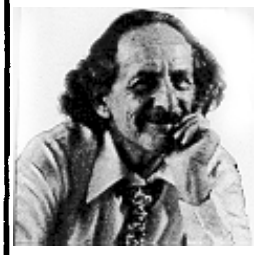
Essays of an Information Scientist, Vol:8, p.37-49, 1985
Current Contents, #5, p.3-15, February 4, 1985



Current Comments®

EUGENE GARFIELD
INSTITUTE FOR SCIENTIFIC INFORMATION®

The 250 Most-Cited *Citation Classics* from the Essential Decade 1955-1964

Number 5 February 4, 1985

Two years ago,[1] I reported the plans for publication of the 1955-1964 cumulation of the *Science Citation Index®* (*SCI®*). Since then, we have made occasional references to this compilation that contains more than 13,500,000 citations to more than 8,250,000 cited papers and books. For the record, this cumulation was distributed to our subscribers in April 1984. And you will be seeing ads in many journals describing this as the "essential" decade. Certainly the list of classic publications that follows demonstrates that point.

As is the custom for each *SCI* cumulation, the 1955-1964 set contains a separately published *Guide and Lists of Source Publications*.[2] It also contains several statistical tables. One of these shows the chronologic distribution of the references cited each year. In Table 1 we have reproduced the figure showing the matrix of citations from each of the 10 source years covered (1955-1964) to authored items published during the first 35 years back to 1930.

It is interesting to note an abrupt change in citation percentages between 1939 and 1940. This corresponds with the interruptions in publication that occurred during the war years. Among others, Derek J. de Solla Price has used these data to make extrapolations about the size of the literature of the 20th century.[3,4] (There is no complete census of scientific papers and books.) In a typical year, four percent of the citations are to publications issued in the same year. There are about 11 percent to each of the two previous years. So more than 26 percent of the citations occur in less than three years!

When you cumulate these figures for the entire decade, these percentages change significantly. The last column in Table 1 summarizes the entire 10-year file. The "peak year" is 1960. We'll have more to say about such statistical patterns in the future.

The main purpose of this essay, however, is to call attention to the most-cited publications of that decade. In particular, we want to emphasize the 61 papers and books that have not been identified in earlier citation studies. These are indicated in the Bibliography at the end of this essay by the symbol "#." The other publications in the Bibliography have been discussed in previous essays.[5,6] These papers and books are identified with various symbols to indicate the studies in which they have appeared.

Why did we not identify the 61 "new" classics in earlier studies? To publish the 1955-1964 *SCI*, we had to process the journal literature for 1955-1960. We also added more journals to the then-existing files for 1961-1964. For this reason, many of these key papers and books, mainly for the 1950s, were not identified. These works were well-cited soon after publication in most cases, but did not reach the citation threshold established in our earlier studies.

Incidentally, the list of 250 publications that follows was first published in the *Guide* to the newly issued cumula-

tion for 1955-1964. The Bibliography is identical, but we have added here, in columns A and B, the citation frequencies for each paper for 1955-1964 and for 1965-1983. This dichotomy provides an interesting perspective on the longevity of most classical papers. It does not, however, tell us about the early citation history of each paper, except in the case of papers published in the 1960s, of which there are only seven. Indeed, the study tells us nothing about papers published in this decade that became well cited in later years. Such delayed recognition is not uncommon.

Far from delayed recognition, the least-cited publication by John A. Sibley and Albert L. Lehninger was cited 290 times from 1955 to 1964 and 346 times thereafter. The average number of citations for items in the Bibliography was 517 and 1,828, respectively, for the two periods. By contrast, the most-cited item, Lowry's Folin phenol method of protein determination, received 5,021 cites for the decade and needs no further comment by me. Lowry has done this admirably on two separate occasions.[7,8] The oldest paper, however, is the one by Folin and Wu published in 1919.

If we censor the data to exclude the 189 papers and books that appeared in previous citation studies, the citation average for 1955-1964 is 371 and 354 for 1965-1983. When you censor the data to exclude just the 98 super-cited classics (those cited over 1,000 times), these averages change to 450 cites for 1955-1964 and 486 for 1965-1983.

Most of the publications listed will be known to *Current Contents*® (*CC*®) readers as "classics" in their fields. If there is a commentary published on the relevant *Citation Classic*™ , the date and edition of the *CC* are indicated in parentheses after each entry in the Bibliography. There are 62 of these.

Some of the authors of these papers, not surprisingly, are dead. And a large number of items are single-author works. This is characteristic of an earlier era. Ninety-seven items had one author; 93 had two; 38, three; 8, four; and 13 had five or more. *Bergey's Manual of Determinative Bacteriology*, edited by Breed, Murray, and Smith, actually contained 94 additional contributors. Breed died before the book was published. Murray and Smith are also deceased. Strictly speaking, this multi-authored work should not have been included. Note that we did not check the *SCI* for each of the 94 separate contributors for additional cites.

We have often said that one of the greatest predictors of future citation activity is past performance. There is a remarkable *increase* in the use and citation of these works 10 or more years after the base year of 1955. Indeed, this includes papers published in earlier decades. Two of the oldest papers continue to be explicitly cited even today. Cyrus H. Fiske and Yellapragada SubbaRow, Harvard Medical School, coauthored a paper published in the *Journal of Biological Chemistry* in 1925. This methods paper was cited over 900 times in 1983 and 1984 alone. Clearly the determination of phosphate levels in the blood and urine remains important. The Fiske and SubbaRow paper is still cited in papers on calcium absorption and excretion.

Another example is the 1931 paper by George M. Higgins and Reuben M. Anderson, then of the Mayo Foundation, Rochester, Minnesota. They studied the regeneration rate after surgical removal of 65 to 75 percent of the rat liver. In the past two years, this paper was cited over 200 times, over half the number for the 1955 to 1964 period. In fact, it was cited over 2,000 times from 1965 to the present.

Perhaps the tacit definition of a classic is its longevity. But why is there so much variation for classic papers? One possible explanation is the rate at which methods and theories are absorbed into the literature in different countries and disciplines. What may be "old hat" to a molecular biologist in the US may be the alternative technology needed by a third-world scientist. A well-known field of mathematics in the USSR may be re-

Table 1: *Science Citation Index®, 1955-1964* chronological distribution of citations to authored items (non-patents).

Percentage of Unique Citations

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1955-1964 Cumulated
1964										3.91	1.00
1963									4.25	11.29	3.39
1962								3.83	10.17	10.98	4.54
1961							3.91	10.06	10.20	9.06	5.21
1960						4.09	10.46	10.73	9.05	7.69	5.83
1959					3.92	10.67	10.58	8.84	7.30	6.20	5.73
1958				3.93	10.77	10.84	8.85	7.27	6.13	5.21	5.61
1957			3.93	10.89	10.64	8.76	7.20	6.08	5.20	4.40	5.35
1956		3.91	10.71	10.92	8.69	7.37	6.22	5.23	4.48	3.80	5.19
1955	4.10	10.86	10.85	8.92	7.52	6.13	5.35	4.57	3.96	3.38	5.06
1954	10.81	10.64	8.73	7.24	6.26	5.20	4.55	3.88	3.40	2.89	4.60
1953	10.58	8.73	7.27	6.19	5.29	4.55	3.97	3.43	3.01	2.57	4.04
1952	8.46	7.14	6.01	5.09	4.44	3.85	3.39	2.94	2.61	2.20	3.39
1951	7.05	6.03	5.10	4.33	3.80	3.32	2.97	2.56	2.25	1.92	2.91
1950	5.98	5.12	4.40	3.76	3.35	2.91	2.57	2.27	1.99	1.73	2.59
1949	4.73	4.07	3.53	3.03	2.70	2.39	2.13	1.88	1.65	1.42	2.13
1948	3.75	3.22	2.82	2.44	2.17	1.93	1.72	1.53	1.32	1.17	1.74
1947	2.91	2.46	2.16	1.91	1.70	1.48	1.34	1.19	1.05	0.90	1.36
1946	2.17	1.85	1.64	1.44	1.29	1.14	1.04	0.92	0.81	0.71	1.05
1945	1.60	1.40	1.25	1.09	0.95	0.86	0.80	0.74	0.64	0.55	0.80
1944	1.51	1.35	1.18	1.06	0.92	0.85	0.76	0.69	0.61	0.52	0.77
1943	1.56	1.37	1.21	1.10	0.99	0.87	0.80	0.71	0.62	0.55	0.80
1942	1.68	1.45	1.27	1.15	1.03	0.94	0.84	0.76	0.68	0.59	0.84
1941	1.76	1.57	1.41	1.26	1.11	1.03	0.92	0.84	0.73	0.63	0.93
1940	1.83	1.58	1.41	1.28	1.17	1.02	0.94	0.85	0.76	0.65	0.96
1939	1.86	1.64	1.45	1.29	1.17	1.07	0.97	0.89	0.76	0.67	1.01
1938	1.76	1.58	1.42	1.27	1.13	1.02	0.95	0.86	0.76	0.65	0.99
1937	1.67	1.49	1.31	1.20	1.09	0.98	0.92	0.81	0.73	0.64	0.95
1936	1.50	1.38	1.25	1.11	0.99	0.90	0.84	0.77	0.67	0.58	0.89
1935	1.37	1.24	1.11	1.02	0.91	0.84	0.76	0.70	0.62	0.54	0.82
1934	1.25	1.11	1.04	0.92	0.83	0.76	0.71	0.64	0.57	0.49	0.76
1933	1.17	1.07	0.98	0.87	0.80	0.71	0.67	0.60	0.54	0.47	0.72
1932	1.12	1.05	0.92	0.84	0.74	0.68	0.65	0.58	0.52	0.45	0.70
1931	0.99	0.93	0.83	0.75	0.66	0.61	0.57	0.53	0.48	0.41	0.64
1930	0.92	0.85	0.80	0.70	0.63	0.58	0.56	0.49	0.45	0.40	0.62

cently rediscovered by mathematicians or computer scientists in the US or Japan. In addition, language and other barriers may account for the use of older literature by Soviet, Chinese, or other scientists.

