Current Comments®

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The 170 Surviving Journals That *CC* Would Have Covered 100 Years Ago

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I have often wondered what *Current Contents*® (*CC*®) would have been like if it had been available 100 years ago. *CC/Life Sciences* (*CC/LS*) was first published in 1958. Over the years we have expanded *CC* into seven categorical editions, each of which contains the contents pages of approximately 1,000 journals. In total we cover about 7,000 journals in the arts and sciences. However, only about 10 percent of the journals covered in the science-related issues of *CC* were in existence 100 years ago.

We have identified a list of 170 journals established circa 1887 that are currently included in the science-related *CC* editions (Table 1). Many of these journals have changed titles over the last 100 years. The *American Journal of Insanity*, established in the nineteenth century, is known today as the *American Journal of Psychiatry*. Some journals have branched into multiple editions. The *Proceedings of the Physical Society of London*, established in 1874, is now called the *Journal of Physics* and is published by the Institute of Physics in Bristol. It currently has seven editions reflecting the many specialized fields in the broad science of physics. The much larger *Physical Review*, published by the American Physical Society, did not start until 1893.

The journals listed in Table 1 come from 19 countries and attest to the strength of science 100 years ago. According to Daniel J. Kevles, professor of history, California Institute of Technology, Pasadena, and colleagues, chemistry was the largest research area.[1] Table 1 includes about 20 chemistry journals from eight different countries. In the US alone, Kevles and his coauthors estimate that around 1880 there were about 2,000 chemists-exploring atomic weights, chemical analysis, and the identification of the elements. The US mathematicians were primarily focusing on the computations necessary to further the more prominent science of astronomy. And the field of biology was generally concerned with natural history, particularly as it concerned Darwin's theory of evolution.[1]

The second half of the nineteenth century was a particularly dynamic time for the science journal. Michael Wolff, University of Massachusetts, Amherst; John S. North, University of Waterloo, Canada; and Dorothy Deering, Purdue University, West Lafayette, Indiana, note that this period was marked by improved education, increased literacy, and technological breakthroughs, such as the invention of high-speed printing. Moreover, in the UK the dissemination of scientific information was made easier in the 1880s by the reduction of stamp and paper duties, advertisement taxes, and postal charges.[2] (p. x)

As a result science journals flourished during this period. This growth is illustrated in a graph (Figure 1) developed by Derek J. de Solla Price (1922-1983), then a science historian at Yale University. The graph, which depicts the number of scientific journals founded as a function of date, shows that about 100 journals were established at the beginning of the nineteenth century, increasing to 1,000 by the middle of the century, and presumably reaching 10,000 by 1900. Price estimated that the number of "journals" doubled every 15 years, a growth rate that has been relatively constant until recently.[3] (p. 169) Derek never actually did a precise census. Most of the

published figures available included deceased titles that, like living journals, also occupy space in libraries.

Nor did he try to take into account the size and character of the publications involved. Most estimates include thousands of trade and other types of domestic and foreign serial titles that are often lumped under the heading of "scientific." Even today, were we to add 3,000 journals to the 7,000 we now cover in *CC*, we would be adding primarily small, low-impact journals. In short, while the information flood is a reality, there is a tendency to overdramatize the numbers involved.

While the nineteenth century was a time of journal proliferation, many journals folded after a short period of time for a variety of reasons. This remains true today. A.J. Meadows, Department of Astronomy and History of Science, University of Leicester, UK, notes that, with so many journals available, the potential number of subscribers to a single journal was often too small. In addition, library budgets were often insufficient to cover subscriptions to any but the most major journals.[4] (p. 81) W.H. Brock, Victorian Studies Centre, University of Leicester, states that the journals were "at the mercy of the financial solvency, as well as the personal whims, of proprietors and publishing houses, the changing tastes of their readers and advertisers, as well as the general economic climate."[5] The problem still exists today, as described in a recent *Science* article.[6]

A selected list of the most important journals in natural history founded between 1810 and 1900 was compiled by Ralph W. Dexter, American Nature Study Society, Kent State University, Ohio. One hundred forty journals are included in the list, covering the fields of botany, entomology, conchology, and microscopy, but only seven of these journals are still in existence today, including the *Proceedings of the California Academy of Sciences*, *Transactions of the Academy of Science of St. Louis*, and *American Naturalist*.[7]

