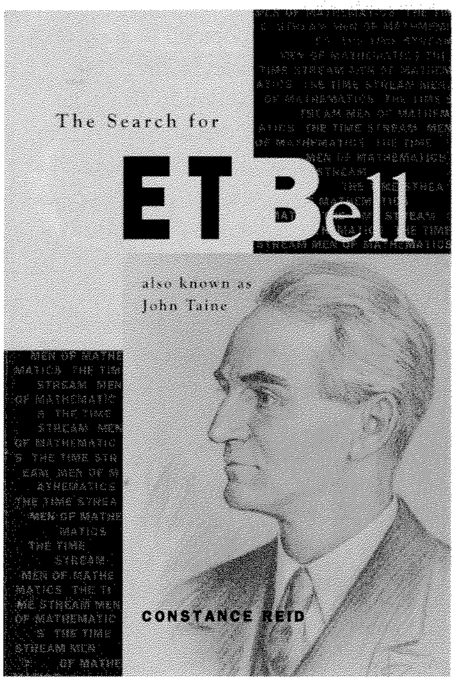
Books



The Mathematical Association of America, 1993
372 pages
$35.00

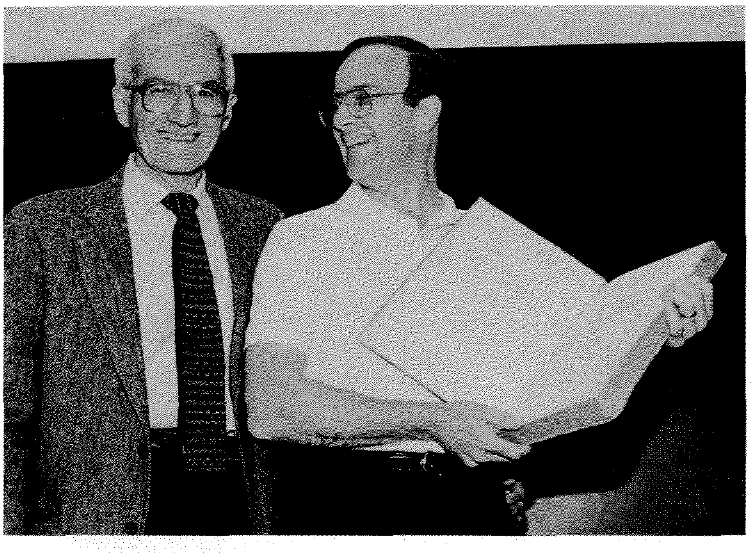
"A Cat That Can't Be Caught" is the first chapter of this quite readable story of the life of Eric Temple Bell. Constance Reid carries us along on her private-eye-like search for the truth about his early years, which he had kept secret from his friends, his family, and even from his beloved wife, and which he had even distorted (the polite word) when filling out a form for the Caltech administration in 1943. By a combination of diligence and luck the author has discovered that when Bell was about a year old his father moved the family from Scotland to San Jose, thence south to the farm country of Santa Clara County, where he began a fruit orchard. It was here that Bell spent his boyhood, and images of an idealized pastoral countryside find their way into many of his poems and stories. Why was it necessary for him to keep these years secret? Reid never finds this out.

He was a teenager when his father died, and his mother returned the family to England, where Bell entered what we would call a high school and fell in love with mathematics. But it was back in the United States that Bell did his university work—Stanford, Washington, and Columbia. After finishing his PhD, he began his teaching career and for many years seemed to want little more. Mathematical research was a minor activity. Poetry demanded more attention, and it was the time for beginning an epic work, *The Scarlet Night*, the revision of which was to occupy the last years of his life. It was also the time for his marriage, at the age of 27, to his beloved Toby.

The author said to Bell's son Taine: "The thought has passed my mind that your father might have preferred being a poet to being a mathematician," to which Taine replied, "I think he might have if he had had any success." Bell found no conflict between his dual interests, and wrote that "mathematics and poetry are simply isomorphic."

His mathematical research began to expand in original directions, which were, however, apparently not very well described in his publications. One of the reviewers contacted by Reid had two favorite instances of Bell's style: "the following complete sentence: 'Hence, etc.' and my very favorite footnote: 'A set of elements form a semi-group if they have the *group property*, etc.'" A few years later his "recreational writing" began under the name of John Taine (the basis for the name is obscure—it is not in his family history) in the genre we now call science fiction. A friend suggested that it served "as a relief from the grind of mathematics."

Although Reid comments clearly on Bell's fictional products, her descriptions of his mathematics is another matter; for



Lyle Bell (right), E. T. Bell's grandson, presents to the Caltech Archives the 1670 edition of the *Arithmeticorum* of Diophantus, given to Bell when he retired from Caltech. The volume reproduces Fermat's famous margin notes postulating his "last theorem" and is signed by all the members of the 1953 mathematics faculty. Accepting the book is Tom Apostol, professor of mathematics, emeritus, one of the signers.

example: "The paper contains the fundamental general treatment of the algebraic properties of generating functions that he used to explain the development of his theory of numerical functions, especially factorable or multiplicative functions." I have always thought of myself as one of those readers so sought after by writers in *Scientific American*— the "educated layman"— but that sentence mystifies me. Unhappily, it is not a unique example.

In the mid-1920s, R. A. Millikan persuaded Bell to come to Caltech, in spite of better financial offers from eastern universities, such as the University of Chicago. He and Toby acquired their small house on the corner of San Pasqual and Michigan, and later the lot next door where he built his small hexagonal study in the midst of a bamboo jungle. This was to be the "generating site" for his mathematical papers, the expanding list of John Taine sci-fi novels, and another type of publication that now began to get his attention: books and pamphlets intended to popularize science and mathematics. (This last seemed ironic to some of his colleagues who found his descriptions of his own work obscure.)

