The Publishing Game: Getting More for Less

Meet the Least Publishable Unit, one way of squeezing more papers out of a research project

In 1958, when James D. Watson worked his way up to the rank of associate professor at Harvard, the young biochemist had on his curriculum vitae 18 papers. One of them, published 5 years earlier, described the structure of deoxyribonucleic acid.

Today, the bibliography of a candidate facing a similar climb often lists 50 or even 100 papers.

As the comparison suggests, paper inflation has become a fact of academic life during the past two decades. This is especially the case in biology and medicine, where researchers sometimes list 600 or 700 papers.

The increases stem not from a sharp rise in productivity but rather from changes in the way people publish. Coauthorship is on the rise, as is multiple publication of the same data. The length of papers, meanwhile, has been decreasing.

These changes do not always bode well, according to two dozen sociologists, journal editors, compilers of scientific indexes, statisticians, and bench researchers with whom *Science* spoke recently. Take for example the emergence of the Least Publishable Unit (LPU), a term associated with the shrinking length of papers. LPU is a euphemism in some circles for the fragmentation of data. A researcher publishes four short papers rather than one long one. This fragmentation contributes to a host of problems, not the least being the sheer growth of the literature. One estimate holds that *Index Medicus* for 1985 will weigh more than 1 ton.

Keeping up with the literature is an old struggle, but changes in publishing are also creating new problems and raising new questions. Take coauthorship, where names are often added gratuitously. An editor at one journal, *Blood*, recently received a call from an irate researcher who asked that his name be removed from a manuscript that he had just seen and with whose conclusions he did not agree. His sole contribution had been a few seconds of conversation with the lead author in an elevator.

This type of event is rare, but the overall problem of paper inflation affects everyone writing a bibliography. In essence, hard numbers on a curriculum vitae no longer necessarily add up to hard work. In reference to this, some sociologists speak of researchers today being able to publish *and* perish, and administrators voice concern over what should be the arbiter of career promotion. In some cases, sophisticated means of reading a research record, such as citation analysis, are emerging. But there is still a sense of unease. The fellowship application for the American College of Physicians asks a candidate to list percent participation in studies in which he is a listed author. Though seemingly a workable solution, the accuracy of the resulting judgments has been called into question. In at least one instance, when a whole research team applied for fellowships, their total participation came to 300 percent.

Of the forces that encourage paper inflation, the rise in coauthorship is the one that leaves the clearest statistical trail. According to the Philadelphia-based Institute for Scientific Information, which indexes 2800 journals, the average number of authors per paper rose from 1.67 to 2.58 between 1960 and 1980. There is great variation from field to field. *The Astrophysical Journal* today has multiple authorship for 67 percent of the articles, while *Cancer Research* has 95 percent. Editors at the *New England Journal of Medicine* say coauthorship has been rising exponentially since the journal's inception, today averaging about five authors per paper.

Causes of the increase are diverse. Arnold Relman, editor of the *New England Journal*, notes the rise of multiinstitutional clinical trials that involve literally hundreds of researchers. Interdisciplinary papers are also more frequently published, due to diverse techniques being brought to bear from many laboratories. He also agrees that the fragmentation of data and the gratuitous listing of coauthors is on the rise.

Emerging as well is the question of who is responsible in a multiauthored study for methods and ethics. The lead article in the 12 January 1978 issue of the *New England Journal* was a report on paranoid schizophrenics, authored by four researchers. Soon after it came out, Relman noted that a similar article published in the January 1978 issue of the *American Journal of Psychiatry* reached conclusions that were the opposite. He also noted that the papers shared two authors in common. Authors who were not involved in the snafu pleaded innocence. "Coauthorship," the *New England* editors wrote in a 18 May column on the incident, "like sole authorship, must surely imply responsibility for a paper and not merely endorsement of parts of it. If it does not, who, if anyone, is responsible?"

Contributing to the rise in coauthorships, according to Robert Gallo at the National Cancer Institute, is the free and easy listing of those who had isolated a cell line, clone, or virus—a practice that can result in hundreds of "papers" for the isolator. Gallo believes that such materials should be made available to colleagues, with the understanding that no attribution is wanted or needed. In his own case, he says that on at least five occasions researchers have tried to list him as a coauthor because he gave them a cell line. "I guess people who automatically put your name on a paper are used to demanding that their names be on things."

Requests for the removal of gratuitously added names have only materialized in the past 2 years, according to Evelyn S. Meyers, managing editor of the *American Journal of Psychiatry*.

How does the editor of the *New England Journal of Medicine* deal with LPU's? "As tactfully as I can."

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Why are the names added in the first place? One reason, says Meyers, is that a research group may split, and the lead author of the splinter group will list all the original group out of courtesy. This leads to problems, however, when "the coauthors who are named but not involved" do not like the direction that the research took. Then, too, "it's sometimes a glory kind of thing, putting the chairman in even though he was not directly involved, trying to bask in the light of a greater name."