Abstract and Specialized Journals

By 1830 there were about 300 science journals published worldwide. At this time it became apparent that scientists could not keep up with all the published work relevant to their interests. As Thomas H. Huxley noted in his 1886 presidential address before the Royal Society of London, "Of late years it has struck me that those who have toiled for the advancement of science are in a fair way of being overwhelmed by the realization of their wishes. It has become impossible for any man to keep pace with the progress of the whole of any important branch of science."[8]

The increased volume of scientific information determined the types of journals that developed as well as their formats. For instance, the abstract journal was created to help scientists keep up with research. Figure 1 shows that abstract journals have multiplied by a factor of 10 in every half-century, resulting in about 1 new abstract journal for every 300 new scientific journals.[3] (p. 167)

The accumulation of scientific knowledge also gave rise to the extension and growth of the specialized journal. Robert M. Gascoigne, School of History and Philosophy of Science, University of New South Wales, Sydney, Australia, found that in 1830 over 50 percent of the scientific periodicals dealt with general science but by 1880 this number had decreased to about 36 percent.[9] Meadows states that the growing volume of information resulted in the sciences themselves becoming more clearly differentiated.

General science periodicals became less effective, while new, specialized journals became necessary.[4] (p. 72-3) For example, Bernard Houghton, Department of Library and Information Studies, Liverpool Polytechnic, UK, notes that in the early 1800s the *Journal of the Franklin Institute* played an important role as a digest of scientific progress by including descriptions of newly granted American patents.[10] However, in 1872 when the *Official Gazette* of the US Patent Office was started, this role became less important.

Commercial Journals

The earliest scientific journals, dating back to the seventeenth century, were stimulated by the growth and activity of the public record of the learned societies. However, in the nineteenth century, scientific journals

Table 1: List of journals included in science-related *Current Contents®* editions that were also in existence 100 years ago. A=title. Titles given in parentheses indicate the first title of journal. B=first year of publication. C=country of origin. D=1985 unadjusted impact factor. For a discussion of impact-factor adjustment, see **Garfield E.** Why are the impacts of the leading medical journals so similar and yet so different? Item-by-item audits reveal a diversity of editorial material. *Current Contents* (2):3-9, 12 January 1987.

