TECHNICAL REPORTS in PHYSICS LITERATURE

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IN the fifteen years since World War II the technical report as a medium of scientific and technical communication has increased rapidly in importance. The increased volume is primarily a result of the growth of defense-related research and development programs sponsored by Government agencies. Normal channels of scientific reporting such as books and journals do not satisfy the requirements of security and speed of communication. Industrial research and development have led to a further increase in the production of technical reports.*

The question arises, however, as to how important technical reports are to the practicing scientist. The answer is needed by librarians and documentalists who must decide which reports are needed for a collection and how long they should be retained. To seek an answer, we have surveyed some important physics journals to determine how often technical reports are cited, which reports predominate, and what time distribution they follow.

The citation-count method has been used in a number of recent studies of serial literature by Brown,[2] Burton,[3] Westbrook,[4] and Raisig,[5] among others. A basic assumption of all citation-count studies is that the items cited by the author of a paper were actually used by him in its preparation and that he has cited all the significant material which he used.

The source journals were *The Physical Review* and *Journal of Applied Physics*. For comparison, the *Physical Society (London) Proceedings* and *The Philosophical Magazine* were also examined. All issues of these titles for the period January–June, 1959 were checked, and all citations to technical reports were coded for machine sorting. Some results are shown in Table I.

Two figures from this table are of immediate interest. First, technical reports are *not* cited to any significant degree. Less than three percent of all the citations were to technical reports. No effort was made to locate citations to published papers which first appeared as technical reports. The work of Gray and Rosenborg [6] suggests that there would not be a great number of these.

Second, there appears to be a significant difference in the degree to which American and British physicists document their papers (1.44 references per British page vs. 2.84 for US physicists). The British authors seem to cite technical reports to an even smaller extent than Americans. This might reflect different editorial policies.

It seems evident that more technical reports are being cited currently than in the past. In 1949 Fussler,[7] studying the characteristics of the literature used by physicists in the United States, did not specifically mention citations to technical reports. Any that he found in his study were lumped with all "monographs",

* Dwight E. Gray [1] has defined the technical report as "a form of publication which is characterized principally by its heterogeneity of style, professional stature, size and form of reproduction and by the absence of anything like volume and number relationships".

Table I. Source Journals

Title	*Pages Checked*	*Total References*	*References Per Page*	*Total Technical Reports*	*Technical Report References Per Total References*
The Physical Review	3365	9759	2.90	292	0.030
Journal of Applied Physics	955	2502	2.62	43	0.017
Total	4320	12 261	2.84	335	0.027
Physical Society Proceedings	983	1602	1.63	13	0.008
Philosophical Magazine	783	940	1.20	3	0.003
Total	1766	2542	1.44	16	0.006

a category which included everything but serials, theses, and patents. In any case, he did not feel that reports were important enough to be categorized. Brown [8] in 1953, on the other hand, listed technical reports with the serial citations he found. A review of his lists and a recounting of the citations he found in *The Physical Review* and *Journal of Applied Physics* indicates that only 1.7 percent of the citations were to reports.

The distribution of the cited reports according to the year of publication is shown in Table II and Fig. 1.

Table II. Date of Issue of Cited Reports

Year of Issue	*Reports Cited*	*Percent*	*Cumulated Percent*
1959	10	3.0	3.0
1958	57	17.3	20.3
1957	69	21.0	41.3
1956	48	14.7	56.0
1955	48	14.7	70.7
1954	28	8.5	79.2
1953	24	7.3	86.5
1952	11	3.3	89.8
1951	6	1.8	91.6
1950	7	2.1	93.7
1949	9	2.7	96.4
1948	4	1.2	97.6
1947	1	0.3	97.9
1946	1	0.3	98.2
1945	2	0.6	98.8
1944	2	0.6	99.4
1943	0	0.0	99.4
1942	1	0.3	99.7
...			
1907	1	0.3	100.0
Unknown	6	...	...
Total	335	100.0	

As is seen in Fig. 1, the data can be described with some accuracy as the product of a growth and a decay function. The growth function is characterized by a half-life of 1.0 years while the decay function has a characteristic half-life of 2.1 years.