Requests for removal occur most often while a paper is still in manuscript. This is because of the revised copyright law, which demands that each author sign a release when an article is accepted for publication. On occasion, however, even this does not prevent a squabble associated with coauthor abuse from breaking into print. In September 1979, *Fertility and Sterility* published a study by 16 authors affiliated with McGill University in Canada entitled "Prolonged amenorrhea and oral contraceptives." The three and a half page paper concluded that evidence does not support the existence of a "postpill" syndrome. That December, a cryptic letter arrived at the offices of the journal. "Among some 12 or more so-called coauthors, my name is listed as well," wrote George H. Arronet, of the Royal Victoria Hospital in Montreal. "I would like to inform you that I have no part in this paper whatsoever nor do I agree with the conclusions drawn from his study." The letter was published in the March 1980 issue. Also published was a reply from the lead author of the article, who said he believed "that an erratum is indicated."

While rises in coauthorship are a statistical fact, trends in the multiple publication of the same data are based on the observations of individuals. David T. Durack, a researcher at the Duke Medical Center who has written on the subject of inflated publishing, notes that "many of us are guilty of premature publication of studies still in progress," mostly due to career pressures or fear of being scooped. This results in an interim report and then a final report, one often indistinguishable from the other. Durack recommends that editors create a new category for manuscript approval: "accept, contingent upon eventual satisfactory completion of the work."

Subtle changes in the presentation of data, says Gallo at NCI, makes multiple publication difficult for even careful reviewers to catch. "About 6 years ago we found a growth factor, and today there is this group of very bright guys who are making quite a name for themselves with it. They've done a blitzkrieg in the field since we founded it, clearly publishing the same, overlapping data in different places, often in prestigious journals. The only way to stop it is meticulous review." Meyers at the *American Journal of Psychiatry* agrees. "Good reviewers say to us, look, this [manuscript] is only a little bit different from what's been published a few months ago in *Lancet* by the same people."

Unlike the rise in multiple publication, which is apparent only to those who follow a particular field, the shrinking length of papers has been revealed by statisticians. According to King Research, a Washington-based consulting firm that does work for the National Science Foundation, the overall trend in scientific literature since 1970 has been toward fewer pages per article, with the trend in the life sciences being slightly more pronounced. Of all fields, moreover, the life sciences have the shortest articles, averaging six pages.

Again, reasons are diverse. Editors, faced with the explosion of information, consistently tell authors to trim the fat. More and more journals are passing on the increased costs of operation to authors in the form of page charges, another incentive to trim. As new research techniques become widespread, the "methods" section more often is deleted or squeezed. Short manuscripts are also more likely to be processed quickly, as the priority-conscious are quick to point out. In addition, many journals during the past decade have institutionalized a "brief communications" section for short papers. "There is no question about the popularity of our concise communications," says Paul Marks, editor of *Blood*, which started printing the section in 1979. "Authors really are willing to write shorter manuscripts."

This shrinking has also encouraged the rise of the LPU, according to many editors. It is evident, however, that brevity alone does not make for fragmented reporting of research. The sterling example of this is the original paper in *Nature* on the structure of DNA, in which Watson and Crick touched off a revolution with a one-page article. In many instances, however, smaller is not necessarily better. "It's a big problem," says Clifford A. Bachrach, editor of *Index Medicus*. "Take an epidemiological project that looked at the relationship of several variables to the incidence of disease. It ended up being printed as fairly brief papers in three journals instead of one slightly longer one. People just subdivide more than I like."

Especially troublesome is the effect of the LPU on those who are least prepared to cope with the difficulties it presents. Raymond Owen, of the California Institute of Technology, is currently drawing up the outlines for a genetics course. "Here the fragmentation is clearly unfortunate because students confronted with a half-dozen short papers have a hard time seeing the forest for the trees."

Sociologists say paper inflation is growing to the point that it is possible to publish *and* perish.

Slowing the rise of the LPU is, again, best done by conscientious peer review, according to Meyers at the *American Journal of Psychiatry*. "Good reviewers say, look, these authors are going to string this out into five papers when we could get one really good one."

How does Relman at the *New England Journal* deal with LPU's? "As tactfully as I can. There is a fine line between dictating how people should do their work and being a tough, rigorous editor. If it's clear that this is the first of many little pieces, then I try to tactfully inquire whether there might not be more. It happens about once every three weeks."

Fat bibliographies, fed by short papers and a growing bevy of authors, have become the object among some administrators of a sort of reverse snobbery. Bachrach says editors of new journals who are lobbying for inclusion in the *Index Medicus*, which contains some 2600 journals, often send bibliographies of themselves or members of their editorial board in an attempt to impress. "We see things containing 600 or 700 papers," he says, "but I'm really much more impressed by 35." In any event, he notes that inclusion is made on the basis of journal content, not on the thickness of a curriculum vitae. At the *New England Journal*, Relman too feels that understatement is the key. "My own feeling is that good people who do good work don't have to advertise by inflating bibliographies. If you've really written a superb paper that's moved the field ahead, then people know it, and you

don't have to pad." In marginal cases, however, Relman admits that the art of creative bibliography reading is becoming more complex. "You have to know the journals, and what impact they have on the fields. You have to know the institutions, the people, the meetings. You can quickly sort out the papers that are derivative and not original. With the original, you then have to decide which people are the driving force behind the research and which were the also-rans. It's a ticklish matter."