A	B	C	D
Acta Chirurgica Scandinavica (Nordiskt Medicinskt Arkiv)	1869	Sweden	0.8
Acta Mathematica	1882	Sweden	—
Acta Medica Scandinavica (Nordiskt Medicinskt Arkiv)	1869	Sweden	0.9
Allgemeine Forst und Jagdzeitung	1825	Germany	0.8
American Bee Journal	1861	US	0.2
American Journal of Mathematics	1878	US	0.6
American Journal of Obstetrics and Gynecology (American Journal of Obstetrics and Diseases of Women and Children)	1868	US	1.8
American Journal of Ophthalmology	1884	US	0.6
American Journal of Psychiatry (American Journal of Insanity)	1844	US	3.5
American Journal of Science	1818	US	2.8
American Journal of the Medical Sciences (Philadelphia Journal of the Medical and Physical Sciences)	1820	US	0.6
American Naturalist	1867	US	3.1
Analyst	1877	UK	1.4
Anatomischer Anzeiger	1886	Germany	0.4
Angewandte Chemie	1888	Germany	5.4
Annalen der Physik	1799	Germany	0.3
Annales de Chimie—Science des Materiaux (Annales de Chimie et de Physique)	1789	France	0.2
Annales de la Societe Entomologique de France	1832	France	0.1
Annales de la Societe Royale Zoologique de Belgique	1863	Belgium	—
Annales de Medecine Veterinaire	1852	France	0.5
Annales de Physique (Annales de Chimie et de Physique)	1789	France	0.5
Annales des Sciences Naturelles—Botanique et Biologie Vegetale (Annales des Sciences Naturelles)	1824	France	0.6
Annales des Sciences Naturelles—Zoologie et Biologie Animale (Annales des Sciences Naturelles)	1824	France	0.3
Annales Medico-Psychologiques	1843	France	0.1
Annals of Botany	1887	UK	1.0
Annals of Mathematics (Analyst)	1874	US	1.4
Annals of Surgery	1885	US	3.6
Annals of the New York Academy of Sciences	1877	US	0.8
Archives Internationales de Physiologie et de Biochimie (Travaux du Laboratoire de Leon Fredericq, Institut de Physiologie de l'Universite de Liege)	1885	Belgium	1.0
Archives of Dermatology (Journal of Cutaneous and Genito-urinary Diseases)	1882	US	1.9
Archives of Ophthalmology	1869	US	1.7
Astronomical Journal	1849	US	2.1
Astronomische Nachrichten	1821	Germany	0.4
Astrophysical Journal (Sidereal Messenger)	1882	US	3.5
Auk (Bulletin of the Nuttall Ornithological Club)	1876	US	1.2
Berichte der Deutschen Botanischen Gesellschaft	1883	Germany	0.5
Berliner und Munchener Tierarztliche Wochenschrift (Rundschau auf dem Gebiete der Thiermedicin und Vergleichenden Pathologie)	1885	Germany	0.4
Bijdragen tot de Dierkunde	1848	Netherlands	0.3
Biological Chemistry Hoppe-Seyler (Zeitschrift fur Physiologische Chemie)	1877	Germany	—
Biologisches Zentralblatt	1881	Germany	0.8
Botanical Gazette	1875	US	0.8
Botanical Magazine—Tokyo	1887	Japan	0.5
Brain	1878	UK	4.0
British Dental Journal	1872	UK	0.9
British Journal of Dermatology	1888	UK	2.3
British Medical Journal	1857	UK	3.0
British Veterinary Journal (Veterinary Journal and Annals of Comparative Pathology)	1875	UK	0.7
Bulletin de l'Academie Nationale de Medecine	1836	France	0.1

A	B	C	D
Bulletin de la Societe Botanique de France—Actualites Botaniques (Bulletin de la Societe Botanique de France)	1854	France	0.1
Bulletin de la Societe Botanique de France—Lettres Botaniques (Bulletin de la Societe Botanique de France)	1854	France	—
Bulletin de la Societe Chimique de France (Bulletin de la Societe Chimique de Paris)	1858	France	0.6
Bulletin de la Societe Geologique de France	1830	France	0.6
Bulletin de la Societe Mathematique de France	1872	France	0.3
Bulletin de la Societe Royale de Botanique de Belgique	1862	Belgium	0.2
Bulletin de la Societe Zoologique de France	1876	France	0.3
Bulletin des Sciences Mathematiques (Bulletin des Sciences Mathematiques et Astronomiques)	1870	France	0.2
Bulletin des Societes Chimiques Belges (Bulletin de la Societe Chimique de Belge)	1887	Belgium	0.6
Bulletin of the American Museum of Natural History	1881	US	0.7
Bulletin of the New York Academy of Medicine	1860	US	8.2
Bulletin of the Torrey Botanical Club	1870	US	0.4
Canadian Entomologist	1868	Canada	0.6
Canadian Field Naturalist (Transactions of the Ottawa Field Naturalists' Club)	1879	Canada	0.2
Canadian Mining Journal (Canadian Mining Review)	1882	Canada	0.2
Chemiker-Zeitung (Allgemeine Chemiker-Zeitung)	1877	Germany	0.7
Chemische Berichte (Berichte der Deutschen Chemischen Gesellschaft)	1868	Germany	1.9
Chemistry & Industry (Journal of the Society of Chemical Industry)	1882	UK	0.5
Chinese Medical Journal	1887	China	0.1
Comptes Rendus de l'Academie des Sciences. Series I, II & III (Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences)	1835	France	0.3-I 0.3-II 0.3-III
Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales	1849	France	0.3
Deutsche Entomologische Zeitschrift	1881	Germany	0.1
Deutsche Medizinische Wochenschrift	1875	Germany	1.3
E&MJ—Engineering and Mining Journal (American Journal of Mining)	1866	US	0.3
Engineering	1866	UK	0.1
Eye—Transactions of the Ophthalmological Societies of the United Kingdom (Transactions of the Ophthalmological Societies of the United Kingdom)	1880	UK	0.7
Flora	1818	Germany	0.6
Forstwissenschaftliches Centralblatt (Monatschrift fur das Forst- und Jagdwesen)	1857	Germany	0.9
Fresenius Zeitschrift fur Analytische Chemie (Zeitschrift fur Analytische Chemie)	1862	Germany	1.1
Gazzetta Chimica Italiana	1871	Italy	0.5
Geological Magazine (Geologist)	1858	UK	1.1
Ibis	1859	UK	0.7
IEE Proceedings—A & B (Society of Telegraph Engineers Journal)	1872	UK	0.3-A 0.6-B
Irish Journal of Medical Science (Dublin Journal of Medical Science)	1832	Ireland	0.2
JAMA—Journal of the American Medical Association	1883	US	4.2
Journal American Water Works Association (Proceedings of the American Water Works Association)	1881	US	0.9
Journal de Mathematiques Pures et Appliquees (Annales de Mathematiques Pures et Appliquees)	1810	France	0.8
Journal de Pharmacie de Belgique (Journal de Pharmacie)	1845	Belgium	—
Journal de Physiologie (Archives de Physiologie Normale et Pathologique)	1868	France	0.9
Journal de Physique (Journal de Physique Theorique et Appliquee)	1872	France	1.2
Journal fur die Reine und Angewandte Mathematik	1826	Germany	0.6
Journal fur Ornithologie	1853	Germany	0.4
Journal fur Praktische Chemie	1834	Germany	0.6
Journal of Anatomy (Journal of Anatomy and Physiology)	1866	UK	1.2
Journal of Bone and Joint Surgery—American Volume (Transactions of the American Orthopedic Association)	1887	US	1.7

