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UNCITEDNESS OF ARTICLES IN *NATURE*, A MULTIDISCIPLINARY SCIENTIFIC JOURNAL

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Abstract—In an earlier investigation [1] it was noted that, on the average, 14·7% of the 222 test articles that appeared in a discipline-oriented scientific serial namely, *Journal of the American Chemical Society* (JACS) (Jan-Feb 1965) were not cited during any given year. It was further observed that only one (or 0·45%) paper remained continuously uncited during the entire 6 yr period of study (1965–70) following its publication. These findings were in disagreement with the conjectures of both PRICE [2] and CAWKELL [3]. According to Price and Cawkell, the average annual uncitedness of scientific articles is 35 and 64%, respectively. Price further predicted that about 10% of scientific literature published is never cited. On the other hand, KESSLER and HEART [4] conjectured that papers not cited during the first 5 yr of their publication are not likely to be cited in future. The aim of this study was to investigate the extent to which these predictions on uncitedness hold true, especially with reference to communications published in a multi-disciplinary (as opposed to a discipline-oriented) research journal like *Nature*, which is international in character.

NATURE: A CASE STUDY

Nature is an important journal that publishes results of investigations in various branches of science and technology. It occupies an interesting and noteworthy place among the leading, prestigious journals of the world. A selective review of the relatively recent bibliometric studies revealed that *Nature* is:

(1) one of the highly productive journals of the world, in terms of the coverage of its articles in secondary journals and services [5–13];

(2) one of the most frequently used science journals in libraries [14–24] and one of the most favorite journals regularly scanned and widely read by the researchers in various fields of scientific activity [25–28]; and

(3) one of the most heavily cited research journals in science [29–40].

In the light of above outstanding characteristics, it was considered worthwhile to study the phenomenon of uncitedness of the articles in *Nature*, and to test the validity of the predictions mentioned earlier [2–4].

MATERIALS

Nature publishes scientific communications of two kinds: longer papers or leading articles and short papers or letters to the editor. For the present study, 327 papers published in the first 5 issues (Nos. 4966–4970) of Vol. 205 (Jan. 2–30, 1965) of *Nature* were chosen as test papers. The year 1965 was selected as the base year so the *Science Citation Index Five-Year Cumulation, 1965–1969* [41] could be used to advantage for data collection. A total of 8 yr, 1965–1972 inclusive, was the period studied for the uncitedness of the test papers. A range of 8 yr was chosen to specifically test the validity of Kessler and Heart's prediction [4] that articles not cited in the first *five* (italics mine) years following their publication are unlikely be cited in the subsequent years.

For the purpose of the present study, any leading article or letter to the editor that carried the name and address of its author(s) was considered a test paper. The remaining items including editorials, notes and news, obituaries, book reviews, etc., signed or otherwise, were excluded from the scope of this study. The distribution of the 327 test papers, according to the types and the issues they were published in, is presented in Table 1.

METHOD

The method followed in this study was essentially the one used in the earlier investigation [1]. Briefly, each test paper was searched for in the *Citation Index* volumes of the 1965–72 SCI. A count was obtained for the number of papers citing each of the 327 test papers in any particular year, and cumulatively for the total period of study (1965–1972). Similarly, the number of papers

Table 1. Distribution of 327 test papers in *Nature* according to types and the issues published in

Issue no. and date	Type of test papers		
	Leading articles	Letters	Total
4966 (2 Jan 1965)	18	56	74
4967 (9 Jan 1965)	12	52	64
4968 (16 Jan 1965)	16	50	66
4969 (23 Jan 1965)	16	52	68
4970 (30 Jan 1965)	13	42	55
Total (5 issues):	75	252	327

that remained uncited in a given year, and also for consecutive years (starting with 1965, the base year) for all the 8 yr (1965–1972) studied was counted and recorded. Necessary corrections were made for compound surnames and the transliterated foreign names of the cited authors (that is, the authors of the test papers) by conducting searches for them in possible places in the *Citation Index* of the SCI.

RESULTS

The 327 test papers were cited a total of 3965 times during 1965–72, with 75 leading articles being cited 1557 times and the remaining 252 letters 2408 times. Thus, each test paper was cited, on the average, about 12·1 times during the 8-yr period of study or 1·5 times in any calendar year. Since the present investigation was primarily aimed at studying the phenomenon of uncitedness, no details relating to citedness of the test papers were considered appropriate for inclusion in this report. These data, however, are available upon request.

