7 SCIENTISTS WRITING FOR SCIENTISTS

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Writing papers is an integral part of normal scientific practice. Improvement of form and content is achieved by continual writing throughout a career. The more important problem for Guyana, however, is for a greater scientific output, particularly devoted to the development of indigenous resources. "Paper writing settles itself if there is something to write about".

In this Session, we shall be concerned with the writings that scientists do for fellow-scientists - not for the general public, or even, mainly, for scientists working outside the general fields of activity of the authors.

I think it should be said at the outset, however, so as to maintain a perspective, that the problems connected with such writing are dwarfed by the main central problem for science in Guyana, which is to develop an embryo into a thriving individual, having a decisive effect on the use of the country's own resources, animate and inanimate. Paper-writing settles itself if there is something to write about.

1. Various Sorts of Scientific Publication

I shall deal mainly with the scientific paper, the essential step in the communication of new knowledge. There are other scientific publications which are widely used, however:-

(a) reviews, which may appear in scientific journals, technical encyclopaedias, or even in general encyclopaedias like the Britannica. These, to varying degrees, give an overall view of the state of a particular subject;

(b) books or monographs which emerge when a particular subject has so grown in theory and practice as to justify such an extended review: both reviews and monographs may also contain original, previously unpublished work; and

(c) patents which are monopoly claims to new methods for making mechanical devices or useful chemicals. These are now mainly not in the hands of individuals but owned by companies and government departments.

Their object is to get a lead in production and keep competitors off; thus patents sometimes present a minimum of information consistent with the patent laws. The utility of a patent as scientific literature is very variable, therefore, but it should by no means be ignored by the scientific worker. Books summarising patent literature in specific fields are now published regularly.

II. The Paper as Part of the Scientific Process

It is essential for an understanding of the writing of scientific papers to consider this activity as an integral part of the entire process of accumulation of scientific knowledge - in other words, of the way in which science works and grows (see Ref. 1).

The flow diagram (Fig 1) summarises this; the notes below refer to the numbers of the blocks in this diagram.