A	B	C	D
Journal of Cell Science (Quarterly Journal of Microscopical Science)	1852	UK	2.0
Journal of Conchology (Quarterly Journal of Conchology)	1874	UK	0.3
Journal of Laryngology and Otology	1887	UK	0.4
Journal of Morphology	1887	US	0.9
Journal of Nervous and Mental Disease (Chicago Journal of Nervous and Mental Disease)	1874	US	1.2
Journal of Pharmacy and Pharmacology (Year-Book of Pharmacy)	1870	UK	1.4
Journal of Physics A, B, C, D, E, F & G (Proceedings of the Physical Society of London)	1874	UK	2.6-A 2.6-B 2.7-C 1.1-D 0.7-E 2.1-F 1.5-G
Journal of Physiology—London	1878	UK	3.6
Journal of the American Chemical Society	1879	US	4.3
Journal of the American Veterinary Medical Association (American Veterinary Review)	1877	US	0.9
Journal of the Chemical Society (Memoirs and Proceedings of the Chemical Society of London)			
—Chemical Communications	1878	UK	2.4
—Dalton Transactions	1878	UK	2.0
—Faraday Transactions I & II	1878	UK	1.6-I 1.9-II
—Perkin Transactions 1 & II	1878	UK	1.3-1 1.4-II
Journal of the Franklin Institute (American Mechanics' Magazine)	1825	US	0.6
Journal of the Marine Biological Association of the United Kingdom	1887	UK	1.2
Journal of the Mathematical Society of Japan (Proceedings of the Tokyo Mathematico-Physical Society)	1884	Japan	0.3
Journal of the Physical Society of Japan (Proceedings of the Tokyo Mathematico-Physical Society)	1884	Japan	1.6
Journal of the Royal Statistical Society Series A—General (Journal of the Royal Statistical Society)	1838	UK	1.2
Journal of the Society of Dyers and Colourists	1884	UK	0.4
Klinische Monatsblatter fur Augenheilkunde	1863	Germany	0.3
Klinische Wochenschrift (Berliner Klinische Wochenschrift)	1864	Germany	1.3
Lancet	1823	UK	12.2
Liebigs Annalen der Chemie (Justus Leibig's Annalen der Chemie)	1832	Germany	1.3
Listy Cukrovarnicke	1882	Czech.	0.1
Mathematische Annalen	1869	Germany	0.6
Medical Journal of Australia (Australian Medical Journal)	1856	Australia	1.3
Metallurgical Transactions A & B (Transactions of the American Institute of Mining)	1871	US	1.3-A 1.1-B
Meteorological Magazine (Symon's Meteorological Magazine)	1866	UK	—
Mineralogy and Petrology (Mineralogische Mittheilungen)	1871	Austria	0.5
Monatshefte fur Chemie (Monatschefte fur Chemie und Verwandte Teile Anderer Wissenschaften)	1880	Austria	0.66
Monthly Notices of the Royal Astronomical Society	1827	UK	2.2
Nature	1869	UK	12.9
Naturwissenschaften (Naturwissenschaftliche Rundschau)	1886	Germany	0.8
Naunyn-Schmiedebergs Archives of Pharmacology (Archiv fur Experimentelle Pathologie und Pharmakologie)	1873	Germany	3.8
Nautilus (Conchologists' Exchange)	1886	US	0.1
Neues Jahrbuch fur Mineralogie—Abhandlungen (Neues Jahrbuch fur Mineralogie, Geologie und Palaeontologie—Abhandlungen)	1881	Germany	0.4
New England Journal of Medicine (Boston Medical and Surgical Journal)	1828	US	19.2
New York State Journal of Medicine (Transactions, New York State Medical Association)	1884	US	0.4
New Zealand Medical Journal	1887	New Zealand	0.7
Nuovo Cimento della Societa Italiana di Fisica A, B, C & D (Nuovo Cimento)	1855	Italy	0.7-A 0.9-B 0.5-C 0.5-D
Observatory	1877	UK	1.0
Pflugers Archiv—European Journal of Physiology (Archiv fur die Gesamte Physiologie des Menschen und der Tiere)	1868	Germany	3.0

