data, permitting a statistically meaningful evaluation.

There are two possible dangers associated with the emergence of a new approach like scientometrics. Both the overestimation and underrating of its potential should be avoided. I am convinced that, although scientometrics is neither an omnipotent diagnostic tool, nor a panacea, it can be most instrumental in revealing and solving a variety of problems in science. This approach certainly has its limitations and one of our objectives is to explore and recognize these limits.

The proliferation of journals is alarming for all conscientious scientists. This is particularly true for those interested in the sociological aspects of science, including the editors of this new journal. In my opinion the launching of *Scientometrics* is justified by the lack of an adequate forum for papers dealing with the quantitative aspects of the science of science and science policy. *Scientometrics* should be a journal for the publication of meaningful and valuable contributions to this new field of science, providing

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a possibility for the confrontation of different views. The definition of basic concepts, revealing the most significant problems, is of crucial importance for any new approach. I do believe that *Scientometrics* will be of good service for the whole scientific communit

M. T. BECK

The analysis of science policies in a variety of countries reveals an imperative demand in objective and quantitative data for the management of science in its manifold processes of functioning.

A necessary stage in the emergence of any science is the development of branches specialized in the quantitative characterization of phenomena and processes most widely differing in nature. It is remarkable that, whereas such directions have first evolved in technical and exact sciences (e. g. biometry), they are now actively developing in social sciences (econometrics, sociometrics, bibliometrics, etc.).

Currently we are witnessing the emergence of a similar direction from the framework of studies aimed at the organization and management of science, combined under the term "scientometrics". Experience in measuring quantitative parameters of science is being accumulated both in individual countries and on an international scale.

The greatest emphasis and longest historical past are associated with scientometric work on analysis of the *informational* parameters of science development, such as the number of papers, patents, journals, laws of "aging" and "dissipation" of scientific information, structure of the flow of scientific documents, citation processes, etc. The results of these types of studies are published in several periodicals including Social Studies of Science, Science Studies, Mezhdunarodnyi forum po informatsii i dokumentatsin Journal of ASIS, Nauchno-tekhnicheskaya informatsiya and Naukovedenie i informatika.

It should be strongly emphasized that the orientation of scientometrics toward systems analysis and practical management of science should encompass all the aspects of the functioning of science susceptible to quantitative evaluation, namely the amount of scientific results, number of scientists, number and structure of scientific institutions, financial support, intensity and direction of scientific relations, efficiency of research, etc. The complex consideration of these aspects permits to judge the rate and trends of science policy and sometimes to predict their outcome. This approach, based on experience and the principles of systems analysis, requires a wider interpretation of scientometrics to include the concept of the system of indexes with a characteristic data base and methods of measurement. This system consists of the following main types of indexes: informational characteristics based on the analysis of the flow of scientific-technological information; parameters of organizational relations and features of science, based on existing data, expert appraisal and experiments with current

"models" of science organization; economic parameters of science contained in official statistics and archives; socio-psychological characteristics derived from actual investigations in scientific systems.

Successful application of the above concept depends on a number of conditions to be fulfilled in scientometric studies. First of all, the quantitative methods of scientometrics should always be followed by a qualitative analysis of the results. The efficiency of the application of scientometric results in practical science management strongly depends on the correct interpretation of these data.

It is also important to ensure comparability of the systems of indexes selected on interdisciplinary, national and above all on international scales. Scientometric investigations should be aimed at determining series of dynamic indexes describing science systems in the process of their development, taking into account that science is a probability system, consequently, the results obtained are probablitistic in nature.

Clearly, the prospects of "computerized" science management and the creation of specialized information-control systems for this purpose depend not only on the solution, of strictly technical problems, but also on the establishment of a suitable information base, whose nucleus is the system of scientometric data.

Emphasis should be placed on the necessity of methematical analysis of the empirical data of scientometrics, with special reference to the application of statistical methods, graph theory, cluster analysis, etc.

Although the systematization of scientometric results is a timely problem, in a sea of scientific journals none can be found that would combine in itself the many aspects of this interdisciplinary subject. The present international journal is devoted to discussions concerned with the most important problems of scientometric studies, the systems representation of their results and the application of the data in decision-making processes of science policy.

I believe that the combined efforts of scientists from different countries will make this journal an efficient international forum of scientometrics, promoting fruitful discussions and international cooperation.

G. M. DOBROV

When the Citation Index was first developed, its primary purpose was information retrieval. We were always aware of the possible uses for historiographical and sociological research [Garfield; Historiographs, Librarianship, and the History of Science, in *Toward a Theory of Librarianship: Papers in Honor of Jesse Hauk Shera*, C. H. Rawski (Ed.), Scarecrow Press, Metuchen, N. J. 1973.]. However, we never dreamed that the availability of large scale citation indexes would spur the development of an entirely new field of scientometrics. Of course, people have been measuring science

in one way or another for a long time; and Derek Price has been one of the pioneers. There is little doubt that the specific organization and availability of the *Science Citation Index* has made possible measurement of scientific activities in a way that was previously difficult or impossible.

My colleagues and I were measuring science without even knowing it from the earliest days of our experimentation with citation indexes. Thanks to the help of collaborators like Derek Price, John Tukey, Robert Merton, and others our sensitivity to such uses of citation data increased over the years. I often felt a sense of remorse that I did not seize the opportunities available to me to publish a large number of data compilations that were simple by-products of our indexing efforts. But, during those early years, struggling to build the *Science Citation Index*, we could not afford the luxury of such diversions.

