

Commentary

Too many authors, too few creators

A few years ago, Robert Fefferman, dean of physical sciences at the University of Chicago, made an interesting remark. He mentioned that Enrico Fermi, wanting to encourage individual creativity and innovation, required his PhD students to select their problem, solve it, and submit the results for publication in their name alone. Fermi also was aware that a multi-author paper with one famous author might receive automatic acceptance rather than a thoughtful and thorough review. Many PhD students then and since have published their theses under joint authorship with their advisers. Unfortunately, the need among grant-seeking academics to publish and be cited often grew stronger, especially during federal funding cutbacks, the most recent example being the cuts in science budgets under President George W. Bush. When applying for government grants, an applicant team's record of many cited publications was important to confirm that the submitted proposal had significant cachet for continuing support. A vicious cycle began.

Over the years, publication lists were increasing. Some colleagues boasted more than 300 publications and one close to 800! The number of authors associated with each published article was also increasing; single-author papers had become relatively rare. Were Albert Einstein, Enrico Fermi, Richard Feynman, and other great scientists just lucky in finding simple ideas that one mind could understand and present? Or was technological creativity becoming so difficult that great teams of scientists were required to recognize and develop it?

Seeking answers, I made a cursory examination of some publication records of the last half century. I selected the eight publications listed in the table to the right and selected the first issue of each from January 1965 and from January 2011. To compare innovation over time, I included data on the first 100 patents issued to US applicants by the US Patent and Trademark Office during the corresponding periods. The data were gleaned from the office's weekly *Official Gazette*.

The results seem truly astonishing. Although the data sets selected are relatively small, they show the downward

trend of individual creativity. Most of the papers studied were written by authors in, or associated with, academia. A few came from government laboratories and some from industry.

It has long been evident that some professors established groups of graduate students whose main activities were often focused on publishing research results. Authorship of such articles expanded to include all members of the group despite only the peripheral or negligible contributions by some, historically referenced in an acknowledgments section. Over the years, non-academic groups, especially in the life and pharmaceutical sciences, added to the publication proliferation; R&D directors often put their names on every paper leaving their lab. A person even

slightly involved with a project would be added as an author. What began as an innovative topic of investigation became an opportunity to be published and thereby increase one's personal citation numbers. Thus participants who simply made measurements, or converted the measurements into appropriate numbers, or kept the equipment operating were all listed as purportedly creative coauthors. What was actually the creativity of one or two authors became the work of a great many. And each such paper carried the name of the professor whose contract or grant paid for the work. Thus if the paper turned out to be important, the multitude of authors could add impressively to their CVs.

On occasion there even may have been a sinister element to the process of

Contrasting individual creativity over time

		Authors per paper (% of total)			
Journal	Date	One	Two	Three	Four or more
Physical Review Physical Review A	1/4/1965	35	40	18	7
	1/1/2011	6	27	29	38
Journal of the American Chemical Society	1/1/1965	14	43	25	18
	1/12/2011	0	14	25	61
Proceedings of the National Academy of Sciences	1/15/1965	32	34	20	14
	1/4/2011	0	11	15	74
Applied Optics	1/1/1965	58	26	11	5
	1/1/2011	0	17	11	72
Journal of Theoretical Biology	1/1/1965	47	53	0	0
	1/7/2011	20	33	27	20
Proceedings of the IEEE	1/1/1965	57	35	6	2
	1/1/2011	12	19	19	50
Science	1/1/1965	78	11	7	4
	1/7/2011	41	15	5	39
Nature	1/2/1965	45	34	18	3
	1/6/2011	28	14	9	49
		Inventors per US patent (% of sample)			
First 100 US patents issued per time period	1/1/1965– 6/1/1965	70	18	10	2
	1/1/2011– 1/8/2011	41	24	12	23

(Data compiled and processed by Crystal Forsher.)

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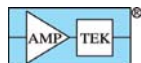
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adding authors. For example, the author list might include a friend or colleague of the lead scientist, an indirect financial supporter, or a contractor's technical representative. No author would ever discuss this matter publicly.

Many problems of irrelevant authorship arise with the journals themselves. Although all journals provide manuscript preparation guidelines that include some type of warning against "double publishing"—that is, repeating significant portions in another paper—only a few ask the contact author to confirm that the listed authors all contributed to the paper. Both *Science* and *Cell*, for example, do ask that all authors of an accepted paper "state their contribution to the paper," but they do not list any criteria for actual authorship, nor whether specific types of contributors should be relegated to an acknowledgment section.

A friend of mine, a former Bell Labs physicist, defended the inclusion of his name to the end of the author queue of each paper published by his students though many of the ideas were entirely his. His reasoning was that "the graduate student should always have top billing so that his career can be advanced." Each author's personal list of "first author" publications was certainly increased by my friend's unselfish generosity. It remained up to the reader to figure out whose ideas were actually being presented.

Whereas in former days, a PhD candidate during graduate school would

prepare only a single paper based entirely on his or her work, the trend today is to leave graduate school with a raft of publications, considered essential for a job or postdoctoral appointment. Unfortunately, the time spent getting published often seems to be at the expense of obtaining the greater in-depth knowledge of the science itself. In the hundreds of interviews and CV reviews I have conducted over the past 25 years, I have found the presence of the basic building blocks of the science decreasing with each passing year. When a recent PhD in a physical science said that helium formed diatomic molecules, I knew we were in trouble!

The patent data shown in the table are of particular interest. The percentages for two or three inventors per invention for the most recently issued patents do not vary greatly from the percentages for 46 years earlier. Here's why: If a listed inventor, or "innovator," did not actually contribute to the invention, the issued patent will be void if such deception is ever discovered. The patents most easily challenged in court may well be those with extraordinary numbers of inventors.

Here's a final Fermi-inspired question: How many of today's tenured faculty members or research directors have never written a single-author paper?

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Letters

Radioactive toothpaste and reversed helicity

Maurice Goldhaber, who died in May 2011, shortly after his 100th birthday (PHYSICS TODAY, May 2011, page 40, and October 2011, page 65), was not only a great nuclear and particle physicist but also a witty and engaging speaker. Many years ago, when someone asked him if he was yet retired from Brookhaven National Laboratory, he said, "How can I be re-tired; I am not even tired yet."

On the occasion of the 50th anniversary of his mentor James Chadwick's 1932 discovery of the neutron, Goldhaber gave talks about the early days of nuclear physics. When he spoke at the University of Michigan, someone drew his attention to a radioactive toothpaste, named Doramad, that was produced in

Germany from the 1920s to the 1940s. At a later talk I attended at Duke University, he showed a poster advertising Doramad. I told him that the toothpaste had been manufactured as a byproduct by the industrial firm Auergesellschaft near Berlin; my father, an organic chemist, worked there until our emigration from Nazi Germany in 1935. During my entire childhood I brushed my teeth with Doramad!

Naturally occurring thorium has a half-life of 14 billion years and emits 4-MeV alpha particles—a very mild activity. It was extracted by my father's company from monazite sand, imported from India primarily as a source of rare-earth elements. Those rare-earth materials were used by the company's founder, Austrian scientist Carl Auer von Welsbach, to impregnate the mantles in gas lanterns, so they would shine brightly, and for a number of other products, including tinted sunglasses