A	B	C	D
Pharmaceutisch Weekblad—Scientific Edition (Pharmaceutisch Weekblad voor Nederland)	1864	Netherlands	0.8
Philosophical Magazine A & B (London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science)	1798	UK	1.7-A 2.9-B
Philosophical Transactions of the Royal Society of London. Series A & B (Philosophical Transactions of the Royal Society of London)	1665	UK	1.3-A 2.7-B
Plant Systematics and Evolution (Vesterreichische Botanische Zeitschrift)	1851	Austria	0.6
Practitioner	1868	UK	0.3
Proceedings of the Academy of Natural Sciences of Philadelphia	1841	US	0.2
Proceedings of the Biological Society of Washington	1880	US	—
Proceedings of the Edinburgh Mathematical Society	1883	UK	0.2
Proceedings of the Entomological Society of Washington	1884	US	0.2
Proceedings of the Institution of Civil Engineers Parts I & II (Minutes of Proceedings)	1837	UK	0.1-I 0.2-II
Proceedings of the London Mathematical Society	1865	UK	0.7
Proceedings of the National Academy of Sciences of the United States of America (Proceedings of the National Academy of Sciences)	1863	US	9.4
Proceedings of the Royal Irish Academy. Sections A & B (Proceedings of the Royal Irish Academy)	1836	Ireland	0.2-A 0.3-B
Proceedings of the Royal Society of Edinburgh. Sections A & B (Proceedings of the Royal Society of Edinburgh)	1832	UK	0.3-A 0.2-B
Proceedings of the Royal Society of London. Series A & B (Proceedings of the Royal Society of London)	1800	UK	1.4-A 2.8-B
Public Health Reports	1878	US	0.7
Quarterly Journal of the Royal Meteorological Society (Proceedings of the British Meteorological Society)	1861	UK	1.7
Recueil de Medecine Veterinaire	1824	France	0.2
Recueil des Travaux Chimiques des Pays-Bas—Journal of the Royal Netherlands Chemical Society (Recueil des Travaux Chimiques des Pays-Bas et de la Belgique)	1882	Netherlands	1.4
Revista Medica de Chile	1872	Chile	0.3
Revue de Medecine Veterinaire (Journal des Veterinaire du Midi)	1838	France	0.3
Revue Suisse de Zoologie (Recueil Zoologique Suisse)	1883	Switzerland	0.3
Schweizer Archiv fur Tierheilkunde	1859	Switzerland	0.3
Schweizerische Medizinische Wochenschrift (Korrespondenzblatt fur Schweizer Aerzte)	1870	Switzerland	0.6
Science	1880	US	10.9
Scientific American	1845	US	3.0
Stahl und Eisen	1881	Germany	0.4
Tijdschrift voor Diergeneeskunde (Tijdschrift voor Veeartsenijkunde)	1863	Netherlands	0.3
Transactions of the American Fisheries Society (Proceedings of the American Fish Culturists' Association)	1872	US	1.0
Transactions of the American Microscopical Society (Proceedings of the American Microscopical Society)	1878	US	0.4
Transactions of the Royal Society of South Africa (Transactions of the South African Philosophical Society)	1877	South Africa	0.4
Union Medicale du Canada	1872	Canada	0.5
Virchows Archiv A & B (Archiv fur Pathologische Anatomie und Physiologie und Klinische Medizin)	1847	Germany	1.7-A 1.6-B
Wiener Medizinische Wochenschrift	1851	Austria	0.1
Yakugaku Zasshi—Journal of the Pharmaceutical Society of Japan	1881	Japan	0.5
Zeitschrift fur Klinische Medizin—ZKM	1879	Germany	—
Zeitschrift fur Physikalische Chemie—Leipzig (Zeitschrift fur Physikalische Chemie, Stoechiometrie und Verwandtschaftslehre)	1887	Germany	0.4
Zentralblatt fur Chirurgie	1874	Germany	0.2
Zentralblatt fur Gynakologie	1877	Germany	0.1
Zoologischer Anzeiger	1878	Germany	0.3