Table 2 provides a chronologic analysis of publication dates. Ten percent of the items were published before 1940; 25 percent in the 1940s. More than 50 percent were published in the 1950s. And three percent were published between 1960 and 1964. Naturally these percentages are affected by the exponential growth of the literature during that period. It is interesting to observe the differences in the percentage of classics published in the various 5- and 10-year periods shown in Table 2 in column A. In

Table 2: Chronologic distribution of publication dates of the 250 most-cited items from the 1955-1964 *SCI®* cumulation. A=publication year. B=number of items. C=percent of items. D=percent of citations, 1955-1964 cumulation (last column, Table 1).

A	B	C	D
1910-1919	1	.4	*
1920-1929	6	2.4	*
1930-1939	18	7.2	8.1
1940-1944	18	7.2	4.3
1945-1949	44	17.6	7.1
1950-1954	89	35.6	17.5
1955-1959	67	26.8	26.9
1960-1964	7	2.8	20.0

*Years prior to 1930 account for 16.1 percent of the citations represented in the cumulation.

columns B and C, the numbers and percentages for classics are shown. In column D is the corresponding figure obtained from the last column of Table 1.

Whereas 10 percent of the classics were published before 1940, about 24.2 percent of citations in the 1955-1964 cum are pre-1940. While 25 percent of the classics were published in the 1940s, there were only 11.4 percent of citations to this period. On the other hand, about two-thirds of the classics were published in the 1950s, while only 44.4 percent of the cites go to these years. While 36 percent of the classics were published in the early 1950s, only 17.5 percent of the cites were to this period. Twenty-seven percent were published in the late 1950s, and 26.9 percent of the cites were to this period.

In general, classics or best-known papers are more current than the average least frequently cited paper. This would tend to indicate that, more often than not, important or milestone papers have more *immediate* impact than average papers and then continue to be heavily cited. The 250 papers in this study account for about 0.01 percent of the estimated papers published that could be cited. They received, however, 0.5 percent of the cites, or about 50 times the average. This figure matches the results for other studies of highly cited authors, as, for example, our study of Nobel Prize winners.[9]

Although we have reported on highly cited books in the past, these studies have been limited. We are planning to do more about this in the future. Ten of the 28 books listed have not turned up in the studies that we cited in the Bibliography. We did not attempt to identify multi-authored book volumes. This will be of special interest, when we have detailed analyses of multi-authored volumes, in planning a citation index to scientific books. The *Bergey Manual* mentioned earlier was the exception because it was so consistently cited under the editor's name. Note that in the early history of the *SCI*, we treated both the cited chapter author and the editor as separate citations.

Like lists of most-cited authors, this list is deficient in certain respects. We have not made allowances for field or disciplinary differences. The most-cited work in fields like botany, radioastronomy, mathematics, and so on, would not turn up on this undifferentiated list. Every identifiable discipline or specialty warrants its own analysis. To do justice to all of the fields of science covered in the *SCI*, we would have to publish a separate study every day of the year. That this would give me great pleasure is a truism. But there are limitations in time and space. That is why we encourage scholars to use our databases to develop lists relevant to their particular needs. We are eager to work with professional societies and others with this purpose in mind. However, we do plan to do a research-front analysis of the 1955-1964 file so that we can cluster the core papers for each field. We plan to publish that compilation as a supplement to the cumulation.

There are 49 Nobel Prize authors in the Bibliography: 16 in physics, 12 in chemistry, and 21 in biomedicine. While citation analysis cannot predict who will win a Nobel Prize, it is interesting that four were identified in our earlier studies of scientists before they had been recognized formally as being of Nobel class. A much larger number are members of academies or have been recognized by other significant awards.

While 61 publications ("#" in the Bibliography) are unique to this study, 10 of these have been identified earlier as *Citation Classics*. Therefore, 51 have not necessarily been invited to comment on their papers. Forty-three percent of these articles were in biomedicine.

The most-cited "new" ("#" in the Bibliography) classic is the 1958 paper by Strominger and colleagues, University of California, Berkeley, cited about 600 times from 1955 to 1964, and about 250 times from 1965 to the present. The paper presents a comprehensive table of

all the radioactive and stable isotopes of the chemical elements. It includes half-life values and other salient features of each isotope.

Another newly identified paper was written by Don H. Nelson and Leo T. Samuels, University of Utah, College of Medicine, Salt Lake City. Published in 1952 in the *Journal of Clinical Endocrinology and Metabolism*, the paper describes a method for measuring cortisol levels in blood. Cortisol is a naturally occurring steroid that, among other things, controls inflammation in the body. It is produced by the adrenal glands. Synthetic cortisol, or hydrocortisone, is used to treat rheumatoid arthritis. Nelson discussed this paper in *Current Contents* in 1981.[10] "The many citations of the paper are probably due to the fact that this was not only the first reproducible method for the measurement of '17-hydroxycorticosteroids' in peripheral blood or plasma but also the first demonstration that cortisol was the major circulating corticosteroid, and establishment of the amounts present in the circulation."

A final example is one of the four listed papers by George E. Palade, Rockefeller Institute, New York. This classic appeared in the *Journal of Biophysics and Biochemical Cytology* in 1956. It reviews the history of the endoplasmic reticulum, which was identified in 1945 by Keith R. Porter, Albert Claude, and E. F. Fullam, also of the Rockefeller Institute. They discovered a new cytoplasmic system that was characterized by a reticular disposition and vesicular component elements. Few, if any, of these vesicular elements were found in the exoplasmic, or peripheral area, of the cytoplasm. They seemed to be concentrated in the endoplasmic, or inner fluid, of the cytoplasm.[11] Citations to this paper dropped off after 1964. While the paper was cited about 500 times in the first nine years, it has received "only" 200 since 1965. In fact, this paper and most others in the list are still cited many times more than that of the average paper indexed in the *SCI*.

I have stressed the longevity of most classic papers. At the same time, it is worth noting that the use of about six percent of these papers has fallen off significantly since 1964. Methods and ideas change. Certain works are superseded by others for a variety of reasons. For example, a 1961 paper by Sydney Brenner, University of Cambridge, UK, and colleagues, was cited 300 times in the first 4 years after publication, but only 150 times in the following 20 years. The authors of this article, published in *Nature*, investigated the way in which ribosomes receive genetic information from the gene. They agreed with other researchers who thought that ribosomal ribonucleic acid (RNA) was not the intermediate carrier of information from the gene to the protein. An unstable intermediate or "messenger" structure was thought to convey information from genes to ribosomes.[12]

Another paper that experienced a decline in explicit citations after 1964 is "Paper chromatography of steroids" by Robert B. Burton, Alejandro Zaffaroni, and E. Henry Keutmann, University of Rochester, New York. This paper received 366 citations from 1955 to 1964. From 1965 to 1983, it only picked up an additional 130 citations.

As you can see, some of the 59 newly identified classics did not receive enough citations from 1965 to 1983 for us to recognize that they were already citation classics. Others may not have turned up because our journal coverage in the late 1960s was not as completely balanced as is the coverage of the 1955-1964 cumulation. By using *Journal Citation Reports®*, we could observe gaps in our coverage for the primordial *SCI* first produced in 1963. We added dozens of journals not originally covered in the *SCI*.

Indeed, with hindsight, we can now detect gaps in our coverage of the late 1960s. We plan to fill in the data in future compilations. These gaps are not large. But when they occur, it is frustrating if you are trying to study the full history and development of a particular journal

or paper. And such historical uses of the *SCI* are increasing. This use of the *SCI* parallels the growth in the profession of the history of science. There are now 30 years of cumulated citation data available to search the scientific literature. You can use this information to trace the evolution of your particular field. By using the older years of cumulated *SCI* data, you can identify the primordial papers of your research specialty. These studies can confirm your subjective recollections.