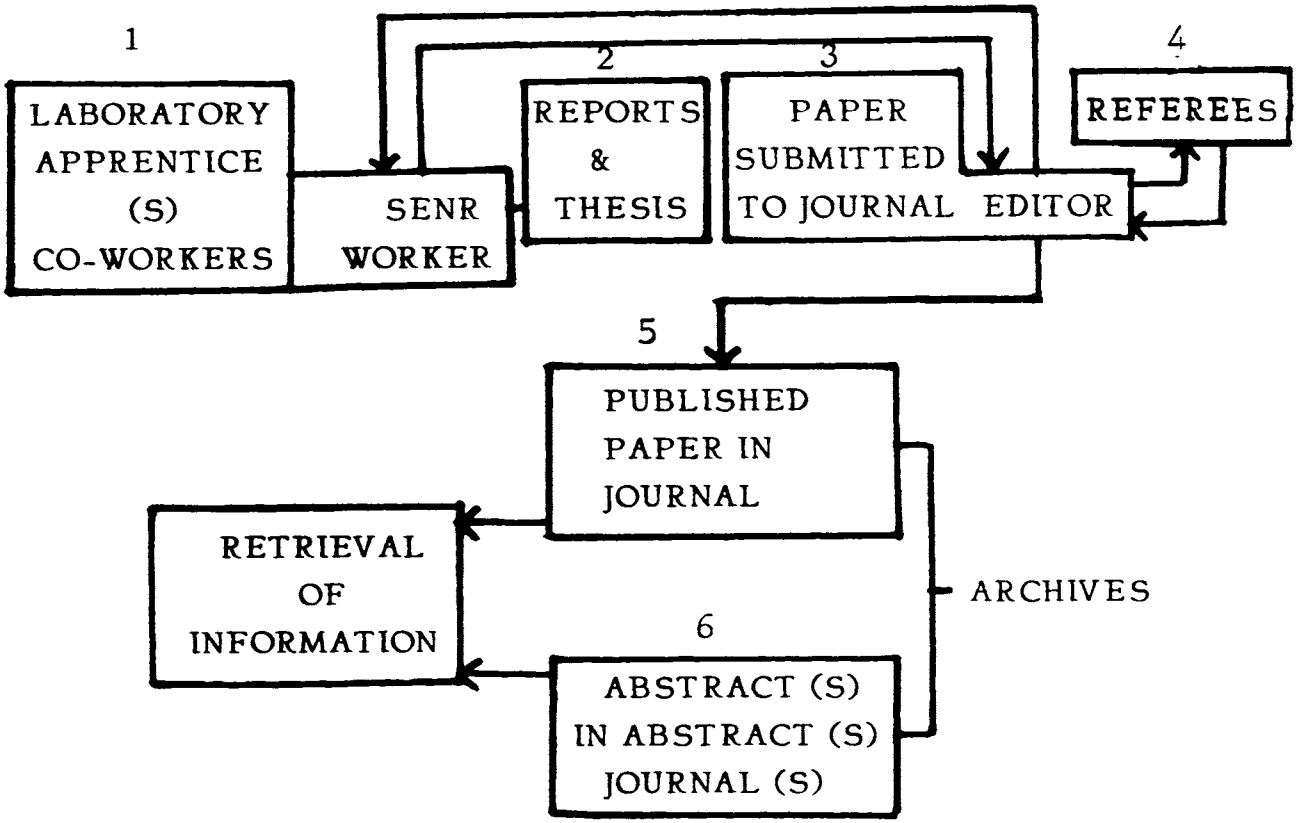

FIG. 1.

WRITING AS PART OF THE SCIENTIFIC PROCESS

1. The "apprentice" can be a post-graduate or sometimes an under-graduate student in a university or other teaching institution, or can be an employee working in the laboratory of a government parastatal, or private organisation.

2. Writing reports, not necessarily intended for publication, is an essential part of the scientific process. It is good practice because it

    (a) enables a continual, critical assessment to be made of the work in progress so that one does not "press on regardless", like a donkey;

    (b) gives practice in writing relative to this; and

    (c) provides sifted raw material for any future published work.

    A thesis is no more than an extended report and has a status not much higher than such. In some countries, they are indexed, but the work in them of any value will normally appear in published papers.

    Laboratory records and reports may attain the status of scientific publication if edited and published later (delay or non-publication of worthwhile work is usually due to a secrecy or security policy on the part of the employing organisation). A classic case of this is the publication of the B.I.O.S. and F.I.A.T. reports after World War II disclosing valuable information on German technology and science used during the war.

3. (a) The paper, the outcome of a creative piece of scientific work, is submitted when the senior worker thinks it right (but subject, sometimes, to the over-riding publication policy of government or industry if he is so employed).

    (b) Writing of the paper itself, or of part of it, is part of the training process, particularly of the junior author(s). Quite commonly, he (they) does a first draft, which is knocked about, or often completely rewritten by the senior author who has the final responsibility for the finished product.

    (c) The best guide to the preparation, organisation and arrangement of the material is obtained from a study of other papers, particularly those in the journal to which the paper is submitted, and of its editor's requirements. The form of presentation may, however, have to be adapted to suit the particular piece of work being presented.

The journal selected for the submission of the paper normally decides itself; it will be from among a small number of specialised journals in one's field. But an author who thinks he has "hit the jackpot", because the paper is of wide interest, and he wants to establish priority claim (for there may be others working in the same field) may submit a shortened version to a quick-publishing journal, such as "Nature". There is also a growing tendency to send short papers to other quick-publishing journals which have arisen in increasing numbers.

(d) In the actual writing, a distinction should be be borne in mind between technical terms and jargon. The former are a form of recognised shorthand for processes, procedures, phenomena, chemical formulas, and so on, and save an enormous amount of space and time in writing. As they are intended for scientists in one's own field, and not for the public, or even, primarily, for scientists outside this field, they are absolutely legitimate. By jargon, I mean those clumsy, circumlocutary, or obscure modes of expression which often hide the author's confusion of thought. Poetic utterances or "high prose" seldom emerge from scientific laboratories, or if they do, may be axed by editors or referees, not because they are against poetry, but because the sort of emotional meaning is not that sought by the readers. Such writing may, however, appear in scientific books. Ref. 2, gives brief examples of various sorts of science writing with my comments.

There are a number of books on writing scientific papers which may be useful to the scientist lacking other guidance. I must admit that I have not read a single one, nor do I intend to. What I do recommend to my co-workers are:-

(a) a book like "Plain Words" by Gowers, originally written to improve the standards of civil service writing, but of great value to anyone interested in the straightforward expression of ideas which is the essence of science writing; and

(b) "Roget's Thesaurus" which is of great help in the selection of appropriate words and phrases, and thus, at the very least, is an aid to relieving monotony in writing (Ref. 3).

