Scientific Information Exchange in Psychology

The immediate dissemination of research findings is described for one science.

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The "scientific information crisis" is generally understood to refer to an increasing quantity of literature, especially in the archival journals. Coping with the crisis is usually assumed to be a matter of improving the publication, distribution, and retrieval of this literature. But the literature is only a portion of a system that encompasses many forms of information exchange; and without denying the great importance of the archival journals, it may be said that they have received a disproportionate share of the attention being given to the mechanisms by which scientific information is disseminated. In psychology, at least, the exchange of new scientific information between its principal producers and consumers does not wait upon journals. The active scientist makes use of a whole network of means of communication, many of them informal or of small range, and yet apparently highly efficient. Their efficiency lies not only in their expeditiousness but also in their selectivity, for the group that is actively interested in a particular set of findings is often quite small. Indeed, often the readership of a particular paper in a current journal may consist largely of people who already know its content from earlier sources.

The importance of devices that direct information in a selective manner becomes clear when we consider the scale of scientific psychology. There are about 30,000 psychologists in the United States, about 40 percent of them employed in academic institutions. It is in the academic institutions that research and other scholarly work in psychology is concentrated, but contributions are also made by psychologists in industrial organizations, hospitals, and government research centers. Most of the important formal channels of scientific information are managed by scientific and professional organizations. The largest of these is the American Psychological Association (APA), which sponsors information-exchange activities for the entire range of subject matters included in psychology. It has a membership of 22,000, it publishes the principal journals, and it holds annual meetings that are attended by as many as 10,000 persons, of whom 1000 present papers. In addition, there is a hierarchical structure of regional and state organizations affiliated with APA, which hold annual meetings of their own; more than 1000 scientific papers are presented annually at state and regional meetings.

Outside the APA structure, there are approximately 20 organizations, each concerned primarily with a limited subject matter within psychology. Although their scale is small, their combined membership includes a fifth of all APA members, and they are apparently increasing in number as well as in size. The largest has about 1000 members, and the largest of their meeting programs consists of perhaps 100 papers. Besides formal meetings and the publication of journals, their scientific information-exchange activities are extensive and may include preprint or reprint exchanges and the arrangement of informal conferences (some at the APA annual meeting). There appear to be about 2000 psychologists who are extremely active in the processes of scientific communication. This group on the whole consists of members of APA who are also members of at least one of the special psychological organizations. They furnish most of the research material that requires or warrants information exchange, and their efforts keep psychology going as a basic science—that is, they regularly publish journal articles and make formal presentations at annual meetings; they are the producers of books on psychological subjects; they are the holders of the major federal research grants and often serve as monitors or advisers on other federal grants. There also appears to be a larger circle of persons who are extremely active in handling and producing information (and who are, therefore, an important part of the first group's audience) but whose information activities are always directed to some extent to other disciplines and do not affect the main stream of psychology.

Journals of some professional interest to psychologists number close to 1000. About 20 of these, including 5 or 6 that serve fields other than psychology, may be considered central, in the sense that large numbers of psychologists use them to obtain information. A recent issue of these 20 journals considered as one contains 500 to 600 articles. There are in addition about 400 institutions that issue technical reports of some relevance to the work of psychologists. Book publication is less amenable to measurement, since it does not fall into an ordered series and also because not all books of interest to psychologists are clearly identified with their discipline. If books in all of psychology and psychiatry and the relevant margins of other social sciences, biology, and engineering are counted, 200 to 300 technical books of scientific interest to psychologists are published in a single year.

Dissemination before Journal Publication

Over the last 3 years the American Psychological Association has conducted a series of studies, the Project on Scientific Information Exchange in Psychology (*1*), which, among other things, has traced the process from the time producers start the work that is ultimately to be reported in the journals until reports of it have appeared in secondary publications. These findings could be organized in a number of ways. We have chosen to present them here by diagramming the course of

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an average research report. In this diagram (page 1657), the four ovals each represent a significant point in the producer's work. The line connecting these four points also divides the figure into two sections: To the right lie possible forms of an oral report of the work, each indicated by a rectangle. To the immediate left lie possible forms of a written report, and at the far left lies the smaller category of forms of secondary publication and of index listings of the study. The ordinate on the left gives the median time of each form of dissemination relative to the time of journal publication, some exceptions being noted in footnotes to the figure (*2*). Finally, the entire figure is lightly shaded except for the small area that contains forms of dissemination through which the information is generally available to the scientific public. All other forms, lying in the shaded area, have audiences which are to some degree restricted.