We have already embarked on processing 1945-1954 journals so that the *SCI* will cover the post-war years. We can then work on the first half of the century. In the meantime, these data help us identify *Citation Classics* by older authors who are increasingly more difficult to locate. But we gain a special insight from these classic authors, so that when we do find them, we are grateful that they take the time and energy to tell newer generations about their pioneering work.

We invite any authors on this list of classics to submit *Citation Classic* commentaries if they have not already done so. Each will of course receive a formal invitation. We have made every reasonable effort to locate these authors, but it is not always possible to do so. So we hope that *CC* readers will direct this invitation to those authors who have not yet written a commentary for publication in *CC*.

As a final note, we must apologize for the brevity of this list. Of the two million or more papers or books published in this decade, just to list the top 2,000 would cover less than one-tenth of one percent. Even during those early days when little science was well on its way to becoming big science, there were certainly several thousand scientist authors and their papers worthy of mention.

From past experience, we have learned how much these nostalgic voyages into the past interest our readers. So we expect to extend our listings for this highly productive decade in the future. Eventually this extended list of classics will be part of the larger database we are creating to identify the most active research fronts of this essential decade. Indeed, this will be yet another step in the direction of completing the *Atlas Encyclopedia of Science*.[13]

* * * * *

My thanks to Thomas Atkins, Abigail Grissom, and Amy Stone for their help in the preparation of this essay.

REFERENCES

1. **Garfield E.** The 1955-1964 *Science Citation Index* cumulation—a major new bibliographic tool for historians of science and all others who need precise information retrieval for the age of space and molecular biology. *Current Contents* (5):5-8, 31 January 1983.
2. **Institute for Scientific Information.** *SCI—Science Citation Index 1955-1964, ten year cumulation. Guide and lists of source publications*. Philadelphia: ISI, 1984. 51 p.
3. **Price D J D.** A general theory of bibliometric and other cumulative advantage processes. *J. Amer. Soc. Inform. Sci.* 27:292-306, 1976.
4. ----------. *Little science, big science*. New York: Columbia University Press, 1965. 118 p.
5. **Garfield E.** *Essays of an information scientist, 1962-1983*. Philadelphia: ISI Press. Vols. 1-6.
6. ----------. The articles most cited in 1961-1982. Pts. 1-5. *Current Contents* (23):3-9, 4 June 1984; (29):3-12, 16 July 1984; (35):3-9, 27 August 1984; (40):3-9, 1 October 1984; (42):3-12, 15 October 1984.
7. ----------, Citation frequency as a measure of research activity and performance. *Essays of an information scientist*. Philadelphia: ISI Press, 1977. Vol. 1. p. 406-8.
8. **Lowry O H.** Citation Classic. Commentary on *J. Biol. Chem.* 193:265-75, 1951. *Current Contents* (1):7, 3 January 1977.
9. **Sher I H & Garfield E.** New tools for improving and evaluating the effectiveness of research. *Essays of an information scientist*. Philadelphia: ISI Press, 1984. Vol. 6. p. 503-13. (Reprinted from: Yovits M C, Gilford D M, Wilcox R H, Staveley E & Lemer H D, eds. *Proceedings of the Conference on Research Program Effectiveness*, 27-29 July 1965, Washington, DC. New York: Gordon and Breach, 1966. p. 135-46.)
10. **Nelson D H.** Citation Classic. Commentary on *J. Clin. Endocrinol. Metab.* 12:519-26, 1952. *Current Contents/Clinical Practice* 9(1):16, 5 January 1981.
11. **Palade G E.** The endoplasmic reticulum. *J. Biophys. Biochem. Cytol.* 2(4, Suppl.):85-97, 1956.
12. **Brenner S, Jacob F & Meselson M.** An unstable intermediate carrying information from genes to ribosomes for protein synthesis. *Nature* 190:576-81, 1961.
13. **Garfield E.** Introducing the *ISI Atlas of Science: Biotechnology and Molecular Genetics, 1981/1982* and bibliographic update for 1983/1984. *Current Contents* (41):3-14, 8 October 1984.

BIBLIOGRAPHY

The 250 most-cited items from the *SCI*® cumulation, 1955-1964, arranged in alphabetic order by first author. A = 1955-1964 citations. B = 1965-1983 citations. C = bibliographic data. An asterisk (*) indicates that the item was the subject of a *Citation Classic*™ commentary. The issue, year, and edition in which the commentary appeared are listed in parentheses following the bibliographic citation. The symbol # indicates that the item is appearing in an ISI® citation study for the first time. If the author was previously identified in ISI's study of the 1,000 most-cited scientists, 1965-1978, a dagger (†) appears after the author's name. The volume and page numbers in square brackets after each item indicate where the item has been previously identified in a citation study published in *Essays of an Information Scientist*. (See reference 5.) Items followed by a double dagger in square brackets [‡] appeared in *Current Contents* in 1984 in our five-part study of most-cited articles, 1961-1982. (See reference 6.) These will be included in Volume 7 of *Essays*, now in press.

A	B	C
672	1754	*Abell L L, Levy B B, Brodie B B† & Kendall F E. A simplified method for the estimation of total cholesterol in serum and demonstration of its specificity. *J. Biol. Chem.* 195:357-66, 1952. (34/79/LS) [‡]
427	21	#Ajzenberg F & Lauritsen T. Energy levels of light nuclei. V. *Rev. Mod. Phys.* 27:77-166, 1955.
577	474	*Ajzenberg-Selove F & Lauritsen T. Energy levels of light nuclei. VI. *Nucl. Phys.* 11:1-340, 1959. (13/79/PC&ES) [3:126]
436	768	#Albright F & Reifenstein E C. *The parathyroid glands and metabolic bone disease.* Baltimore, MD: Williams & Wilkins, 1948. 393 p.
484	720	Alder K, Bohr A, Huus B, Mottelson B & Winther A. Study of nuclear structure by electromagnetic excitation with accelerated ions. *Rev. Mod. Phys.* 28:432-542, 1956. [‡]
589	1200	*Allen R J L. The estimation of phosphorus. *Biochem. J.* 34:858-65, 1940. (39/82/LS) [‡]
304	360	*#Allen W M. A simple method for analyzing complicated absorption curves, of use in the colorimetric determination of urinary steroids. *J. Clin. Endocrinol.* 10:71-83, 1950. (24/79/LS)
308	291	#Amin A H, Crawford T B B & Gaddum J H. The distribution of substance P and 5-hydroxytryptamine in the central nervous system of the dog. *J. Physiol.* 126:596-618, 1954.
348	1237	Anson M L. The estimation of pepsin, trypsin, papain, and cathepsin with hemoglobin. *J. Gen. Physiol.* 22:79-89, 1938. [‡]
293	853	*Astrup T & Mullertz S. The fibrin plate method for estimating fibrinolytic activity. *Arch. Biochem. Biophys.* 40:346-51, 1952. (41/84/LS) [‡]
295	274	Avery O T, MacLeod C M & McCarty M. Studies on the chemical nature of the substance inducing transformation of pneumococcal types. *J. Exp. Med.* 79:137-58, 1944. [3:79]
310	352	Baker J R. The histochemical recognition of lipine. *Quart. J. Microscop. Sci.* 87:441-71, 1946. [3:48]
350	338	Baldwin E D, Cournand A & Richards D W. Pulmonary insufficiency. *Medicine* 27:243-78, 1948. [3:79]
324	375	*#Bandurski R S & Axelrod B. The chromatographic identification of some biologically important phosphate esters. *J. Biol. Chem.* 193:405-10, 1951. (48/81/LS)
752	1706	Bardeen J, Cooper L N & Schrieffer J R. Theory of superconductivity. *Phys. Rev.* 108:1175-204, 1957. [‡]
1446	1811	*Barker S B & Summerson W H. The colorimetric determination of lactic acid in biological material. *J. Biol. Chem.* 138:535-54, 1941. (46/83/LS) [‡]
279	261	Barton D H R†. The stereochemistry of *cyclo*hexane derivatives. *J. Chem. Soc.* 1953:1027-40, 1953. [3:354]
604	735	Bellamy L J. *The infra-red spectra of complex molecules.* New York: Wiley, 1954. 323 p. [3:354]
490	598	Berenblum I & Chain E. An improved method for the colorimetric determination of phosphate. *Biochem. J.* 32:295-8, 1938. [2:613]
520	495	Berghuis J, Bertha I J, Haanappel M, Potters M, Loopstra B O, MacGillavry C H & Veenendal A L. New calculations of atomic scattering factors. *Acta Crystallogr.* 8:478-83, 1955. [3:126]
540	301	Biggs R & Douglas A A. The thromboplastin generation test. *J. Clin. Pathol.* 6:23-9, 1953. [2:660]
329	271	#Billingham R E, Brent L & Medawar P B. 'Actively acquired tolerance' of foreign cells. *Nature* 172:603-6, 1953.
346	324	#Billingham R E, Brent L & Medawar P B. Quantitative studies on tissue transplantation immunity. III. Actively acquired tolerance. *Phil. Trans. Roy. Soc. London B* 239:357-412, 1956.
475	669	#Blatt J M & Weisskopf V F. *Theoretical nuclear physics.* New York: Wiley, 1952. 864 p.
304	502	Bloch F. Nuclear induction. *Phys. Rev.* 70:460-74, 1946. [3:57]
604	1486	*Bloembergen N†, Purcell E M & Pound R V. Relaxation effects in nuclear magnetic resonance absorption. *Phys. Rev.* 73:679-712, 1948. (18/77) [‡]
454	1192	Boas N F. Method for the determination of hexosamines in tissues. *J. Biol. Chem.* 204:553-63, 1953. [‡]
707	993	#Bohr A & Mottelson B R. Collective and individual-particle aspects of nuclear structure. *Mat. Fys. Medd. Dan. Vid. Selsk.* 27(16):1-174, 1953.
470	968	Bonsnes R W & Taussky H H. On the colorimetric determination of creatinine by the Jaffe reaction. *J. Biol. Chem.* 158:581-91, 1945. [‡]
351	1345	*Bowden K, Heilbron I M, Jones E R H & Weedon B C L. Researches on acetylenic compounds. Part 1. The preparation of acetylenic ketones by oxidation of acetylenic carbinols and glycols. *J. Chem. Soc.* 1946:39-45, 1946. (20/79/PC&ES) [3:57]