The growth period is presumably the time required for using the report and publishing new work, the mean time being about 1.4 years. Using a technique described by the senior author in another paper,[9] we may calculate the median age of the citations to technical reports.* The median age of technical-report literature in physics is 2.4 years as compared to 4.6 years for all physics literature. The curve described by the cumulated percentages (Fig. 2) yields, at any year, the percentage of reports likely to be cited which are more recent in publication than that year. For example, 90 percent of the cited technical reports were published since the beginning of 1952.

Randall,[10] in studying loans of technical reports to aeronautical engineers, developed data which show a median age for technical reports in this field of 1.5 years. The borrowers were made aware of the existence of these reports through library publications and indexes rather than through footnote references in journals. The difference of approximately one year in the median ages of the two sets of report literature can possibly be accounted for by the time lag between the submission of a paper (containing references to an already published report) to a journal and its appearance in print.

The issuing agencies of the technical reports cited were categorized in two ways. First, they were grouped by the kind of governing or operating body responsible for them as in Table III. Second, they were characterized as "atomic" or "nonatomic" as in Table IV.

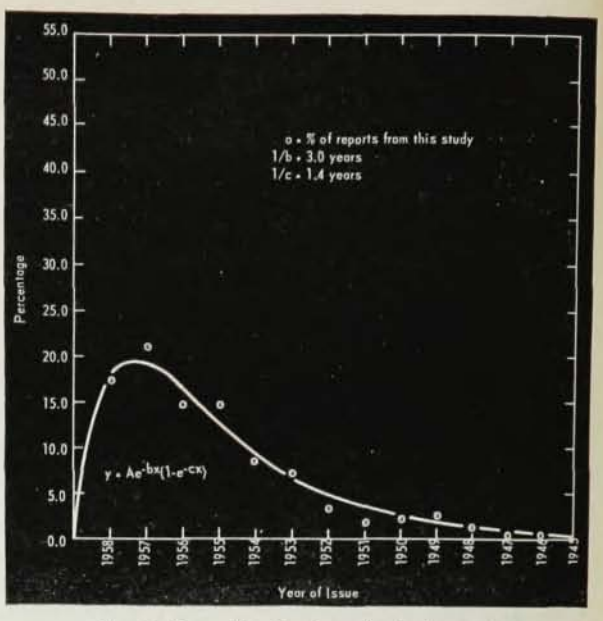

Fig. 1. Time distribution of cited reports.

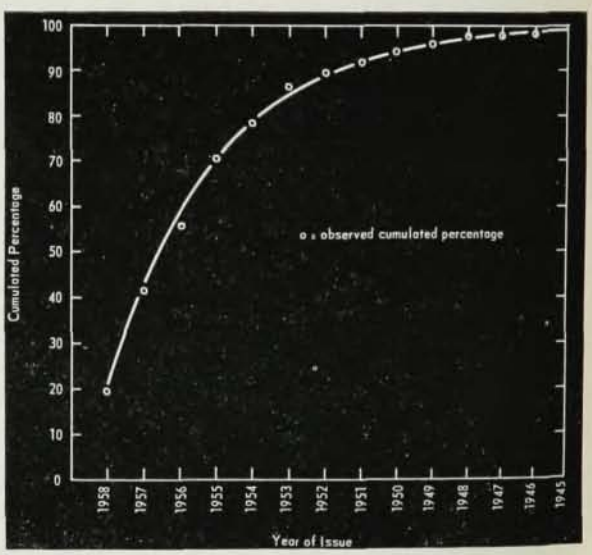

Fig. 2. Cumulative age of cited reports.

* While the phrase "literature half-life" has been applied to this figure, it more properly should be referred to as the median age.