unrelated to societies began to come into existence as commercial publications. *Nature*,[11] established in 1869, and *Science*, established independently of the American Association for the Advancement of Science (AAAS) in 1880, come readily to mind. We have discussed the history of *Science* and how it became the official publication of AAAS in an earlier essay.[12]

Brock notes that privately published commercial journals fall into three categories: those launched as financial speculations to

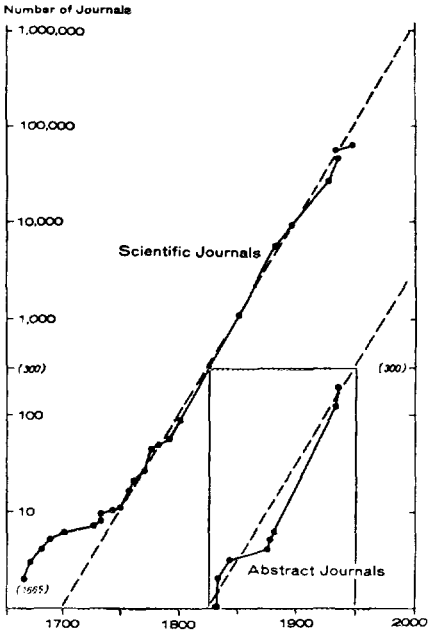
be abandoned at the first sign of questionable profitability; those launched as altruistic enterprises, supported by contributions; and those launched "with a genuine desire to further science and to give proprietor, editor, and, possibly, contributors a fair financial return for their time and effort."[5] However, this is a somewhat simplistic division since many private publishers have worked cooperatively with professional societies in a variety of relationships and joint ventures. In addition, the term commercial is ambiguous since those engaged in "commerce" may or may not be private. Some of the most successful and aggressive publishers are not-for-profit organizations.

The Waterloo Directory of Victorian Periodicals is a partial list of about 29,000 periodicals published in the UK between 1824 and 1900.[2] Of these, about 530 deal with science. According to Brock, approximately 64 percent of the science periodicals listed were commercial publications.[5] In the list we compiled for Table 1, approximately 45 percent of the journals are published by private, for-profit publishers.

Private journals were established for a variety of reasons. For instance, society-related journals often had time delays between the reading of a scientific paper at a society meeting and the subsequent publication of the paper in the society's journal. Often smaller societies needed to accumulate sufficient material before publishing their proceedings. However, private journals could publish more often, therefore reducing the time delays.