A	B	C
577	1249	**Boyden S V.** The adsorption of proteins on erythrocytes treated with tannic acid and subsequent hemagglutination by antiprotein sera. *J. Exp. Med.* 93:107-20, 1951. [‡]
423	1354	***Boyer P D.** Spectrophotometric study of the reaction of protein sulfhydryl groups with organic mercurials. *J. Amer. Chem. Soc.* 76:4331-7, 1954. (25/79/LS) [‡]
702	1902	**Bratton A C & Marshall E K.** A new coupling component for sulfanilamide determination. *J. Biol. Chem.* 128:537-50, 1939. [‡]
424	1829	**Breed R S, Murray E G D, Smith N R & 94 Contributors.** *Bergey's manual of determinative bacteriology*. Baltimore, MD: Williams & Wilkins, 1957. 1094 p. [2:4]
318	756	**Brenner S† & Horne R W.** A negative staining method for high resolution electron microscopy of viruses. *Biochim. Biophys. Acta* 34:103-10, 1959. [‡]
303	145	**#Brenner S†, Jacob F† & Meselson M.** An unstable intermediate carrying information from genes to ribosomes for protein synthesis. *Nature* 190:576-81, 1961.
450	769	***Brown J B.** A chemical method for the determination of oestriol, oestrone and oestradiol in human urine. *Biochem. J.* 60:185-93, 1955. (2/83/LS) [‡]
444	1516	***Brunauer S, Emmett P H & Teller E.** Adsorption of gases in multimolecular layers. *J. Amer. Chem. Soc.* 60:309-19, 1938. (35/77) [‡]
389	616	**Burn J H & Rand M J.** The action of sympathomimetic amines in animals treated with reserpine. *J. Physiol.—London* 144:314-36, 1958. [‡]
648	9936	***Burton K.** A study of the conditions and mechanism of the diphenylamine reaction for the colorimetric estimation of deoxyribonucleic acid. *Biochem. J.* 62:315-23, 1956. (26/77) [‡]
366	130	**#Burton R B, Zaffaroni A & Keutmann E H.** Paper chromatography of steroids. II. Corticosteroids and related compounds. *J. Biol. Chem.* 188:763-71, 1951.
824	705	***Bush I E.** Methods of paper chromatography of steroids applicable to the study of steroids in mammalian blood and tissues. *Biochem. J.* 50:370-8, 1952. (3/84/LS) [‡]
391	965	**Caulfield J B.** Effects of varying the vehicle for OsO_4 in tissue fixation. *J. Biophys. Biochem. Cytol.* 3:827-9, 1957. [‡]
349	1552	***Chance B† & Williams G R.** The respiratory chain and oxidative phosphorylation. *Advan. Enzymol. Relat. Areas Mol. Biol.* 17:65-134, 1956. (49/83/LS) [‡]
356	1725	**Chandrasekhar S.** Stochastic problems in physics and astronomy. *Rev. Mod. Phys.* 15:1-89, 1943. [‡]
302	262	**#Chew G F & Low F E.** Effective-range approach to the low-energy *p*-wave pion-nucleon interaction. *Phys. Rev.* 101:1570-9, 1956.
397	594	**Clark E P & Collip J B.** A study of the Tisdall method for the determination of blood serum calcium with a suggested modification. *J. Biol. Chem.* 63:461-4, 1925. [3:48]
388	571	**Cohn E J, Strong L E, Hughes W L, Mulford D J, Ashworth J N, Melin M & Taylor H L.** Preparation and properties of serum and plasma proteins. IV. A system for the separation into fractions of the protein and lipoprotein components of biological tissues and fluids. *J. Amer. Chem. Soc.* 68:459-75, 1946. [3:48]
293	175	**#Cohn E J, Gurd F R N, Surgenor D M, Barnes B A, Brown R K, Derouaux G, Gillespie J M, Kahnt F W, Lever W F, Liu C H, Mittelman D, Mouton R F, Schmid K† & Uroma E.** A system for the separation of the components of human blood: quantitative procedures for the separation of the protein components of human plasma. *J. Amer. Chem. Soc.* 72:465-74, 1950.
365	237	**Consden R, Gordon A H & Martin A J P.** Qualitative analysis of proteins: a partition chromatographic method using paper. *Biochem. J.* 38:224-32, 1944. [3:48]
702	1217	***Coons A H & Kaplan M H.** Localization of antigen in tissue cells. II. Improvements in a method for the detection of antigen by means of fluorescent antibody. *J. Exp. Med.* 91:1-13, 1950. (6/81/LS) [‡]
318	698	**Coons A H, Leduc E H & Connolly J M.** Studies on antibody production. I. A method for the histochemical demonstration of specific antibody and its application to a study of the hyperimmune rabbit. *J. Exp. Med.* 102:49-60, 1955. [3:180]
431	291	**#Courvoisier S, Fournel J, Ducrot R, Kolsky M & Koetschet P.** Proprietes pharmacodynamiques du chlorhydrate de chloro-3 (dimethylamino-3'-propyl)-10 phenothiazine (4.560 R.P.) (Pharmacodynamic properties of 3-chloro-10(3'-dimethylaminopropyl) phenothiazine chlorohydrate (4.560 R.P.). *Arch. Int. Pharmacodyn. Ther.* 92:305-61, 1953.
404	300	**Cruickshank D W J.** The accuracy of electron-density maps in X-ray analysis with special reference to dibenzyl. *Acta Crystallogr.* 2:65-82, 1949. [3:57]
408	1743	**Davis B D & Mingioli E S.** Mutants of *Escherichia coli* requiring methionine or vitamin B_{12}. *J. Bacteriol.* 60:17-28, 1950. [‡]
355	217	***de Duve C†, Pressman B C†, Gianetto R, Wattiaux R & Appelmans F.** Tissue fractionation studies. 6. Intracellular distribution patterns of enzymes in rat-liver tissue. *Biochem. J.* 60:604-17, 1955. (12/77) [‡]
544	1458	**Dische Z.** A new specific color reaction of hexuronic acids. *J. Biol. Chem.* 167:189-98, 1947. [‡]
430	541	**Dische Z.** Uber einige neue charakteristische Farbreaktionen der Thymonukleinsaure und eine Mikromethode zur Bestimmung derselben in tierischen Organen mit Hilfe dieser Reaktionen (Some new characteristic color reactions of thymonucleic acid and a micromethod for its determination in animal organs using these reactions). *Mikrochemie* 8:4-32, 1930. [2:613]
355	1139	**Dische Z & Shettles L B.** A specific color reaction of methylpentoses and a spectrophotometric micromethod for their determination. *J. Biol. Chem.* 175:595-603, 1948. [‡]
822	2789	**Dole V P.** A relation between non-esterified fatty acids in plasma and the metabolism of glucose. *J. Clin. Invest.* 35:150-4, 1956. [‡]
689	2344	**Dulbecco R† & Vogt M.** Plaque formation and isolation of pure lines with poliomyelitis viruses. *J. Exp. Med.* 99:167-82, 1954. [‡]
913	5750	***Duncan D B.** Multiple range and multiple *F* tests. *Biometrics* 11:1-42, 1955. (4/77) [‡]
294	78	**#Durrum E L.** A microelectrophoretic and microionophoretic technique. *J. Amer. Chem. Soc.* 72:2943-8, 1950.