Work published in a psychological journal this month would have started about 30 to 36 months ago. Between 18 and 21 months ago, it would have reached a stage at which a rather complete report of it could be made; and shortly thereafter, between 15 and 18 months ago, the first reports would have appeared. These would have been very informal oral reports at colloquia within the producer's own institution. During this same period a more formal oral report is likely to have been given at a meeting of a small special-interest group. A few months later a formal oral report may have been made to a fairly large audience at a national or regional meeting. About one in five articles which appear in the principal psychological journals has previously been reported to a national meeting, and one in ten to a regional meeting. In the case of work reported to the APA annual convention, the first public announcement is made in the form of a listing of the title and abstract in the published program distributed to all APA members prior to the convention. The program of meetings serves not only the convention attendant but also the nonattendant who is actively trying to locate work relevant to his own. Within the period of a year, about 30 percent of APA members use a program of meetings they did not attend to locate sources of relevant information. Although the convention presentation is offered to about 3000 attendants at regional and up to 10,000 attendants at national meetings, the number who actually attend a particular paper session rarely exceeds 100.

An informal kind of written dissemination, the distribution of copies of the presentation, occurs shortly after the convention. From 70 to 100 percent of authors, the number depending on the meeting and the distribution of its program, receive requests for copies. Usually, however, there are few requests for any single presentation. The convention presentation and any distribution of its text are interim reports in the sense that the majority of persons who make convention presentations seek journal publication.

An author begins writing the journal article about 17 months prior to publication and typically completes it in 2 to 3 months. Shortly thereafter —12 to 15 months prior to publication—he begins to use a variety of means of disseminating it (including the convention presentations already described). The first important dissemination of a reasonably complete written report of the work is made in the form of typed or mimeographed copies. Approximately 60 percent of authors distribute such copies; the number distributed is small, however, and recipients are generally local colleagues. Also during this period, 8 percent of authors will produce and distribute technical reports (with regard to these the picture is not clear because of the rather complicated distribution systems).

The next stage, which occurs approximately a year prior to journal publication, is the distribution of preprints or prepublication copies of the article. Approximately 40 percent of authors distribute preprints, the average number of copies being about 10, although some authors distribute as many as 200. The primary purpose of this distribution is to provide immediate reports to persons working in the same area. (It is interesting to note that 15 percent of these preprints are distributed in response to requests from persons familiar with the work through knowledge of prior oral presentations.) Preprint distribution occurs at several points around the time at which the article is submitted to a journal. Some authors distribute preprints just before submitting manuscripts, most prefer to distribute after submitting, and some delay distribution until editorial acceptance.

On the average, the interval between submission and publication is approximately 9 months. Approximately 20 percent of published articles have previously been rejected by one or more journals, however, and in their case the times in the dissemination process previously discussed are, on the average, set back a year. Curiously, few rejected articles fail to appear in one journal or another. The data suggest that rejection keeps an article out of a particular journal—not out of the literature.

