Scientific articles

A controllable aspect of the information explosion?

from Virginia Trimble

THE scientific information explosion needs no introduction. More journals are publishing more papers by more authors on ever-more-specialized topics than ever before. And, at least within the major American journals of astronomy and astrophysics, there are now also more words per paper than ever before (Abt, H.A. *Publs astr. Soc. Pac.* **93**, 269; 1981). The rise in mean paper length started shortly after the Second World War, since when it has been monotonic and more than linear with time, with the result that a typical 1980 paper is nearly three times wordier than typical 1910 - 40 ones. A similar trend was recently identified in European and American astronomical letters journals (Harris, W.E. *Publs astr. Soc. Pac.* **95**, 989; 1983). Despite editors' avowed intent to favour short communications over long ones, the average letter is 30 per cent longer today than it was 10 years ago. The obvious questions are why, and can anything be done about it? Determining just how widespread the phenomenon is and how it correlates with other properties of the papers may suggest answers. To quantify the data, I use a words-in-mean-paper-index (WIMPI), whose charm is that it readily permits comparisons among disciplines, decades and nations. Investigations of the subject can easily be performed by anyone with access to a large library and a strong index finger (at least the latter should probably be your own).

A preliminary investigation of one English-language journal each of physics, mathematics and chemistry from the UK, the USA and Japan (see the figure legend) shows that the trend spotted by Abt and Harris is very widespread. For every journal examined, WIMPI was larger in 1980–83 than in 1950. Increases ranged from 13 to 115 per cent, with an unweighted average of 64 per cent. This drops to 43 per cent, however, if we set the Japanese baseline year at 1955, by which time the effects of the immediate post-war woodpulp shortage had largely disappeared.

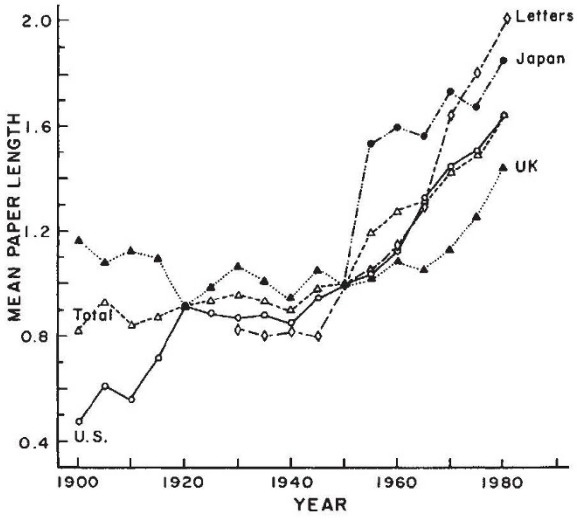
The 13 per cent minimum value belongs to *Monthly Notices of the Royal Astronomical Society* and the 115 per cent maximum to *Journal of the Mathematical Society of Japan*. After renormalizing the Japanese data, *Journal of the Chemical Society London*, *Journal of the American Chemical Society* and the American astronomical journals tie at 82–85 per cent for the largest increases in WIMPI since World War II. Disciplinary and national averages for the per cent increases in words per paper during 1950–80 are: physics, 27; mathematics, 77; astronomy, 62; chemistry, 93; UK, 45; USA, 65; Japan, 85 (but only 20 per cent since 1955). Every reader can surely find something in these numbers to support his most cherished preconceptions.

Among the letter sections and journals (most of which are not more than 20 years old in their present formats), 10 year increases in WIMPI range from 5 per cent (*J. Am. chem. Soc.*) to 38 per cent (*Bulletin of the Chemical Society of Japan*) and 20 year increases from 40 per cent (*Bull. chem. Soc. Japan*) to 170 per cent (*Journal of Physics*). The average values are 26 per cent over the past 10 years and 76 per cent over the past 20. Some of the changes closely parallel changes in editorial policy; for instance, the mean paper length in *Physical Letters* B rose from 3.6 pages in 1973, when the rule was "maximum length not to exceed three printed pages", to 4.6 pages in 1983 when it read "should normally not exceed".

The net result is a 1960–80 average increase of 76 per cent in WIMPI for the letters publications, compared to 29 per cent for their associated main journals. Such a trend persisting over half a century would give us 12,000 word 'letters', equivalent to about 12 pages of *Nature* (whose authors are currently expected to review even rather broad topics in no more than 6). The high prestige associated with getting one's work into many of the letter publications seemingly encourages authors to push constantly at the length limits so as to squeeze in contributions that should really be full papers.

The complete range of data shows several other trends, strongly suggestive of causality. UK paper lengths shrank (though not as much as total numbers of papers published) during the First World War and the Depression and rose slightly during World War II (while paper numbers, of course, dropped enormously). American paper lengths changed little during these periods. The reader will immediately think of a variety of explanations in terms of the kinds of people available to do scientific research and the resources available to them. For *Physical Review* and *Proceedings of the Physical Society* (=*Journal of Physics*) the 1980 WIMPIs have only just climbed back to the pre-war peaks reached in 1920 and 1930 respectively. *Annals of Mathematics* is unique in showing a continuous nearly-linear rise in WIMPI ever since the turn of the century. Its 1980 papers are, on average, 3.3 times the length of its 1900 ones, reflecting an increasing determination on the part of the editors to accept only papers that present a major new idea in full detail (Rector, D.L., personal communication).

The main trends — universal post-war WIMPI creep most heavily concentrated in letter publications, correlations with world economic and political events, responses to editorial policy, and differences among disciplines and nations in (perhaps) expected directions — are all strongly suggestive of an effect largely driven by forces external to the kind of scientific research being reported. This, in turn, provides some hope of moderating the current exponential literature growth. Unfortunately, the sociology of publishing is such that each author's doing what he perceives as best for himself is unlikely to lead to the best possible result for the scientific community as a whole. Perhaps the time has come for some sort of Social Contract among authors, editors, referees, readers and sponsoring agencies. □



Changes in WIMPI, normalized to 1950 ≡ 1.00. The journals represented are: for the UK, *J. chem. Soc.* (1900–82), *Proc. Lond. math. Soc.* (1903–81), *Proc. Phys. Soc. Lond.* (became *J. Phys.* 1921–83) and *Mon. Not. R. astr. Soc.* (1940–82); for the USA, *Ann. Math.* (1900–80), *Phys. Rev.* (1913–83), *J. Am. chem. Soc.* (1920–80) and the American astronomical journals studied by Abt (1910–80); and for Japan, *Bull. chem. Soc. Japan*, *J. Math. Soc. Japan*, *Prog. theor. Phys.* and *Publs astr. Soc. Japan* (all 1950–80). The letters average includes the corresponding short-communications sections and journals plus *Phys. Lett.* B, published in Europe. Data for the earlier years are generally averages (for example, 1910 ≡ 1908–12) and each point represents at least 300 papers.

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