The yearwise distribution of the number and per cent of 327 test papers that remained uncited during the entire period of study are shown in Table 2. For the sake of comparison, these data are further organized according to the type of papers, such as leading article or letter.

Table 2 shows that, on the average, 38·0% of the leading articles (n = 75) and 51·8% of the letters (n = 252) were not cited in a year, while the average cumulative uncitedness for all the 327 test papers was 48·6% per yr. In other words, the yearly average rate of uncitedness of the letters was significantly higher than that of the leading articles. Further, the difference of 13·8% between these two types of test papers was also found to be statistically significant (chi square = 3·88;

Table 2. Distribution of *uncited* test papers by year and by type

Years NOT cited in	Type of test papers					
	Leading articles (n = 75)		Letters (n = 252)		Total (n = 327)	
	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1965	28	37.3	124	49.2	152	46.5
1966	20	26.7	103	40.9	123	37.6
1967	22	29.3	118	46.8	140	42.8
1968	24	32.0	111	44.0	135	41.3
1969	25	33.3	137	54.4	162	49.5
1970	35	46.7	143	56.7	178	54.4
1971	34	45.3	147	58.3	181	55.3
1972	40	53.3	162	64.3	202	61.8
Yearly average of uncited papers	28.5	38.0	130.6	51.8	159.1	48.6

$P = 0{\cdot}05$). It is further observed that in both types of test papers the average annual uncitedness was lowest in the second year of their publication (that is, in 1966). An interesting phenomenon that was noted in this study was a steady increase in the rate of uncitedness of the papers from the second year (1966) through the eighth year (1972), except for a slight decline in the seventh year (1971) for the leading articles and in the fourth year (1968) for the letters. In order to determine the effect of aging on the rate of uncitedness t test was performed of these two sets of data, and it was found that as the years went by the per cent of uncitedness of the test papers also increased; however, the rate of increase was found to be higher in letters.

Now, as mentioned in the beginning of the article, in order to determine the possible trend of *continuous uncitedness* of the test papers, from the base year to the end of the study, a separate count was obtained. These data were further categorized according to the type of test papers and are summarized in Table 3.

Table 3. Distribution of *continuously uncited* test papers by year and by type

Years NOT cited in	Type of test papers			
	Leading articles (n = 75)	Letters (n = 252)	Total (n = 327)	
	Nos.	Nos.	Nos.	Per cent
1965 alone	28	124	152	46.5
1965-1966 combined	9	66	75	22.9
1965 through 1967	7	50	57	17.4
1965 through 1968	4	36	40	12.2
1965 through 1969	4	30	34	10.4
1965 through 1970	3	26	29	8.9
1965 through 1971	3	24	27	8.2
1965 through 1972	3	21	24	7.3

It is evident from Table 3 that the number and per cent of papers that remained *continuously uncited* decreased consistently over the years. Of the 327 test papers, 34 (that is, 10·4%) were not cited in the first 5 yr of publication. Of these 34 papers, 10 (one leading and 9 letters) were, however, cited in the subsequent 3 yr. Thus, 29·4% (that is, 10 out of 34) of the test papers which remained uncited in the first 5 yr of the study (1965–69), were cited in the following 3 yr (1970–72). The remaining 24 (that is, 7·39% of 327) test papers were *never cited* during the entire 8-yr studied. Of these 24 *continuously uncited* papers, 3 were leading articles and the remaining 21 letters. In other words, of the 327 test papers, 3 (that is, 0·9%) leading articles and 21 (that is, 6·4%) letters remained continuously uncited, from the beginning to the end of the study. By performing regression analysis of these data it was found that the per cent of continuous uncitedness tapered off, with increasing age, at a higher rate with letters than with leading articles. This is just opposite to what was found with discrete yearly rate of uncitedness (Table 2) where the per cent (of uncitedness) increased as the years went by.