Since only a few administrators have the time and sophistication to sift through a thick bibliography that at first glance looks promising, problems and misjudgments are probably more common than is ever admitted. A recent example is the case of Elias A. K. Alsabti, a 25-year-old researcher from Jordan who listed 60 papers on his curriculum vitae (*Science*, 27 June 1980). Alsabti had pirated at least seven of his papers and published them in obscure journals. This, however, was unknown to administrators at Baylor College in Houston, where Alsabti was almost accepted into a residency program in neurosurgery—until a researcher who had worked with Alsabti told an administrator at Baylor the details of his academic rise.

Rather than trying to cope with the effects of paper inflation, some researchers have recommended radical steps to prevent the growth of padded bibliographies in the first place. Durack, writing in the 6 April 1978 *New England Journal of Medicine*, says, half-seriously, that the National Institutes of Health should limit the number of papers by each author to five per year, with a stepwise reduction in funding as an automatic penalty for each paper published above five. Other observers, instead of recommending a reliance on bureaucratic sanctions, have called for rigorous self-restraint by researchers.

Since an element of self-deception probably plays a part in the whole process, attempts at restraint may not have much impact. Says one geneticist: "Priority is the rationale that is used for lots of this publishing, for the brief communications. Some people probably believe it. But the cases where somebody is hot on their trail are the exceptions rather than the rule."

Self-restraint is beside the point to some observers. They say there is a good side to paper inflation because it forces administrators and those who judge research careers to dig beneath appearances on a bibliography and discover the truly worthwhile aspects of a research record. But to many others, who are faced with a growing horde of journals filled with fragmented and redundant research, paper inflation represents a time-consuming chore. It may even affect Nobel laureates. At 7:40 one recent morning, *Science* called Watson at Cold Spring Harbor, where he is now the director, and inquired if he would discuss some of the issues involving paper inflation. "I have no time," he said at a brisk clip, and then added, right before he hung up, "My life is too busy." Perhaps he was buried in a stack of journals, struggling to keep up with the literature.—WILLIAM J. BROAD

MIT Committee Seeks Cryptography Policy

Questions of who should do research on cryptography and how results should be disseminated are the first order of business

Within the next 10 years, networks consisting of tens of thousands of computers will connect businesses, corporations, and banks in giant webs, predicts Michael Dertouzos, director of the Laboratory for Computer Science at the Massachusetts Institute of Technology. But the interconnectedness of these computers, which is their very strength, is also their weakness, he says. Unless steps are taken to assure the privacy of computer data and to assure that computer messages can be "signed," it becomes extraordinarily easy to commit crimes and hard to detect them.

Although a number of computer crimes have been reported, many more are not because banks and corporations do not wish to publicize the weaknesses of their systems. And the crimes that are detected, many experts believe, are only the tip of the iceberg. The FBI, aware of this problem, has mounted a major effort to detect computer crimes in the banking industry.

Dertouzos and others at MIT are extremely concerned about the consequences for individuals and for society if computers continue to be connected, as they are now, according to local decisions by individual entrepreneurs. The security of computer data varies greatly and there is no general assurance that data are safe.

Last fall, MIT formed a committee, headed by Dertouzos and called On the Changing Nature of Information, to look into questions of computer security and other matters arising from the proliferation of computer networks. The committee's members include Francis Low and Walter Rosenblith, the current and past provosts of MIT, and John Deutch, the under secretary of energy in the Carter Administration. They also include a computer scientist and lawyer, and professors of political science, philosophy, and management.

As Dertouzos explains, even if a computer is thought of simply as a filing cabinet, the problem of preventing crime is considerable. The very power of the computer can be used to break the defenses of the installation. It is relatively easy to send computer programs between connected machines and to instruct a program to search for, select, and copy data from anywhere in a network. Then the program can be instructed to remove itself without leaving a trace. By analogy, he says, "Consider a network of filing cabinets, connected by subterranean tunnels. Now imagine that agents can crawl through these tunnels, copy anything they want from any of the files, and leave with no signs of their presence. That is one of the situations we are faced with."

Other issues that will arise as computer networks proliferate, the MIT committee predicts, are questions about what types of data should be stored in computers and for how long, how programs can be protected since they can neither be patented nor effectively copyrighted, the extent to which information should be treated as property, and who is liable if a mistake is made, for example in a medical diagnosis that is assisted by a computer. Although the committee intends eventually to address these ques-

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