A	B	C
351	3190	*Eagle H. Amino acid metabolism in mammalian cell cultures. *Science* 130:432-7, 1959. (5/77) [‡]
415	683	Eagle H. Nutrition needs of mammalian cells in tissue cultures. *Science* 122:501-4, 1955. [3:181]
306	645	*Earle W R, Schilling E L, Stark T H, Straus N P, Brown M F & Shelton E. Production of malignancy in vitro. IV. The mouse fibroblast cultures and changes seen in the living cells. *J. Nat. Cancer Inst.* 4:165-212, 1943. (46/78) [3:80]
496	848	Elson L A & Morgan W T J. A colorimetric method for the determination of glucosamine and chondrosamine. *Biochem. J.* 27:1824-8, 1933. [‡]
293	670	Fatt P & Katz B†. An analysis of the end-plate potential recorded with an intra-cellular electrode. *J. Physiol.* 115:320-70, 1951. [3:181]
382	159	#Feshbach H, Porter C E & Weisskopf V F. Model for nuclear reactions with neutrons. *Phys. Rev.* 96:448-64, 1954.
612	684	Feynman R P & Gell-Mann M. Theory of the Fermi interaction. *Phys. Rev.* 109:193-8, 1958. [‡]
3509	10,009	Fiske C H & SubbaRow Y. The colorimetric determination of phosphorus. *J. Biol. Chem.* 66:375-400, 1925. [‡]
344	685	Folch J, Ascoli I, Lees M, Meath J A & LeBaron F N. Preparation of lipide extracts from brain tissue. *J. Biol. Chem.* 191:833-41, 1951. [3:149]
792	14,318	Folch J, Lees M & Sloane Stanley G H. A simple method for the isolation and purification of total lipides from animal tissues. *J. Biol. Chem.* 226:497-509, 1957. [‡]
297	364	Folin O & Wu H. A system of blood analysis. *J. Biol. Chem.* 38:81-110, 1919. [2:493]
455	829	Folin O & Ciocalteu V. On tyrosine and tryptophane determinations in proteins. *J. Biol. Chem.* 73:627-50, 1927. [‡]
974	1132	Friedmann T E & Haugen G E. Pyruvic acid. II. The determination of keto acids in blood and urine. *J. Biol. Chem.* 147:415-42, 1943. [‡]
365	1189	Gell-Mann M. Symmetries of baryons and mesons. *Phys. Rev.* 125:1067-84, 1962. [‡]
422	324	#Gierer A & Schramm G. Infectivity of ribonucleic acid from tobacco mosaic virus. *Nature* 177:702-3, 1956.
451	3111	Glasstone S, Laidler K J & Eyring H. *The theory of rate processes*. New York: McGraw-Hill, 1941. 611 p. [3:358]
316	437	Gomori G. Aldehyde-fuchsin: a new stain for elastic tissue. *Amer. J. Clin. Pathol.* 20:665-6, 1950. [2:660]
635	1570	Gomori G. *Microscopic histochemistry*. Chicago: University of Chicago Press, 1952. 273 p. [2:4]
405	760	Good C A, Kramer H & Somogyi M. The determination of glycogen. *J. Biol. Chem.* 100:485-91, 1933. [2:614]
339	3340	Goodman L S & Gilman A. *The pharmacological basis of therapeutics*. New York: Macmillan, 1955. 1831 p. [3:358]
380	368	Gordon R S & Cherkes A. Unesterified fatty acid in human blood plasma. *J. Clin. Invest.* 35:206-12, 1956. [3:181]
1181	8415	*Gornall A G, Bardawill C J & David M M. Determination of serum proteins by means of the biuret reaction. *J. Biol. Chem.* 177:751-66, 1949. (13/79/LS) [‡]
487	1168	Grabar P & Williams C A. Methode permettant l'etude conjugue des proprietes electrophoretiques et immunochimiques d'un melange de proteins; application au serum sanguin (Method permitting the combined study of the electrophoretic and the immunochemical properties of protein mixtures; application to blood serum). *Biochim. Biophys. Acta* 10:193-4, 1953. [‡]
474	1654	*Grabar P, Williams C A & Courcon J. Methode immuno-electrophoretique d'analyse de melanges de substances antigeniques (Immunoelectrophoretic method for analysis of mixed antigenic substances). *Biochim. Biophys. Acta* 17:67-74, 1955. (1/80/LS) [3:181]
335	456	#Granit R. *Receptors and sensory perception*. New Haven, CT: Yale University Press, 1955. 366 p.
407	759	#Gross R E. *The surgery of infancy and childhood*. Philadelphia: Saunders, 1953. 1000 p.
344	250	#Grunert R R & Phillips P H. A modification of the nitroprusside method of analysis for glutathione. *Arch. Biochem.* 30:217-25, 1951.
302	254	Hagedorn H C & Jensen B N. Zur Mikrobestimmung des Blutzuckers mittels Ferricyanid (Microdetermination of blood sugar using ferricyanide). *Biochem. Z.* 135:46-58, 1923. [2:493]
935	1261	Hanes C S & Isherwood F A. Separation of the phosphoric esters on the filter paper chromatogram. *Nature* 164:1107-12, 1949. [‡]
582	5973	Hansen M. *Constitution of binary alloys*. New York: McGraw-Hill, 1958. 1305 p. [3:358]
339	291	#Harris G W. *Neural control of the pituitary gland*. London: Edward Arnold, 1955. 298 p.
296	261	#Hershey A D & Chase M. Independent functions of viral protein and nucleic acid in growth of bacteriophage. *J. Gen. Physiol.* 36:39-56, 1952.
354	2612	Herzberg G. *Infrared and Raman spectra of polyatomic molecules*. New York: Van Nostrand, 1945. 632 p. [2:3]
357	5988	*Herzberg G. *Molecular spectra and molecular structure. I. Spectra of diatomic molecules*. New York: Van Nostrand, 1950. 658 p. (13/83/PC&ES) [2:2]
488	1152	Hestrin S. The reaction of acetylcholine and other carboxylic acid derivatives with hydroxylamine, and its analytical application. *J. Biol. Chem.* 180:249-61, 1949. [‡]
349	1989	Higgins G M & Anderson R M. Experimental pathology of the liver. I. Restoration of the liver of the white rat following partial surgical removal. *Arch. Pathol.* 12:186-202, 1931. [‡]
325	246	#Hirs C H W, Moore S & Stein W H. A chromatographic investigation of pancreatic ribonuclease. *J. Biol. Chem.* 200:493-506, 1953.
322	4879	Hirschfelder J O, Curtis S C F & Bird R B. *Molecular theory of gases and liquids*. New York: Wiley, 1954. 1249 p. [3:359]
373	158	#Hoagland M B, Keller E B & Zamecnik P C. Enzymatic carboxyl activation of amino acids. *J. Biol. Chem.* 218:345-58, 1956.