Naturally, I occasionally read with envy the many scientometrics studies now being published which use data that we long ago compiled, but could not expend the effort to analyze and publish. However, any mature scientist soon learns to appreciate instead of envy what colleagues are willing to do, especially when he is not able to do so himself.

My hope is that future contributors to our new journal will be interested in and work in the specialty of bibliometrics because this area of research has great promise in helping to expand our knowledge about the scientific enterprise. The term bibliometrics and its definition is attributed to Alan Pritchard of the Northwestern-Polytechnic School of Librarianship, London, England who first used the term in an article published in the *Journal of Documentation* (A. Pritchard; Statistical Bibliography or Bibliometrics, *Journal of Documentation*, Vol. 25, 1969). He defined it as ". . . the application of mathematics and statistical methods to books and other media of communication." Prior to publication of the article, Pritchard had developed a bibliography of literature on statistical bibliography which contained 700 items [A. Pritchard; Bibliography of Literature on Statistical Bibliography, (unpublished), 1969]. In effect, although he had not yet used the term, it was a rather comprehensive bibliography on the literature of bibliometries.

He defined statistical bibliography in his introduction as, "the statistical analysis of the means of communication in order to illuminate the processes of communication, the factors which influence them and the inter-relationships between the history and sociology of science and the literature of science." The tools of statistical bibliography were listed as citation studies, abstract journal studies, and studies of the literature.

The 700 items in the 1969 bibliography have probably doubled, if not tripled, by now. A bibliography maintained at ISI just on the use of citation data in studies of the history and sociology of science, science policy studies, and scientific communication contains 600 articles. An excellent overview of the field of bibliometrics was

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published recently by Narin and Moll (F. Narin, K. J. Moll; Bibliometrics, Annual Review of Information Science and Technology, Vol. 12, 1977).

We urge the wider utilization, not only of the Science Citation Index data, but of any other bibliographic databases to provide greater insights into the working of science. It is with this sense of purpose that the publication of Scientometrics is welcomed and we will do our utmost to make it a success.

E. GARFIELD

I enjoy having this privilege and opportunity to greet colleagues and friends in the field of scientometrics. It is a field whose growth and interest parallels that of my own scholarly life and it is obviously an important stage for the field and for me personally that this first autonomous journal in the discipline has come into being.

We would be poor scholars if we could not turn the analytical tools of our trade upon our own activities. For many years now we have been guest contributors in the journals of other neighboring fields and the special bibliographies in bibliometrics and science of science testify to the rapid cumulation of a coherent literature. All fields of scholarship burgeon, that is to say they grow, and even exponentially, because our scholarly institutions and populations grow as do our concerns with problems of all sorts. Some fields of scholarly literature, however, not merely *burgeon* but *cumulate*. I use this word to imply that the growth is coherent, with the new advances being laid down on the basis of rather fresh preceding contributions to the field which are relatively assured and certain enough to form foundations for the new growth. Thus, the relatively hard sciences are distinguished from those that are relatively soft.

In the social sciences there are disciplines and subfields that share this sure-footedness and thereby grow and advance in the way that we have come to preceive in physics, chemistry, mathematics and astronomy, rather than in that other mode of continous dialogue reexamination and setting of viewpoint against viewpoint that we tend to find in such fields as literary criticism, philosophy, history and the more polemical and prosey parts of sociology, psychology and even economics.

It was already in the early days of the mid-17th century Scientific Revolution that economics and political science took their first faltering steps towards the hard and cumulative direction of what was to become econometrics and demography. I must remind you that for almost the first century of such activity most scholars laughed at the presumption of those who would attempt to quantify and discuss mathematically such intrinsic human and political concepts as the wealth and labors of the nation and the life and death of its population. Nevertheless, just as biochemistry and physics in their inexorable growth removed many questions such as the nature

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of life, light, and of electricity from merely verbal philosophic argumentation, so, in the same way, econometrics has taken over and treated successfully many parts of economic analysis that had been argued back and forth without previous cumulation. My own goal in scientometrics is to do the same for the scientific analysis of science itself.

Though we approach our subject full of hope for the incredibly rich opportunities offered, both for the joy of understanding and for possible practical application. I think we must be very careful not to promise more than can be reasonably delivered. Scientometrics is certainly no substitute for all other modes of investigation of science. However successful citation analysis becomes it never can replace human judgment and we do not intend it to. However successful we are in understanding the productivity of scientists and the mechanics and pattern of coherence of scientific creativity we shall still need historians, sociologists and psychologists of science for those types of analyses that cannot be expressed in metrical terms.

On the other side, I feel that scientometrics has potentially an even greater possibility of success than econometrics or sociometrics or even general bibliometrics. It becomes apparent, even from our first few decades of analysis, that science and scientific activity is peculiarly measurable *and* peculiarly regular in its behavior even compared with other modes of scholarship. I believe that this arises from the essential singularity that when scientists are creative they act as if they are discovering something that was universal and there to be discovered. They do not act as if what is new is their personal creation as would be a painting, a poem, or a symphony, and they do not act as if it were part of a culture limited to their own region of geography, language, politics and religion, but of universal applicability. I have to believe that if the little green alien people came from a distant planet and communicated with us all else about them might be alien but they would know in some fashion or other such things as Planck's Constant, the velocity of light and the Wave Equation. I believe they might also find reasonable points of correspondence with our scientometrics even if their social arrangements were utterly different from our own.

I hope that this new stage in the institutionalization of a scientific subfield will produce a positive cybernetic feedback and help us all to be aware of each other's work. Journals, after all, are for publishing in rather than for reading and it seems to me the least we can do is to generate a nucleus of a couple of hundred peers and colleagues in this invisible college now making itself visible as a publishing community.

D. de SOLLA PRICE