(c) The general practice is for the names of all the participants in the research to appear in the paper as joint authors. (Thus, in coopera-

tive reseachers as senior author, my own name has appeared first only once: the co-author's name was Watts). Drawbacks to this procedure are sometimes seen when correspondence on the paper goes to the first-named junior author, who has often gone elsewhere, instead of to the senior who is maintaining the continuity of the research and has usually instituted it. He may also be mildly irritated to find a later reference to the authors of the paper as the junior author et alia instead of to himself et alia.

4. The editor normally sends the paper to referee(s) who is (are) usually engaged in research in the same field as the author, or in a closely allied one. They comment on it and advise whether it be accepted, rejected or accepted after amendment. Occasionally, the editor may referee it himself if he thinks he is competent to do so. Referees' comments are passed on, through the editor, to the senior author who has to decide whether to accept them, in whole, in part, or not at all. If "not at all ", it is the editor's responsibility to accept or reject.

5. & 6. An accepted paper is set up in type and the galley proof sent to the submitting author for correction. The paper is then published in the journal. An abstract of the published paper, not necessarily the same as that written by the author as an integral part of the paper, is done by the staff, full or part-time, of an appropriate abstracts journal. Different abstracts may appear in various journals.

7. Scientific journals and abstracts journals are indexed and all of those form part of the archives of science, open knowledge available to anyone interested. Because of the exponential growth of science, however, retrieval of information has become more and more difficult (Ref. 4a). Added to the difficulties are the increasing delays in and expense of publication (Ref. 4b). Various means are being devised to render the process more efficient (Ref. 4c). The status of scientific paper is decided in time by the acceptance or otherwise of the knowledge it discloses and by the effect it has on the course of the work in that field (Ref. 5).

REFERENCES AND NOTES

1. Science as public knowledge

An illuminating writing on this aspect of the workings of science is: "Public Knowledge; an essay concerning the social dimension of science, by J.M. Ziman, Cambridge University Press, 1968. There are also later (and longer) books on this subject by the same author (e.g. The social dimension of science", Oxford University Press).

2. Examples of science writing

The following three excerpts all deal with the same geological subject - the formation of sedimentary rocks.

(a) Straightforward English

"At the beginning, only igneous rocks were present in the crust but no sooner had they cooled, then they began being attacked by rain and gases in the atmosphere. The debris resulting from this destruction was washed into low places and sorted itself into beds of clay, sand or gravel, depending on how fine the particles had become. In time, such deposits reached such great thicknesses that the bottom layers began to press together into solid masses creating the class of rocks known as sedimentary rocks". Adapted from "Prospecting for gem stones and minerals", by John Sinkankas, page 83.

In the above, there are only one or two technical terms, and these are only comprehensible from the context. The passage can be understood by any scientist, and most laymen. But geology, by the very nature of the subject, lends itself to "popularisation".

(b) Scientific gobble-de-gook

"The provenance of sedimentary rocks is rendered comprehensible by a consideration of the various factors exercising an impact on the primary magma-derived igneous rocks. The principal disintegratory causal agency was primarily a concatenation of atmospheric effects, the cumulative attritive effect of which resulted in a particle-size classification. Subsequently, the action of the various impactive and compressive forces exercised caused consolidation of these sediments into sedimentary rocks".

This passage is neither a pleasure to read, nor is its meaning as clear as the one above. It abounds in clumsy expressions, jargon and stilted English.

(c) "Poetical prose"

".....the entire thickness of the sedimentary crust accessible to our observation seems to us only a residue accidentally spared by the two causes of destruction which act on the two faces of the solid crust; destruction by atmospheric agents above, remelting and metamorphism below. Thus suspended between those two infinities of destruction, infinite because they have endless time, the long series of decipherable geological stages is in reality only a final episode, the final spared witness of a very long history forever effaced".

From "Stratigraphical geology", by Maurice Gignoux.

This is the author's summary of rock formation, after a more detailed scientific description. It conveys imaginatively to the reader the immensities of time and of forces involved.

Legitimate chemical shorthand

The following short passage is full of technical terms, but is perfectly comprehensible to anyone with little more than an elementary knowledge of chemistry. To express the same meaning in any other way would result in a long treatise. It is virtually impossible to popularise the detailed content of chemistry.

"The small amount of unsaturation in butyl rubber, made by copolymerizing isobutylene with isoprene, permits vulcanisation by sulphur, and it may also be cross-linked in the presence of oxidising agents by nitrogen-containing derivations of quinone".

3. (a) The complete Plain Words, Sir Ernest Gowers. Penguin Books, 1954.