A	B	C
363	213	**#Hoagland M B, Stephenson M L, Scott J F, Hecht L I & Zamecnik P C.** A soluble ribonucleic acid intermediate in protein synthesis. *J. Biol. Chem.* 231:241-57, 1958.
363	392	**#Hodgkin A L.** The ionic basis of electrical activity in nerve and muscle. *Biol. Rev.* 26:339-409, 1951.
316	2273	***Hodgkin A L & Huxley A F.** A quantitative description of membrane current and its application to conduction and excitation in nerve. *J. Physiol.—London* 117:500-44, 1952. (28/81/LS) [‡]
350	289	**#Hofstadter R.** Electron scattering and nuclear structure. *Rev. Mod. Phys.* 28:214-54, 1956.
347	375	**Hogeboom G H, Schneider W C & Palade G E†.** Cytochemical studies of mammalian tissues. I. Isolation of intact mitochondria from rat liver; some biochemical properties of mitochondria and submicroscopic particulate material. *J. Biol. Chem.* 172:619-36, 1948. [3:81]
338	28	**#Hollander J M, Perlman I & Seaborg G T.** Table of isotopes. *Rev. Mod. Phys.* 25:469-651, 1953.
360	635	**Horecker B L† & Kornberg A†.** The extinction coefficients of the reduced band of pyridine nucleotides. *J. Biol. Chem.* 175:385-90, 1948. [3:49]
384	417	**Hotchkiss R D.** A microchemical reaction resulting in the staining of polysaccharide structures in fixed tissue preparations. *Arch. Biochem.* 16:131-41, 1948. [3:49]
442	538	**Hough L, Jones J K N & Wadman W H.** Quantitative analysis of mixtures of sugars by the method of partition chromatography. Part V. Improved methods for the separation and detection of the sugars and their methylated derivatives on the paper chromatogram. *J. Chem. Soc.* 1950:1702-6, 1950. [3:149]
326	950	**Hull C L.** *Principles of behavior: an introduction to behavior theory.* New York: Appleton-Century, 1943. 422 p. [3:626]
643	582	***Hurlbert R B, Schmitz H, Brumm A F & Potter V R.** Nucleotide metabolism. II. Chromatographic separation of acid-soluble nucleotides. *J. Biol. Chem.* 209:23-39, 1954. (51/83/LS) [3:150]
685	2038	**Jacob F† & Monod J†.** Genetic regulatory mechanisms in the synthesis of proteins. *J. Mol. Biol.* 3:318-56, 1961. [‡]
611	1965	***Jaffe H H.** A reexamination of the Hammett equation. *Chem. Rev.* 53:191-261, 1953. (33/77) [‡]
460	491	***#James A T & Martin A J P.** Gas-liquid partition chromatography: the separation and micro-estimation of volatile fatty acids from formic acid to dodecanoic acid. *Biochem. J.* 50:679-90, 1952. (33/79/LS)
423	1402	**Job P.** Recherches sur la formation de complexes mineraux en solution et sur leur stabilite (Studies on formation and stability of mineral complexes in solution). *Ann. Chim.—Paris* 9:113-203, 1928. [2:494]
342	491	**Johnson H L & Morgan W W.** Fundamental stellar photometry for standards of spectral type on the revised system of the Yerkes spectral *Atlas. Astrophys. J.* 117:313-52, 1953. [3:359]
396	4835	**Kabat E A† & Mayer M M.** *Experimental immunochemistry.* Springfield, IL: C.C. Thomas, 1948. 905 p. [3:359]
303	850	***Kalckar H M.** Differential spectrophotometry of purine compounds by means of specific enzymes. III. Studies of the enzymes of purine metabolism. *J. Biol. Chem.* 167:461-75, 1947. (26/84/LS) [‡]
352	470	**Karmen A, Wroblewski F & Ladue J S.** Transaminase activity in human blood. *J. Clin. Invest.* 34:126-33, 1955. [3:182]
422	1750	**Karplus M†.** Contact electron-spin coupling of nuclear magnetic moments. *J. Chem. Phys.* 30:11-5, 1959. [‡]
389	757	***Kay E R M, Simmons N S & Dounce A L.** An improved preparation of sodium desoxyribonucleate. *J. Amer. Chem. Soc.* 74:1724-6, 1952. (24/80/LS) [‡]
294	346	**Keilin D & Hartree E F.** On the mechanism of the decomposition of hydrogen peroxide by catalase. *Proc. Roy. Soc. B* 124:397-405, 1938. [3:359]
517	780	**King E J.** The colorimetric determination of phosphorus. *Biochem. J.* 26:292-7, 1932. [‡]
360	554	**Kirby K S.** A new method for the isolation of ribonucleic acids from mammalian tissues. *Biochem J.* 64:405-8, 1956. [3:150]
359	2475	***Krebs H A† & Henseleit K.** Untersuchungen uber die Harnstoffbildung im Tierkorper (Studies on urea formation in the animal organism). *Hoppe-Seylers Z. Physiol. Chem.* 210:33-66, 1932. (52/80/LS) [‡]
392	117	**#Kunkel H G† & Tiselius A.** Electrophoresis of proteins on filter paper. *J. Gen. Physiol.* 35:89-118, 1951.
298	588	**Lederberg J & Lederberg E M.** Replica plating and indirect selection of bacterial mutants. *J. Bacteriol.* 63:399-406, 1952. [3:182]
314	101	**#Lee T D† & Yang C N.** Parity nonconservation and a two-component theory of the neutrino. *Phys. Rev.* 105:1671-5, 1957.
348	194	**#Lee T D† & Yang C N.** Question of parity conservation in weak interactions. *Phys. Rev.* 104:254-8, 1956.
461	270	**#Levy A L.** A paper chromatographic method for the quantitative estimation of amino-acids. *Nature* 174:126-7, 1954.
671	2821	**Lillie R.** *Histopathologic technic and practical histochemistry.* New York: Blakiston, 1954. 501 p. [2:4]
1794	6036	**Lineweaver H & Burk D.** The determination of enzyme dissociation constants. *J. Amer. Chem. Soc.* 56:658-66, 1934. [‡]
522	703	***Lipmann F† & Tuttle L C.** A specific micromethod for the determination of acyl phosphates. *J. Biol. Chem.* 159:21-8, 1945. (46/80/LS) [‡]
755	4086	***Litchfield J T & Wilcoxon F A.** A simplified method of evaluating dose-effect experiments. *J. Pharmacol. Exp. Ther.* 96:99-113, 1949. (7/77) [‡]
336	106	**#Littlefield J W, Keller E B, Gross J† & Zamecnik P C.** Studies on cytoplasmic ribonucleoprotein particles from the liver of the rat. *J. Biol. Chem.* 217:111-23, 1955.
408	932	***Lowry O H† & Lopez J A.** The determination of inorganic phosphate in the presence of labile phosphate esters. *J. Biol. Chem.* 162:421-8, 1946. (31/81/LS) [‡]
5021	97,113	***Lowry O H†, Rosebrough N J, Farr A L & Randall R J.** Protein measurement with the Folin phenol reagent. *J. Biol. Chem.* 193:265-75, 1951. (1/77) [‡]

A	B	C
655	9033	*Luft J H. Improvements in epoxy resin embedding methods. *J. Biophys. Biochem. Cytol.* 9:409-14, 1961. (20/77) [‡]
302	243	*Ma T S & Zuazaga G. Micro-Kjeldahl determination of nitrogen. *Ind. Eng. Chem.—Anal. Ed.* 14:280-2, 1942. (34/79/PC&ES) [3:59]
374	714	Malloy H T & Evelyn K A. The determination of bilirubin with the photoelectric colorimeter. *J. Biol. Chem.* 119:481-90, 1937. [2:615]
372	363	Markham R. A steam distillation apparatus suitable for micro-Kjeldahl analysis. *Biochem. J.* 36:790-1, 1942. [3:50]
348	182	Markham R & Smith J D. Chromatographic studies of nucleic acids. 1. A technique for the identification and estimation of purine and pyrimidine bases, nucleosides and related substances. *Biochem. J.* 45:294-8, 1949. [3:50]
453	440	Markham R & Smith J D. The structure of ribonucleic acids. 1. Cyclic nucleotides produced by ribonuclease and by alkaline hydrolysis. *Biochem. J.* 52:552-7, 1952. [3:150]
325	213	*McWeeny R. X-ray scattering by aggregates of bonded atoms. I. Analytical approximations in single-atom scattering. *Acta Crystallogr.* 4:513-9, 1951. (17/81/PC&ES) [2:131]
653	1213	Meßbaum W. Uber die Bestimmung kleiner Pentosemengen insbesondere in Derivaten der Adenylsaure (Determination of small quantities of pentose particularly in derivatives of adenylic acid). *Hoppe-Seylers Z. Physiol. Chem.* 258:117-20, 1939. [‡]
323	327	#Minlon H. A simple modification of the Wolff-Kishner reduction. *J. Amer. Chem. Soc.* 68:2487-8, 1946.
602	1458	Moore S, Spackman D H & Stein W H. Chromatography of amino acids on sulfonated polystyrene resins. *Anal. Chem.* 30:1185-90, 1958. [‡]
611	444	Moore S & Stein W H. Chromatography of amino acids on sulfonated polystyrene resins. *J. Biol. Chem.* 192:663-81, 1951. [‡]
652	1496	Moore S & Stein W H. A modified ninhydrin reagent for the photometric determination of amino acids and related compounds. *J. Biol. Chem.* 211:907-13, 1954. [‡]
692	1039	Moore S & Stein W H. Photometric ninhydrin method for use in the chromatography of amino acids. *J. Biol. Chem.* 176:367-88, 1948. [‡]
400	378	#Moore S & Stein W H. Procedures for the chromatographic determination of amino acids on four percent cross-linked sulfonated polystyrene resins. *J. Biol. Chem.* 211:893-906, 1954.
517	3008	*Moorhead P S, Nowell P C, Mellman W J, Battips D M & Hungerford D A. Chromosome preparations of leukocytes cultured from human peripheral blood. *Exp. Cell Res.* 20:613-6, 1960. (7/83/LS) [‡]
559	776	Morgan J F, Morton H J & Parker R C. Nutrition of animal cells in tissue culture. I. Initial studies on a synthetic medium. *Proc. Soc. Exp. Biol. Med.* 73:1-8, 1950. [‡]
478	763	*Moruzzi G & Magoun H W. Brain stem reticular formation and activation of the EEG. *Electroencephalogr. Clin. Neuro.* 1:455-73, 1949. (40/81/LS) [‡]
403	924	Mulliken R S. Molecular compounds and their spectra. II. *J. Amer. Chem. Soc.* 74:811-24, 1952. [‡]
315	1259	*Nachlas M M, Tsou K-C, De Souza E, Cheng C-S & Seligman A M. Cytochemical demonstration of succinic dehydrogenase by the use of a new p-nitrophenyl substituted ditetrazole. *J. Histochem. Cytochem.* 5:420-36, 1957. (17/79/LS) [‡]
293	260	*#Ne'eman Y. Derivation of strong interactions from a gauge invariance. *Nucl. Phys.* 26:222-9, 1961. (11/80/PC&ES)
498	142	*#Nelson D H & Samuels L T. A method for the determination of 17-hydroxycorticosteroids in blood: 17-hydroxycorticosterone in the peripheral circulation. *J. Clin. Endocrinol. Metab.* 12:519-26, 1952. (1/81/CP)
2139	3762	*Nelson N. A photometric adaptation of the Somogyi method for the determination of glucose. *J. Biol. Chem.* 153:375-80, 1944. (3/77) [3:50]
397	509	Neuman R E & Logan M A. The determination of hydroxyproline. *J. Biol. Chem.* 184:299-306, 1950. [3:151]
327	838	Nirenberg M W† & Matthaei J H. The dependence of cell-free protein synthesis in *E. coli* upon naturally occurring or synthetic polyribonucleotides. *Proc. Nat. Acad. Sci. US* 47:1588-602, 1961. [‡]
459	619	*Ogur M & Rosen G. The nucleic acids of plant tissues. I. The extraction and estimation of desoxypentose nucleic acid and pentose nucleic acid. *Arch. Biochem.* 25:262-76, 1950. (24/77) [3:151]
379	1075	Ouchterlony O. Antigen-antibody reactions in gels. IV. Types of reactions in coordinated systems of diffusion. *Acta Pathol. Microbiol. Scand.* 32:231-40, 1953. [‡]
476	187	#Palade G E†. The endoplasmic reticulum. *J. Biophys. Biochem. Cytol.* 2(4, Suppl.):85-97, 1956.
415	141	#Palade G E†. A small particulate component of the cytoplasm. *J. Biophys. Biochem. Cytol.* 1:59-67, 1955.
1159	1821	Palade G E†. A study of fixation for electron microscopy. *J. Exp. Med.* 95:285-97, 1952. [‡]
382	476	#Palade G E† & Siekevitz P†. Liver microsomes. *J. Biophys. Biochem. Cytol.* 2:171-98, 1956.
330	317	#Paladini A C & Leloir L F. Studies on uridine-diphosphate-glucose. *Biochem. J.* 51:426-30, 1952.
306	237	#Palay S L & Palade G E†. The fine structure of neurons. *J. Biophys. Biochem. Cytol.* 1:69-88, 1955.
296	1312	*Parlser R & Parr R G. A semi-empirical theory of the electronic spectra and electronic structure of complex unsaturated molecules. I. *J. Chem. Phys.* 21:466-71, 1953. (3/79/PC&ES) [‡]
341	1369	*Parlser R & Parr R G. A semi-empirical theory of the electronic spectra and electronic structure of complex unsaturated molecules. II. *J. Chem. Phys.* 21:767-76, 1953. (3/79/PC&ES) [‡]
816	795	*Partridge S M. Aniline hydrogen phthalate as a spraying reagent for chromatography of sugars. *Nature* 164:443, 1949. (14/79/AB&ES) [‡]

