

THE NODULAR PROPOSAL ([^]Rhizobial[^]) would be an even richer etymological pun).

This proposal is the cognate of ^{the} "one of prospective studies of scientific activity," insofar as it stresses the utility of getting information from representative samples of scientists, or of scientific projects, respectively. At the very least, a survey of such a sample would enable us to get a more critical appreciation of the meaning of the aggregate statistics and to verify whether there are significant distortions in applying them as if they were known to pertain to the particular population we have in mind. So, one part of the projected study would be simply a means of cross-checking the same kinds of information as are published in "Science Indicators". This would end up concentrating on questions like funding and manpower throughput by field, and questions about institutional framework of expenditure and of effort.

In my initial formulation of this proposal I really had most in mind that scientists should be consulted about the framing of the paramount questions. I visualized a re^{iter}ative process whereby the framework of inquiry would be revised and enlarged after every interview, and this may well characterize the initial pilot stage of any effort along these lines. The subjects would then be playing an important part in developing the further methodology, not only for the nodular study itself, but for other efforts in science indicators.

I can visualize several kinds of questions to pursue, in the general areas of (a) the general state and health of science, as viewed subjectively, and for suggestions about objective indicators, (b) the adequacy of the institutional framework and (c) difficulties and opportunities in the cognitive framework of the subject's own specialty and of the whole enterprise.

* i.e. the population to which Science Indicators pertains

(a) may itself be viewed as a latent indicator of the health of science from a particular vantage point. The institutional issues ^(b) have been brushed upon by some other surveys (adequacy of funds for research and for training being a perennial question) but a structured interview might deflate some of the self-serving propaganda that may (be thought to) dominate responses to these kinds of questions. Many techniques are available for cross-scaling that would help in this direction. Besides the more obvious issues of financial support there are a number of career-structure problems that ought to be addressed and the respondent's views on the communication system, on the disciplinary structure, on the visible and invisible colleges would all be useful to hear about. (For example, what fraction of a representative sample of scientists is related to which sets (possibly overlapping) of invisible as well as visible networks?) Attitudes ^{and experiences} about the equity of the ^{gatekeeping and} reward structure, and conversely a probing in depth of the trade-offs of equity and efficiency would be worth pursuing.

(c) I also had in mind a probing of the current cognitive situation in a number of specialties, knowing that this would take a considerable degree of skill and information on the interviewer's part. One could raise such questions as to elicit: what are the major discoveries in your field and in other fields; what are their relative values and to whom ^{how} to predict their utilities in terms of economically useful application, to indicate what part of the total value of the scientific enterprise they reflect, to comment on the cost efficacy of social investment in these respective fields and so on. By pursuing very concrete examples generated by the scientists themselves, I think we could go very much further than by asking general questions like: "can you use more money?"

* of Okun's book just out: "Equality & Efficiency... the tradeoff"

It may also be opportune to probe questions like the statistics of use or misuse of hard-won technical expertise in different fields - (to follow through the question of how catastrophic is the diversion of physicists, to give an example).

I would also probe the scientist's views of the process of discovery; whether they feel they are really working on the most important issues in their own field, and if ~~not~~ why not; What they have to say about issues like missed or post-mature discoveries and other aspects of potential sources of inefficiency in the overall enterprise. I am sure that our respondents could greatly amplify our present insight about the quality of science and about the nature of some specific pathologies.

Questions like the frequency of redundancy of discovery and of effort, and of their values, and of the triviality of their and of other work in related and unrelated fields could of course be most revealing.

It would be useful to get a bibliography of existing surveys, a number of which have been done at least by the Carnegie Foundation. (I recall some questionnaire ~~on~~ on the role of professor [but not excluding that of investigator] some while ago). These have already included the attitudes of people at different levels in the career structure about the equity of their place.

The efficient use of time is of course central to most of these morale problems, and it would be illuminating to find out whether there are large variances in the perception and the actuality of that distribution. The sense of mastery of time has been focussed on by others as an important criterion of self-merit and is in itself a kind of indicator. (I have here in mind some studies by a student of Tiedemann, Natalie Cohen).

A detailed examination of how each respondent would answer the question "how would you be able to justify the social utility of your own

work? Can you point to its possible or probable impact both in its ramification as science and in its technical utility?" These should be very helpful in delineating the ways of developing further indicators.

The response of scientists to the notion of indicators (or rather to a variety of concrete manifestations) would be of interest in assessing Price's comment about resistance.

More generally, the attributes of the scientific enterprise that have become the badrock of sociological inquiry deserve to be examined and criticized by such panels with the view to getting some impression of their universality. A rather interesting touchstone would be a sampled response of scientists to the extent to which Jim Watson's book was a fair representation of the degree of competitiveness in his own field and in other fields. (This has the advantage of the already widespread notoriety of that publication).

The occasion might also be used to explore attitudes in a wide variety of ancillary fields, (status of women to give an example) which would be quite inexpensive free riders on such an inquiry, and for which the corelative information would be important to have in hand for cross-correlation.

These inquiries are, of course, overlapping with a number of issues concerning the peer review process, and it would be important to try to get not only the attitudes of respondents but also some statistics concerning their experiences in dealing with grant review and other gate keeping encounters, keeping in mind that many respondents will have been on both sides of that gate at various times.

General questions on where science is going, whether it is better to be a scientist today than it was 10 years ago and so on, could in a rather obvious way furnish a range of other indicators.

related before I received Sayre on Frankfurt

This is by no means as yet a structured proposal but the memo is designed to elicit some further suggestions and comments.

Keeps in mind what would be of most value if we could have had fair samples of responses in 1900-10-70-...