(b) Roget's Thesaurus of English words and phrases, P.M. Roget. Penguin Books, 1966.

4. (a) Problems created (and solutions sought) by the exponential growth of science

An interesting account, based on original research, of the exponential growth of science is given by D. de Solla Price in his book, "Science since Babylon". Yale University Press, 1975.

In 1750, when there were only ten (10) scientific journals in the world, a scientist could keep himself informed on all published scientific work. By 1800, there were one hundred (100) journals; by 1850, one thousand (1,000) journals; by 1900, ten thousand (10,000); by 1950, one hundred thousand

(100,000). This represents a tenfold increase every fifty (50) years. By extrapolation, there would be one million journals by 2000; however, there are distinct signs that this rate is flattening off.

In 1830, when there were three hundred (300) journals, it was already impossible for scientists to keep track of information of interest to them, and so the first abstracts journal was published. These, too, have multiplied by a factor of ten every half century, and so the same problem has arisen in relation to them.

(b) Economic problems of publishing

The economics of publishing (referring here particularly to the English - speaking world, which is of relevance here) have been changing for the worse in recent years, and particularly since 1973. Paper costs and book prices have soared to such an extent that it is the general opinion of those concerned that the hey-day of cheap scholarly publishing is over. Inflation has also led to a cutting, sometimes severe, of the money available to universities and libraries for the purchase of publications.

The monograph, in particular, always a highpriced publication, read by relatively few people, is thought by many to be moving towards extinction.

(c) Solutions sought

(i) The formation of "invisible colleges"

To keep himself abreast of development in his own field, the scientist now keeps in direct touch with his confreres in his own and other countries by correspondence, visits, exchange of papers and of samples, information on work in progress, and participation in international conferences. The last-named activity, in particular, has been made possible by vastly improved means of communication. Proceedings of such conferences are often published.

In this way, what have been called "invisible colleges" have been formed, a new and striking modern development in science.

Many scientists today are thus among the most travelled people; the cynical remarks made about this - especially by those who have to provide the money - are only partly justified. Certainly, though, some discrimination must be exercised in this activity.

(ii) Organisational and technical means

Co-operative publishing is a developing trend, with the aim of cutting down costs. The trouble in the U.K., for example, is the large number of learned societies relative to their output of publications : 228 of them publish only one journal yearly, and only 15% of the smaller societies publish more than one quarterly.

The Aslib group, for example, suggests the establishment of co-operative publishing offices (CPO's), which in the U.K. would become viable if more than 11,000 pages were published yearly.

In the U.S.A., editorial processing centres (EPC's) have existed for some time, increasingly using computer reproduction and other facilities to carry out many routine publishing functions; these are, of course, greater than in the U.K.

A typical example of the new approach to publishing scientific papers is the new Journal of Chemical Research, published in London by the Chemical Society, jointly sponsored by the French and German chemical societies and supported by other European chemical societies.

This separates "browsing" (which gives current awareness of what is going on) from the archival roles of primary science journals.

Part S contains conventionally printed synopses of papers.

Part M has full texts, reproduced from authors' own typescripts, either as microfiche, a 24:1 photographic reduction which can be read with a hand lens, or as a miniprint 3:1 reduction printed on ordinary paper which can be read with the aid of reading equipment.

Chemists need buy only Part S, browse over synopses, many built round formulae or graphs. If the full version is wanted, Part M is obtainable from an institutional library or photocopies from the Chemical Society's library.

The concept of "camera-ready" copy is now widely accepted, that is, a carefully done typescript which can be edited "on-line" by computer, and then reproduced cheaply, thus avoiding the more costly, multi-stage, older method or producing papers. It does not, however, avoid the necessity of refereeing, which would still have to be concerned with

content. If no refereeing on it is done, such a paper would necessarily have a lower status than one published conventionally. Its main virtue would be in the quick availability of work in progress.

A useful recent reference is: Trends in scholarly publishing. British Library Research and Development No. 5299 MC, 1976,.

5. Status of the published paper

Trivial papers are still published, but there is now more resistance to these by editors because of increasing pressure on space. Editors will also do their best to cut down what they consider to be unnecessarily lengthy papers. The number of papers published by a scientist is not a good criterion of the worth of his contribution to his science. Over-anxiety to appear in prin', regardless of content, is fairly characteristic of beginner scientists; an added incentive is the thought that their promotion prospects depend on such production. A greater regard for content, and a consequent reluctance to publish prematurely, often comes with maturity associated also with a greater concern for one's scientific reputation.