A	B	C
738	908	**Partridge S M.** Filter-paper partition chromatography of sugars. I. General description and application to the qualitative analysis of sugars in apple juice, egg white, and foetal blood of sheep. *Biochem. J.* 42:238-50, 1948. [‡]
919	11,233	*#**Pearse A G E†.** *Histochemistry, theoretical and applied.* London: Churchill, 1953. 530 p. (32/81/LS) [2:4]
349	757	#**Penfield W & Jasper H.** *Epilepsy and the functional anatomy of the human brain.* Boston, MA: Little, Brown, 1954. 895 p.
926	569	**Peterson E A & Sober H A.** Chromatography of proteins. I. Cellulose ion-exchange adsorbents. *J. Amer. Chem. Soc.* 78:751-5, 1956. [‡]
391	420	#**Pillemer L, Blum L, Lepow I H, Ross O A, Todd E W & Wardlaw A C.** The properdin system and immunity. I. Demonstration and isolation of a new serum protein, properdin, and its role in immune phenomena. *Science* 120:279-85, 1954.
358	400	#**Poos G I, Arth G E, Beyler R E & Sarett L H.** Approaches to the total synthesis of adrenal steroids. V. 4b-methyl-7-ethylenedioxy-1,2,3,4,4a,4b, 5,6,7,8,10,10aβ-dodecahydrophenanthrene-4β-ol-1-one and related tricyclic derivatives. *J. Amer. Chem. Soc.* 75:422-9, 1953.
410	358	#**Porter C C & Silber R H.** A quantitative color reaction for cortisone and related 17,21-dihydroxy-20-ketosteroids. *J. Biol. Chem.* 185:201-7, 1950.
321	1697	**Porter R R.** The hydrolysis of rabbit γ-globulin and antibodies with crystalline papain. *Biochem. J.* 73:119-27, 1959. [‡]
393	1144	*#**Poulik M D.** Starch gel electrophoresis in a discontinuous system of buffers. *Nature* 180:1477-9, 1957. (15/84/LS) [‡]
333	520	*#**Puck T T, Marcus P I & Cieciura S J.** Clonal growth of mammalian cells *in vitro*: growth characteristics of colonies from single HeLa cells with and without a "feeder" layer. *J. Exp. Med.* 103:273-83, 1956. (3/83/LS) [3:182]
322	459	**Racah G.** Theory of complex spectra. II. *Phys. Rev.* 62:438-62, 1942. [3:59]
291	235	#**Racker E†.** Crystalline alchohol dehydrogenase from bakers' yeast. *J. Biol. Chem.* 184:313-9, 1950.
1438	4181	**Reed L J & Muench H.** A simple method of estimating 50 percent endpoints. *Amer. J. Hyg.* 27:493-7, 1938. [‡]
312	1542	*#**Reitman S & Frankel S.** A colorimetric method for the determination of serum glutamic oxalacetic and glutamic pyruvic transaminases. *Amer. J. Clin. Pathol.* 28:56-63, 1957. (10/79/CP) [‡]
452	272	**Roe J H.** A colorimetric method for the determination of fructose in blood and urine. *J. Biol. Chem.* 107:15-22, 1934. [2:616]
387	505	**Roe J H, Epstein J H & Goldstein N P.** A photometric method for the determination of inulin in plasma and urine. *J. Biol. Chem.* 178:839-45, 1949. [3:50]
302	749	**Roe J H & Kuether C A.** The determination of ascorbic acid in whole blood and urine through the 2,4-dinitrophenylhydrazine derivative of dehydroascorbic acid. *J. Biol. Chem.* 147:399-407, 1943. [3:50]
315	1778	#**Romeis B.** *Mikroskopische Technik* (Microscopic technique). Munich: Leibniz-Verlag, 1948. 695 p.
352	1744	**Roothaan C C J.** New developments in molecular orbital theory. *Rev. Mod. Phys.* 23:69-89, 1951. [‡]
342	485	#**Rose M E.** *Internal conversion coefficients.* New York: Interscience, 1958. 173 p.
777	850	**Sanger F†.** The free amino groups of insulin. *Biochem. J.* 39:507-15, 1945. [‡]
451	664	**Schales O & Schales S S.** A simple and accurate method for the determination of chloride in biological fluids. *J. Biol. Chem.* 140:879-84, 1941. [3:50]
679	4287	**Scheidegger J J.** Une micro-methode de l'immuno-electrophorese (Immunoelectrophoresis micromethod). *Int. Arch. Allergy Appl. Immunol.* 7:103-10, 1955. [3:362]
322	735	*#**Schilling R F.** Intrinsic factor studies. II. The effect of gastric juice on the urinary excretion of radioactivity after the oral administration of radioactive vitamin B_{12}. *J. Lab. Clin. Med.* 42:860-6, 1953. (38/84/LS; 38/84/CP)
843	2100	**Schmidt G & Thannhauser S J.** A method for the determination of desoxyribonucleic acid, ribonucleic acid, and phosphoproteins in animal tissues. *J. Biol. Chem.* 161:83-9, 1945. [‡]
488	810	**Schneider W C.** Intracellular distribution of enzymes. III. The oxidation of octanoic acid by rat liver fractions. *J. Biol. Chem.* 176:259-66, 1948. [‡]
1050	1555	*#**Schneider W C.** Phosphorus compounds in animal tissues. I. Extraction and estimation of desoxypentose nucleic acid and of pentose nucleic acid. *J. Biol. Chem.* 161:293-303, 1945. (8/77) [‡]
490	1039	**Schneider W C & Hogeboom G H.** Intracellular distribution of enzymes. V. Further studies on the distribution of cytochrome *c* in rat liver homogenates. *J. Biol. Chem.* 183:123-8, 1950. [‡]
362	220	**Schoenheimer R & Sperry W M.** A micromethod for the determination of free and combined cholesterol. *J. Biol. Chem.* 106:745-60, 1934. [2:616]
363	754	*#**Scholander P F.** Analyzer for accurate estimation of respiratory gases in one-half cubic centimeter samples. *J. Biol. Chem.* 167:235-50, 1947. (49/84/LS) [3:51]
354	919	**Seifter S, Dayton S, Novic B & Muntwyler E.** The estimation of glycogen with the anthrone reagent. *Arch. Biochem.* 25:191-200, 1950. [‡]
368	203	**Seitz F.** Color centers in alkali halide crystals. II. *Rev. Mod. Phys.* 26:7-94, 1954. [3:362]
394	1223	**Seldinger S I.** Catheter replacement of the needle in percutaneous arteriography. *Acta Radiol.* 39:368-76, 1953. [‡]
387	663	**Sheehan J C & Hess G P.** Letter to editor. (A new method of forming peptide bonds.) *J. Amer. Chem. Soc.* 77:1067-8, 1955. [3:151]
355	758	**Shockley W & Read W T.** Statistics of the recombinations of holes and electrons. *Phys. Rev.* 87:835-42, 1952. [3:128]
290	346	**Sibley J A & Lehninger A L†.** Determination of aldolase in animal tissues. *J. Biol. Chem.* 177:859-72, 1949. [3:51]
552	13,572	**Siegel S.** *Nonparametric statistics for the behavioral sciences.* New York: McGraw-Hill, 1956. 312 p. [3:630]