DISCUSSION AND CONCLUSIONS

In the present study, an average of 48·6% of the test papers from *Nature* was found to remain uncited in any year. This disagrees with 35 and 64% of average annual uncitedness of scientific articles predicted by PRICE[2] and CAWKELL[3], respectively. Surprisingly enough, this rate of uncitedness was noted to be about 3·3 times higher than that of the earlier study on the JACS articles (14·7%)[1]. The reasons for such large variations are rather hard to explain. One can only surmise that such a difference between the JACS study and the present one may possibly be due to the fact that JACS covers only one discipline of science, e.g. chemistry, whereas *Nature* is multidisciplinary in scope. Cawkell, in the same study[3], also noted that in the second, third and fourth year after publication, the yearly uncitedness of the 60 articles (chosen at random from the 1964 *Source Index* of SCI) was 61·7, 65 and 65%, respectively. Compared to these, the

corresponding data obtained in this study showed a much lower incidence of uncitedness, namely 37·6% in the second year, 42·8% in the third and 41·3% in the fourth year. Assuming that Cawkell's sample, being randomly chosen, was representative of science in general and multidisciplinary in character, one could only think that because of a large difference in the sample size between his study and the present one, such a variation in the rate of uncitedness is possible. Again, may be owing to the extensiveness of the subject coverage by *Nature* the rate of uncitedness noted in the individual years of the present study is much higher than that found in the JACS study[1].

COLE[42] observed that of the 1187 papers from 1963 *Physical Review*, 29% were not cited at all in the fourth year after their publication. Similar statistic in the present study reveals that as much as 41·3% of the 327 test papers were not cited in 1968, which is also about three times higher than that of the JACS articles.

KEAN and RONAYNE[43] found that 16 and 21% of the 1968 *Chemical Communications* (CC) papers, and 22 and 31% of the 1968 *Tetrahedron Letters* (TL) papers were not cited in 1969 and 1970, that is, in the second and third year of their publication, respectively. Compared to these, the uncitedness of letters in *Nature* (considering the fact that CC and TL publish only short papers) in the second and third year after publication, was 40·9 and 46·8%, respectively. Thus, Kean and Ronayne's findings do not approach those of the present study; however, one commonality that was found between these data from the two different studies was that the rate of uncitedness was higher in the third year than that in the second year.

From Table 3, it is clear that the number and per cent of the same set of papers that remained *continuously uncited* in consecutive years was highest (75 or 22·9%) in the first two years combined (1965–66), and over the years, this statistic declined, in a progressive manner, and reached the lowest (24 or 7·3%) in the "1965 through 1972" group. This "decline effect" on the rate of continuous uncitedness can probably be considered as a function of the "latency period" of scientific articles. Simply put, this means that given "sufficient time", scientific articles that appeared, following a rigorous reviewing procedure, in a reputable journal like *Nature*, stand a fairly high chance of being cited. Of course, it would be only reasonable to assume that the "latency period" (and also the frequency of citation) may considerably vary according to the "liveness" of the topic presented in the article, and also in general, from one discipline to another.

In the present study, it is seen that of the 34 papers that remained uncited in the *first five years* of publication (1965–69), 10 were cited in the subsequent 3 yr (1970–72). This nullifies Kessler and Heart's prediction[4] that articles not cited during the first 5 yr of publication are unlikely to be cited at a later date.

There were only 24 or 7·3% of the test papers that were *never cited* during the entire period of study. This observation approaches Price's conjecture that about 10% of scientific literature published are never cited. This, however, again is at great variance with 0·45% (or only one) article found to remain continuously uncited in JACS study[1].

We have already noted from Table 3 that 3 leading articles and 21 letters were never cited during the period 1965–72. It seems interesting to initiate another small study in which these continuously uncited articles (list available on request) can be categorized as to their types, e.g. mere reporting type or review or just confirmatory or accidental discovery, or method paper or a combination of two or more types. This exercise can actually be undertaken in conjunction with two other apparently important factors namely, the prolificness and the potential citability of the authors of the continuously uncited papers. Data on the prolificness of any of the authors can, to a considerable extent, be collected from the *Source Index* of the SCI, and the corresponding citation frequency for each of their works (from the *Citation Index* of the SCI) can give us a fairly good account of the potential citability of the individual authors. This type of study, if done on a large sample of papers from various disciplines, can probably help us establish some sort of correlation between the type/content of an article and its uncitedness.

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