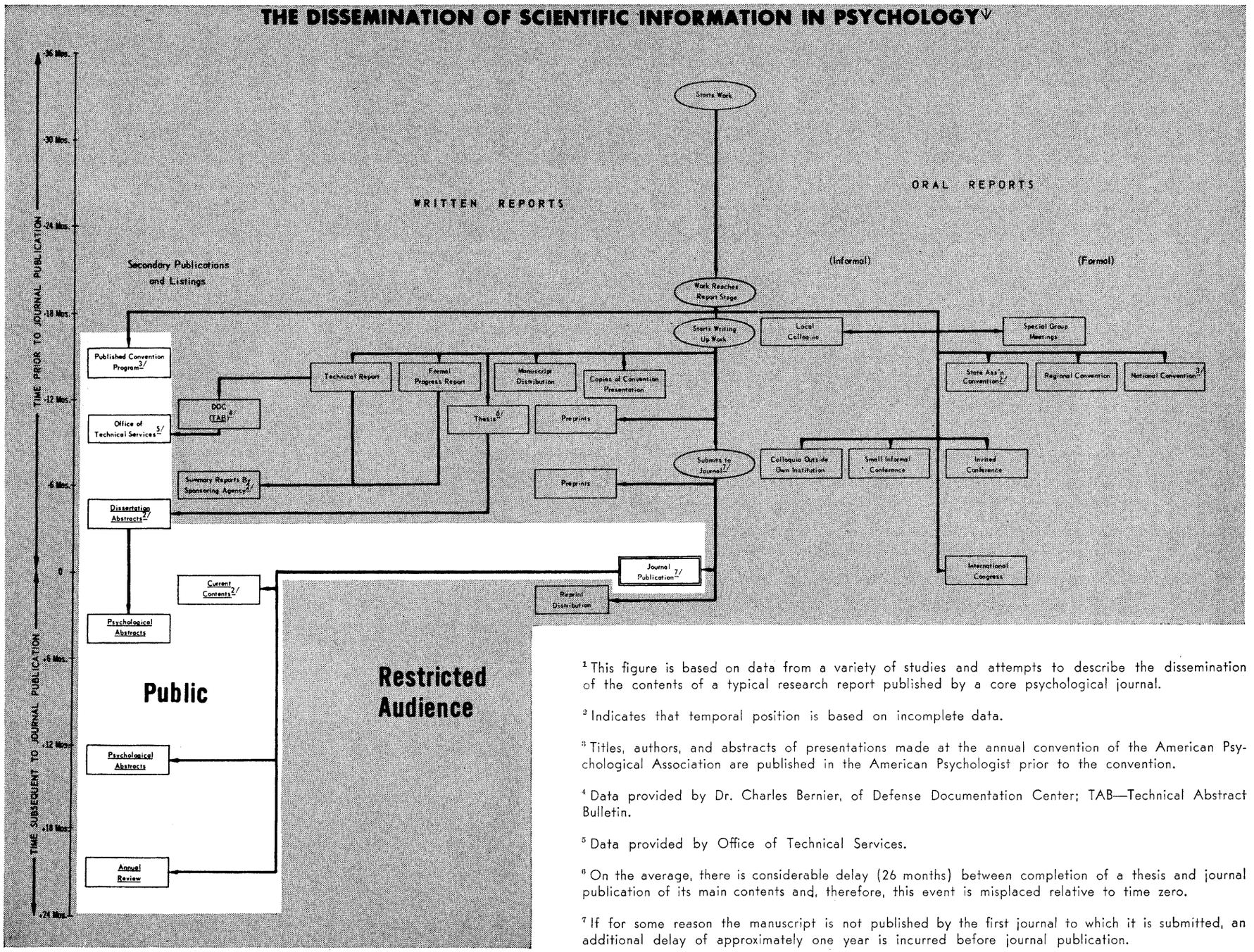
During the period between submission of the manuscript and publication, reports of the work continue to be made. Of published studies, approximately 5 percent are formally reported in this period at colloquia outside the author's own institution; this means of publicizing research appears to be used mostly by prominent researchers who are on something like a "colloquium circuit." Another 5 percent are reported at invited conferences, usually supported by an institution for a very small group of scientists prominent in a specific field.

Journal Publication and Later Dissemination

The process has been described up to the time the work is published in a journal. After publication, the issue containing the article is sent to individual and institutional subscribers. Individual subscribers include as much as 30 percent of the general population of psychologists for the principal journal serving the most numerous specialty (clinical psychology) and as few as 1 percent for principal journals in unusual specialties (psychoacoustics, gerontology, and others). Beside the immediate display of the article to individual subscribers, there is the less direct display through subscriptions held by institutions. The important role of institutional subscriptions is shown by the excess, about 10 percent, of persons reporting that they regularly use a particular journal over the number listed as subscribing.

In the 2 months following publication, up to 20 percent of APA members will pick up the journal, if it is an extremely popular one, and will at least expose themselves to the title of the article in the table of contents. Some of these persons go on to read some part of the article or to scan it.

THE DISSEMINATION OF SCIENTIFIC INFORMATION IN PSYCHOLOGY[1]



[1] This figure is based on data from a variety of studies and attempts to describe the dissemination of the contents of a typical research report published by a core psychological journal.

[2] Indicates that temporal position is based on incomplete data.

[3] Titles, authors, and abstracts of presentations made at the annual convention of the American Psychological Association are published in the American Psychologist prior to the convention.

[4] Data provided by Dr. Charles Bernier, of Defense Documentation Center; TAB—Technical Abstract Bulletin.

[5] Data provided by Office of Technical Services.

[6] On the average, there is considerable delay (26 months) between completion of a thesis and journal publication of its main contents and, therefore, this event is misplaced relative to time zero.

[7] If for some reason the manuscript is not published by the first journal to which it is submitted, an additional delay of approximately one year is incurred before journal publication.

In our collection of data on current readership ("current" meaning within 2 months or so of distribution), no distinctions were made between "skimming" an article and "reading" it, since either could be a means of obtaining information from it; these were simply distinguished from a mere scanning of the table of contents of the issue.

The data suggest that about half the articles in "core" journals will be immediately read, in this specialized sense of the word, by 1 percent or less of a random sample of psychologists, and no research report is likely to be read by more than about 7 percent. The data clearly indicate that the immediate audience for most articles is of an extremely restricted size. The number of current readers increases very slightly as the number of persons *seeing* the issue increases, but even the most popular issues (seen by 20 percent of the sample) contained a sizable percentage of articles that were examined by 1 percent or less of the sample.