Many private journals also provided information from foreign journals to serve readers without access to large libraries. For example, the *Philosophical Magazine*, established in 1798 as a physics journal and published since 1825 by Taylor & Francis, Ltd.,[13] provided translated accounts of work appearing in foreign journals that might not be easily available to British scientists.[5] In addition, private journals often published original research or theoretical speculations that were considered unorthodox by most societies. Brock notes that this practice "kept the scientific societies on their toes, broke their monopolies, and made them less authoritarian and cliquish than they might have been."[5]

Figure 1: The number of journals founded (*not* surviving) as a function of date.



Journal Transition

Journals in the 1880s were in the process of undergoing a transformation to a format that resembles the modern journal. However, a few differences still remained between these journals and their contemporary counterparts. For instance, the content of early journals was not limited to new research. Large libraries were few and far between and often did not subscribe to all the important scientific journals. So contributors published their results in more than one journal to ensure that their findings received reasonable exposure.[4] (p. 68)

For example, in 1884 *JAMA* published the translation of Louis Pasteur's important paper on the rabies virus,[14] which was originally published in the *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*.[15] Pasteur developed a treatment for a person bitten by a rabid animal by inoculating the individual on successive days with a rabies virus of different degrees of strength. He began with a weaker form of the virus, increasing to a more potent form. Prior to Pasteur's efforts, very little was

known about this ancient and feared disease. In fact, although Pasteur himself was working under the assumption that the infectious agent of rabies was a virus, it was not until years after his work that the agent was identified as a virus.

The growth of nineteenth-century science led to an increasingly formalized concept of how scientific papers should be written. Meadows notes that early in the century papers used longer and more descriptive titles instead of abstracts. In addition, the method of citation was often incomplete. Generally the volume number or the year was given, but rarely both. Authors were usually mentioned without including affiliations, and often work was cited only by mentioning the person responsible without further bibliographic reference. It was also common to find many papers that did not contain references to other literature at all.[4] (p. 83)

Meadows found, however, that the number of papers without explicit references generally decreased during the latter part of the nineteenth century. For example, the number of papers published in the *Philosophical Transactions* without formal references dropped from about 15 percent around 1850 to about 5 percent by 1880. Meadows suggests that scientists began to realize the importance of integrating the findings from different laboratories into their own studies.[4] (p. 83)

The latter half of the 1800s was also marked by a gradual standardization of citations imposed by the sheer growth in scientific literature. An angry reader of *Nature* from 1894 described the difficulties encountered by incomplete references:

> Suppose an author refers to a paper by Smith published in *Nature*, volume xi. I have not...the slightest idea when *Nature* was first issued...I am therefore totally in the dark as to whether Smith's work is one year old or twenty years old, and consequently I am ignorant whether he is likely to have used the most modern appliances in his research....[16]

To this day there are journals that do not consider it important enough to include the year of cited references, although they are rare.

Illustrations began to play an increasingly important role in scientific articles from the second half of the nineteenth century. May F. Katzen, of the now defunct Primary Communications Research Centre, University of Leicester, notes that in the *Philosophical Transactions* from 1875 onward illustrations provide significant information for certain papers. In fact the flow of the argument is organized around the illustrations and would be confusing without them. Today illustrations and photographs play an integral role in the reporting of research results by depicting observational details far more accurately and concisely than written descriptions.[17]

Hot Topics from the Late 1800s

Part of the key to the longevity of some of the journals included in Table 1 is the ability of their editors to recognize and publish research of high caliber. For example, in 1882 the journal *Berliner Klinische Wochenschrift*, which is now known as *Klinische Wochenschrift*, published Robert Koch's paper announcing the isolation and growth of the tubercle bacillus.[18] Koch went on to win the 1905 Nobel Prize for his work on tuberculosis. We have mentioned Koch's research in our chlorination[19] and cholera[20] essays.