Table III. Sponsorship of Issuing Agencies

Type of Sponsor	*No. of Citations*	*%*	*No. of Laboratories*	*%*
Government	204	60.9	32	45.1
University	106	31.6	24	33.8
Industry	23	6.9	13	18.3
Other (Societies, etc.)	2	0.6	2	2.8

Table IV. Atomic and Nonatomic Issuing Agencies

Type	*No. of Citations*	*%*	*No. of Labs or Series*	*%*
Total "Atomic"	251	74.9	28	39.4
AEC contract reports	85	25.8	10	14.2
AEC laboratory reports	140	41.7	11	15.4
Atomic Energy of Canada	20	5.6	6	8.4
Atomic Energy Research Establishment	6	1.8	1	1.4
Total "Nonatomic"	84	25.1	43	60.6
US government labs	37	11.1	13	18.3
Other government labs	1	0.3	1	1.4
University labs	30	8.9	20	28.2
Industrial labs	14	4.2	7	9.9
Other	2	0.6	2	2.8

Most noticeable from Table III is the dominance of government-operated laboratories. The reasons for this dominance are evident from Table IV. Nearly 75 percent of all technical reports cited in this study of physics literature were issued by government-sponsored laboratories devoted to atomic and nuclear research. In total, of the 335 citations found, 86 percent were government-sponsored reports.

Westbrook,[11] in studying ceramic literature, distributed citations to serial articles on the basis of the author's affiliation. His results are compared with those in this study in Table V.

Table V. Author Affiliation

(*Percentages*)

Sponsor	*Westbrook*	*"Atomic"*	*"Nonatomic"*
Government laboratories	15	61	17
University laboratories	57.5	32	48
Industrial laboratories	25	7	33
Other	2.5	Less than 1	2

As can be seen, there is reasonable agreement between the source of published papers in ceramics and this study's finding in regard to the source of "nonatomic" technical reports.

The 335 citations found in this survey were to 249 different reports; that is, there were 37 reports cited two or more times for a total of 123 replicate citations. Only 15 laboratories (of the total 71) were responsible for the replicate reports. Table VI shows, in rank order, all laboratories whose reports were cited at least five times. Also shown is the number of individual reports cited from each laboratory.

The fifteen laboratories (and report series) shown in Table VI account for 74 percent of all the citations.

Table VI. Issuing Laboratories by Frequency of Citation

Rank	*Name*	*Total Citations*	*No. of Reports*
1	University of California Radiation Laboratory	72	66
2	Brookhaven National Laboratory	31	7
2	Oak Ridge National Laboratory	31	17
3	Argonne National Laboratory	20	16
3	AEC Technical Information Service TID Series	20	2
4	AEC New York Operations Office	14	11
5	US Naval Research Laboratory	9	4
6	AEC Technical Information Service AECU Series	8	5
6	Los Alamos Scientific Laboratory	8	8
7	Atomic Energy of Canada, Ltd. Chalk River Project	7	5
8	AEC Technical Information Service AECD Series	6	5
8	National Bureau of Standards	6	5
8	Atomic Energy Research Establishment	6	5
8	Wright Air Development Center	6	6
9	Atomic Energy of Canada, Ltd. AECL Series	5	5

Because of the small number of citations found, the rankings of the laboratories should only be considered indicative and not definitive. It is obvious, however, that laboratories sponsored by the Atomic Energy Commission are of considerable importance in the production of cited technical reports.

Summary

The results of this brief study may be summarized as follows:

1. Technical reports do not constitute a significant portion of the cited physics literature. Approximately 3 percent of all references were to technical reports.
2. The citing of technical reports in the more formal literature is increasing, but at a slow rate.
3. Technical report literature in physics is characterized by a short median age, half of the cited reports having been published in 2.4 years prior to the year of study.
4. Reports issued by government-owned facilities or under government contracts constitute the greatest part of the cited reports, some 86 percent.
5. When reports relating to atomic and nuclear research are omitted, the distribution of the sponsors of the cited reports is approximately equivalent to that found for papers published in the normal manner.

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