The articles read by 1 percent or less of the persons sampled—that is, half the articles appearing in "core" journals—would by extrapolation to the population have a total of about 200 readers. Thus, the immediate dissemination through journals is well within the range of that for some of the other forms (preprints, reprints, technical reports), which, because they are sent to interested persons, are likely to have high rates of use.

While "current" journal reading is relevant to the dissemination of research findings, it seems to be a minor portion of the use to which journals are put. For example, it amounted to only about one-third of the journal reading of one group of extremely active psychologists studied by the project. Since so much effort and concern is centered on journals, further studies are being planned to determine the various functions of journals in the scientific and professional work of psychologists.

After journal publication, there is a rather large, immediate distribution of the work (within 8 weeks) in the form of reprints; 62 percent of the authors distribute reprints fairly systematically to a mailing list, the average number distributed in this fashion being about 25. In the period immediately following publication, 94 percent of the authors also receive requests for reprints, the average number being about 13.

The article would be abstracted in *Psychological Abstracts* about 15 months after publication, and possibly placed within a context of other current work in a review some time after that. Of the two principal outlets for reviews, one, the *Annual Review of Psychology*, covers articles published approximately 21 months earlier; the other, the bimonthly *Psychological Bulletin*, probably—for a variety of reasons—embodies an even longer delay. The appearance of an article in any secondary publication is uncertain, but it is quite clear that reviews emphasize popular lines of research in preference to innovative ones.

Dynamics of the System

When the findings of the project are viewed in their entirety, it seems clear that there are two basic determinants of scientific information exchange in psychology.

First, there is a communication system which, for the most part, has been developed over the years by the scientists themselves to meet their information needs. This general system is composed of numerous elements (such as preprint exchange, conventions, publications), and the elements within the system are dynamically related. That is to say, changes or growth occurring in one element affect, in some way and to some extent, the operation of other elements in the system. For example, increasing the rejection rates of manuscripts submitted to journals almost automatically increases the birth rate of new journals. Unfortunately, decreasing the rejection rates, which usually results in increased publication lag, does not reduce the birth rate of new journals, but it probably does decrease the current use of journals and certainly increases the number of preprint exchange groups.

Second, the dynamic nature of the system is a result of the behavior of the scientist within his communication network, that is, how he uses the various elements of the system to satisfy his information needs and how he circumvents the restraints that the existing system places upon him.

The most striking feature of the process of dissemination in psychology is how small a portion is easily available to the scientific community. The public dissemination of information occurs late, takes only a few forms, and, in its complete archival presentation, that is, in scientific journals, has a small immediate audience. Nevertheless, it is these forms which are the primary concern of current work in information retrieval. The system also includes a great variety of informal means of scientific communication. Most of these means, on the other hand, occur relatively early in the process, actually about the time the author would have a complete written report in hand. While some of the audiences for these informal means of dissemination are small, others are comparable in size with those audiences which examine articles shortly after they appear in journals.

Another prominent feature of the process is a considerable degree of redundancy; the same persons receive equivalent forms of the information repeatedly. In particular, the informal means of dissemination tend to seek or be sought by the same people, apparently including a large number of active researchers. The absolute sizes of audiences for journals and for informal means of dissemination suggest that the group that is really interested in a particular set of findings is quite small. Comparison of these audiences suggests that a substantial portion of this group consists of the "repeaters."

Finally, in the total system the national convention is one of the earliest, and certainly the least restricted, of all the "private" forms of dissemination and holds a key position. In many respects the convention is not now an especially effective device, and it is a principal target of efforts to develop innovations in information exchange.

The dynamics of dissemination may be summarized thus: The active scientist displays two seemingly irrepressible motives, one to obtain needed information and the other to publicize findings. Through requesting copies of reports and attending meetings, he attempts to obtain information long before it appears in a journal. The multiplicity of forms of communication, most of which have been informally created by scientists, testifies to the motive to publicize.

These motives, combined with the network of all means of communication within the field, constitute a dynamic and, to some extent, an unstable process. The expression of the two motives is controlled at a particular time by the existing system of means of communication. In the long run, however, any thwarting of these motives causes scientists to modify the

system by creating new means of publicizing and discovering information and by allowing other means to atrophy through lack of use.