Another landmark paper was published in December 1887 in the *Philosophical Magazine*. The paper by Albert A. Michelson, then of Case Institute of Technology, and Edward W. Morley, then of Western Reserve University, "On the relative motion of the earth and the luminiferous aether," attempted to detect the velocity of the earth with respect to the hypothetical luminiferous ether, a medium in space thought to carry light waves.[21] The results reported seriously discredited the popular ether theories commonly used in trying to define the speed of light. Ultimately, the Michelson-Morley experiment led to Einstein's proposal in 1905 that the speed of light is a universal constant.[22]

In 1967 Case Institute of Technology and Western Reserve University, Cleveland, Ohio, federated to form Case Western Reserve University, Cleveland. This year, this institution is honoring the centennial anniversary of the Michelson-Morley experiment in a celebration entitled "Light-Space-Time: Michelson-Morley Centennial Celebration 1987."[23]

The *Comptes Rendus des Séances de l'Académie des Sciences* published an 1898 article by Pierre and Marie Curie announcing the presence of a new element endowed with powerful radioactivity. This was the first stage of the discovery of radium, for which Marie Curie won the 1911 Nobel Prize in chemistry.[24]

Electronic Publishing

We are now in the age of electronic publishing. I am frequently asked how this will affect the growth and quality of journals. While electronic publishing has had a significant effect on the technology of journal production, there is not yet a discernible difference in the journal's basic structure. Undoubtedly manuscripts can be prepared and revised more readily by those who use word processors. And probably in some cases the time lag in publication has been reduced. However, in many parts of the world conventional typesetting is still used because labor costs are not yet significant in relation to the costs of new technology.

In some areas of science and technology, new methods of informal telecommunication may be accelerating the advance of research. The personal interactions at meetings or in computer networks undoubtedly speed up the transmission of ideas. Occasionally, as in the recent example of the March meeting of the American Physical Society on superconductivity, the need "to be there" generates a video journal of the actual proceedings.[25] But it seems to me this has not significantly changed the process of journal publication of archival information, nor will it unless we begin to refer to these electronic forms as we would the printed journal.

Those seeking the ultimate recognition of their peers will continue to publish in journals so that their results can be examined in the quiet and privacy of the home or office.

Conclusion

It is fashionable for publications to claim they are 100 years old. Somehow this claim enhances their stature. For example, Table 1 lists *Scientific American* as being established in 1845. When two former *Life* magazine editors, Gerard Piel and Dennis Flanagan, planned in 1948 to start a new magazine to serve the needs of both scientists and educated laypeople, they ended up buying the then 103-year-old *Scientific American* to use its logo for their new enterprise. In a recent paper about popular science journals, Bruce V. Lewenstein, Department of History and Sociology of Science, University of Pennsylvania, Philadelphia, points out that "the magazine that today we call *Scientific American* is less than 40 years old; the magazine that used to carry that name died in 1948."[26]

Science and society were very different 100 years ago. The dramatic changes that have taken place in that centennial are only briefly indicated in the kind of analysis we have provided. To answer the question I posed at the outset of this review, we can safely say that 100 years ago a single, weekly edition of *Current Contents*, instead of seven, could have easily accommodated the international output of science. Most of the articles would have been published in Europe.

With rare exceptions, most scientists 100 years ago would have been content with surface mail, such as trains or ships. As Rudolf Schmid, Department of Botany, University of California, Berkeley, notes, mail transit times during the turn of the century were invariably faster than today.[27] Incidentally, Rudi has brought it to my attention that the current-awareness journal *Naturae Novitates*, published between 1879 and 1944, could be considered a precursor to *CC*. This journal listed new literature in the general natural sciences, including zoology, botany, physics, and chemistry. The coverage was international with emphasis on middle and western Europe.[28]

In Table 1 the impact factors are included for the journals we have discussed. It is significant that many of these venerable journals have remained or become high-impact today. However, an even larger number seem to have declined in influence relative to other journals that have emerged. A large number of high-impact journals published today did not exist before the turn of the century. Indeed, many of them are post-World

War II. Too many generalizations are not possible without the detailed analysis we hope to conduct in the future. Those who are impatient for these data can, of course, refer to the *Journal Citation Reports®* volumes published each year in the *Science Citation Index®*.

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