A	B	C
291	429	**#Siekevitz Pt.** Uptake of radioactive alanine in vitro into the proteins of rat liver fractions. *J. Biol. Chem.* 195:549-65, 1952.
510	672	**Silber R H & Porter C C.** The determination of 17,21-dihydroxy-20-ketosteroids in urine and plasma. *J. Biol. Chem.* 210:923-32, 1954. [3:183]
418	705	**Singer K, Chernoff A I & Singer L.** Studies on abnormal hemoglobins. I. Their demonstration in sickle cell anemia and other hematologic disorders by means of alkali denaturation. *Blood* 6:413-28, 1951. [3:184]
338	263	**Singer R B & Hastings A B.** An improved clinical method for the estimation of disturbances of the acid-base balance of human blood. *Medicine* 27:223-42, 1948. [3:83]
336	1029	**Slater J C.** Atomic shielding constants. *Phys. Rev.* 36:57-64, 1930. [‡]
380	1005	**#Smith H W.** *The kidney: structure and function in health and disease.* New York: Oxford University Press, 1951. 1049 p.
387	1068	**Smith H W, Finkelstein N, Aliminosa L, Crawford B & Graber M.** The renal clearances of substituted hippuric acid derivatives and other aromatic acids in dog and man. *J. Clin. Invest.* 24:388-404, 1945. [‡]
477	1135	**Smithies O.** An improved procedure for starch-gel electrophoresis: further variations in the serum proteins of normal individuals. *Biochem. J.* 71:585-7, 1959. [‡]
990	1875	**Smithies O.** Zone electrophoresis in starch gels: group variations in the serum proteins of normal human adults. *Biochem. J.* 61:629-41, 1955. [‡]
2653	13,613	***Snedecor G W.** *Statistical methods applied to experiments in agriculture and biology.* Ames, IA: Collegiate Press, 1946. 485 p. (19/77) [3:630]
402	388	**#Sober H A, Gutter F J, Wyckoff M M & Peterson E A.** Chromatography of proteins. II. Fractionation of serum protein on anion-exchange cellulose. *J. Amer. Chem. Soc.* 78:756-63, 1956.
632	1086	**Somogyi M.** Determination of blood sugar. *J. Biol. Chem.* 160:69-73, 1945. [‡]
656	940	**Somogyi M.** A new reagent for the determination of sugars. *J. Biol. Chem.* 160:61-8, 1945. [‡]
667	2080	**Somogyi M.** Notes on sugar determination. *J. Biol. Chem.* 195:19-23, 1952. [‡]
957	8232	**Spackman D H, Stein W H & Moore S.** Automatic recording apparatus for use in the chromatography of amino acids. *Anal. Chem.* 30:1190-206, 1958. [‡]
784	1311	***Sperry W M & Webb M.** A revision of the Schoenheimer-Sperry method for cholesterol determination. *J. Biol. Chem.* 187:97-106, 1950. (22/83/LS) [‡]
414	1665	**Spitzer L.** *Physics of fully ionized gases.* New York: Interscience, 1956. 105 p. [3:362]
591	241	**#Strominger D, Hollander J M & Seaborg G T.** Table of isotopes. *Rev. Mod. Phys.* 30:585-904, 1958.
343	1343	**Svedberg T & Pedersen K O.** *The ultracentrifuge.* Oxford: Clarendon Press, 1940. 478 p. [2:4]
344	787	**Tiselius A, Hjerten S & Levin O.** Protein chromatography on calcium phosphate columns. *Arch. Biochem. Biophys.* 65:132-55, 1956. [‡]
744	2948	***Trevelyan W E, Procter D P & Harrison J S.** Detection of sugars on paper chromatograms. *Nature* 166:444-5, 1950. (6/77) [‡]
300	276	**#Udenfriend St, Titus E & Weissbach Ht.** The identification of 5-hydroxy-3-indoleacetic acid in normal urine and a method for its assay. *J. Biol. Chem.* 216:499-505, 1955.
420	4797	**Umbreit W W, Burris R H & Stauffer J F.** *Manometric techniques.* Minneapolis, MN: Burgess, 1945. 338 p. [3:363]
376	97	**#Van Dyke Tiers G.** Proton nuclear resonance spectroscopy. I. Reliable shielding values by "internal referencing" with tetramethylsilane. *J. Phys. Chem.* 62:1151-2, 1958.
318	1665	***Van Handel E & Zilversmit D B.** Micromethod for the direct determination of serum triglycerides. *J. Lab. Clin. Med.* 50:152-7, 1957. (16/77) [‡]
332	208	**Van Slyke D D & Folch J.** Manometric carbon determination. *J. Biol. Chem.* 136:509-41, 1940. [3:51]
943	980	**Van Slyke D D & Neill J M.** The determination of gases in blood and other solutions by vacuum extraction and manometric measurement. I. *J. Biol. Chem.* 61:523-73, 1924. [‡]
438	1167	***Van Vleck J H.** The dipolar broadening of magnetic resonance lines in crystals. *Phys. Rev.* 74:1168-83, 1948. (31/79/PC&ES) [‡]
329	663	***Vogt M.** The concentration of sympathin in different parts of the central nervous system under normal conditions and after the administration of drugs. *J. Physiol.* 123:451-81, 1954. (16/84/LS) [3:184]
714	2068	**Warburg O & Christian W.** Isolierung und Kristallisation des Garungsferments Enolase (Isolation and crystallization of the enzyme enolase). *Biochem. Z.* 310:384-421, 1942. [‡]
372	4649	***Warren L.** The thiobarbituric acid assay of sialic acids. *J. Biol. Chem.* 234:1971-5, 1959. (36/77) [‡]
477	612	**Watson J D & Crick F H C.** Molecular structure of nucleic acids: a structure for deoxyribose nucleic acid. *Nature* 171:737-8, 1953. [3:152]
401	3061	**Watson M L.** Staining of tissue sections for electron microscopy with heavy metals. *J. Biophys. Biochem. Cytol.* 4:475-9, 1958. [‡]
325	271	**#Watson M L.** Staining of tissue sections for electron microscopy with heavy metals. II. Application of solutions containing lead and barium. *J. Biophys. Biochem. Cytol.* 4:727-9, 1958.
318	204	**#Whistler R L & Durso D F.** Chromatographic separation of sugars on charcoal. *J. Amer. Chem. Soc.* 72:677-9, 1950.
312	421	**#Wilzbach K E.** Letter to editor. (Tritium-labeling by exposure of organic compounds to tritium gas.) *J. Amer. Chem. Soc.* 79:1013, 1957.
619	591	***Wyatt G R.** The purine and pyrimidine composition of deoxypentose nucleic acids. *Biochem. J.* 48:584-90, 1951. (42/81/LS) [3:152]
442	232	**#Youngner J S.** Monolayer tissue cultures. I. Preparation and standardization of suspensions of trypsin-dispersed monkey kidney cells. *Proc. Soc. Exp. Biol. Med.* 85:202-5, 1954.
355	1160	***Zlatkis A, Zak B & Boyle A J.** A new method for the direct determination of serum cholesterol. *J. Lab. Clin. Med.* 41:486-92, 1953. (12/81/LS) [‡]