Such stability as there is in the process of dissemination seems to be related to the long lag in journal publication and to the common assumption among psychologists that journal publication is the normal outlet for research findings. These factors probably sustain the present general form of the process. The system of informal dissemination, the amount of effort devoted to obtaining information prior to journal publication, and the size of the audience that seeks immediate access to the findings when they finally appear in journal form would seem almost certain to change if the publication lag were greatly shortened or if journal publication were less widely sought.

Notes

1. Extended treatments of the results of this research appear as volume 1, Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology (December 1963). A limited number of copies are available from the American Psychological Association, 1200 17th Street, NW, Washington, D.C.
2. The time intervals are actually medians of data reported in one or more of the Project's studies. There are often large deviations about these medians and, as can be seen in the original reports, certain of these deviations are associated with interesting phenomena.
3. The work reported here was supported by grants G-18494 and its continuation GN-281, which were made to the American Psychological Association as part of the program of the Office of Science Information Service of the National Science Foundation. The research was planned and executed by the staff of the Project on Scientific Information Exchange in Psychology which includes (in addition to the authors) Bertita E. Compton, Madelyn J. Miller, Margit Siegmann, and Kazuo Tomita. The Project's advisory panel reviewed research plans and findings. Its members include Raymond A. Bauer, Dorwin Cartwright, Kenneth E. Clark, John G. Darley, Quinn McNemar, Donald W. Taylor, and Arthur H. Brayfield (*ex officio*).

News and Comment

Oceanography: Cost-Effectiveness Technique Employed To Support Case for Basic Research Program

A few years ago, when congressmen first began to ask hard questions about the justification for federal support of basic research, the scientist in the witness chair would generally offer little more than poetic reverie about the virtues of the quest for knowledge. When it was plain that this didn't fully satisfy the questioners, the answers began to take on a more practical tinge: basic research in health, agriculture, and other fields, it was pointed out, paid off in visible economic returns. This was understandably more digestible, and, as a result, the leaders of the various scientific disciplines began thinking hard about the justifications they could offer for sizable public support of their work.

The most advanced product of such thinking has now come forth in the form of a report by the Committee on Oceanography of the National Academy of Sciences–National Research Council. Titled "Economic Benefits from Oceanographic Research,"* it is a compelling document that might be subtitled, "Two Will Get You Seven."

Quite convincingly, it makes the case that investment in oceanography will pay off handsomely, and, since the oceans conceal such interesting things as fish, minerals, and Russian submarines, it does this in a fashion that could not be even remotely approached by its predecessors in this genre: the Report of the Panel on High Energy Physics (sponsored last year by the Atomic Energy Commission and the White House Office of Science and Technology), and the Academy's report, last month, on a 10-year program in ground-based astronomy. But perhaps the most significant aspect of the new report is not the solid case that it makes for investing in oceanography; rather, its principal significance may be that it represents the first attempt at a comprehensive application of the cost-effectiveness technique to a field of basic research.

The committee that wrote the report did not simply state the obvious—that oceanographic research can be expected to produce an attractive economic return; rather, while repeatedly emphasizing the uncertainties inherent in its projections, it sought to calculate the financial returns that might reasonably be expected from such research. And it came to the happy conclusion that annual nondefense expenditures of $165 million over the next 10 to 15 years (the current figure is $138 million and an annual growth of 10 percent seems to have found Congress' favor) could be an "essential component" in saving $3 billion a year, principally through conservation practices, and in adding annual production of about another $3 billion.

To arrive at this conclusion, the committee not only took up the obvious matter of fish (estimating that $50 million in marine research and development could double the $1 billion that fishery industries products now add to the gross national product); and the obvious matter of minerals (estimating, for example, that $50 million worth of research in that field could lead to large-scale mining of marine manganese worth $125 million a year); it went even farther afield and estimated that oceanography's contributions to weather forecasting could produce substantial savings for cattle and hog producers.

States the report: "The farm value of cattle and hog production in 1962 was $9 billion. Weather-produced variations in the size of the crops of corn, oats, and hay have serious economic effects for livestock producers, as do changes from year to year in the productivity of permanent pastures and range lands, caused by variations in seasonal rainfall. Significant savings would be obtained if the farmers could plan how to feed and dispose of their stock on the basis of reliable long-range weather forecasts. A five-percent saving would amount to $450 million."

Similarly, it pointed out that in 1962 "the value of potato production was roughly $500 million and of fruits including grapes perhaps $2 billion. . . . A five-percent gain through better planning and production" might be anticipated from better weather forecasts.

And it even went so far as to attempt extremely cautious estimates of the economic value of contributions that oceanographic research might make to cleaning up and conserving coastal waters for such purposes as

* Publication 1228, 50 pages, $2, Printing and Publishing Office, National Academy of Sciences–National Research Council, Washington, D.C. 20418.