He established good relationships with his fellows on the Caltech math faculty—Harry Bateman, A. D. Michal, Harry Van Buskirk, Morgan Ward (who had been a graduate student of Bell's), and others—and a rather stormy one with H. P. Robertson (also a former Bell student). He enjoyed his contacts with other faculty—T. H. Morgan, Paul Epstein, and, in particular, Edwin Hubble. Bell credits Hubble's wife, Grace, with important assistance in his nonmathematical writings, for example in his famous set of biographies, *Men of Mathematics*.

Toby died in 1940, and it seemed to many that Bell was never quite the same. He devoted most of his energy to the revision of his poem, *The Scarlet Night,* written decades before. He found a retreat in Redondo Beach to work on it without distraction. There, late one night, walking on the beach as was his habit, he was mugged, and was brought back to Pasadena in serious condition. Many of his friends felt that this second event, after Toby's death, caused a deep change in his personality. Nevertheless he continued to work on his poem and on another favorite project, a book about Fermat, called *The Last Problem*. But he was drinking too much and his health was steadily failing. In 1959 his son Taine took him to Taine's home in Watsonville to care for him, and it was there he died the following year.

The book is a good read (apart from a few descriptions of his mathematics). Opinions about his personality and abilities in his later years are expressed by quotes from those who knew him, and a good search of documents covers his earlier life. She enlisted some expert helpers in reviewing this material.

The most interesting discovery for me was the breadth of his activities, which I knew of but never fully appreciated—poetry, fiction, popular science, and one really out of left field: his strong hand in the organization and design of the Chicago World's Fair in the early thirties.

Albert R. Hibbs, BS '45, PhD '55
(Although a physicist, not a mathematician, Hibbs took courses from Bell and contributed one memorable quote to the book. He is now retired from his position as senior scientist at the Jet Propulsion Laboratory.)

Cambridge University Press, 1993
164 pages
$19.95

Most of us probably think we know pretty well what to expect from a book subtitled "what everyone should know about science"; in this case, we would be dead wrong. Of course, since that expectation has little to do with golems, perhaps we should not be too surprised. Collins and Pinch are among the leading practitioners of the field generally known as "sociology of scientific knowledge," or SSK. This discipline examines science from the point of view that truths are accepted, controversies resolved, and knowledge created, not by any logically rigorous "scientific method," but rather by social factors.

To support their viewpoint, Collins and Pinch present seven case studies of controversy in science, varying widely by topic as well as outcome. An excellent illustration is provided by one that might not occur to many contemporary scientists as particularly controversial: the roles of the Michelson-Morley experiment and the Eddington observations of stellar displacement during an eclipse in "proving" the theory of relativity. In the first, complications by various factors that could have caused the observed negative result—no dependence on direction of the speed of light—could not be rigorously excluded. Furthermore, another scientist subsequently obtained a *positive* result (for which he received a prize from the AAAS in 1925). Similarly, in the eclipse studies, some of the results gave deflections compatible with Einstein's prediction, while others were more consistent with classical Newtonian physics. The experiment was announced as confirming Einstein, though; the latter set of results was assumed to be of poorer quality and ignored.

From this and other studies—including episodes such as Pasteur's rejection of spontaneous generation of life, chemical transfer of memory, gravity waves, and cold fusion—Collins and Pinch conclude that there are no rigorous criteria available by which to judge the validity of an experiment and the resulting implications. Instead, such judgment is inextricably bound up with what one already believes: "relativity . . . is a truth which came into being as a result of decisions about how we should live our scientific lives . . . a truth brought about by agreement to agree about new things. It was not a truth forced on us by the inexorable logic of a set of crucial experiments."

The chapter on gravity waves introduces the key concept of the "experimenter's regress." A novel experiment gives a certain result, but is it a good experiment? A good experiment would give the correct result—but until we've carried out such an experiment, we don't know the correct result. Hence, the authors argue, it is impossible to resolve a disagreement by any rigorous experimental criteria. Thus, in their view of the cold fusion controversy, choosing to favor Pons and Fleischmann's positive results or Nate Lewis's negative ones can only be based, ultimately, on whether or not we believe in cold fusion; a dispassionate assessment of the experiments cannot be reached.

Collins and Pinch do challenge us to think about scientific research in ways that are probably rather new to most of us. Nonetheless, it is hard to see that they have even come close to justifying such sweeping conclusions, summed up as: "we have shown that scientists at the research front cannot settle their disagreements through better experimentation, more knowledge, more advanced theories, or clearer thinking." The support for the theory of relativity described above may not have been completely unambiguous, but additional results that Collins and Pinch call "mutually reinforcing" have left no doubt even in their minds about its truth. Isn't that a good example of settling a disagreement through better experimentation and all the rest?

What they do show quite clearly is that science is not Superman—it doesn't leap tall problems in a single bound, but follows an often tortuous and iterative path, affected *(but not* determined*) by the social factors upon which they lay so much stress.*

As for the experimenter's regress, again they go too far. It *is* in fact often possible to assess the validity of an experiment free from any straitjacket of belief. To take an extreme case, in evaluating the failure to observe a signal one might discover that the apparatus had not been plugged in. Some of the mistakes made by cold fusion researchers were not much less egregious. I would imagine that most readers familiar with the cold fusion story to any degree of detail will disagree strongly with the statement: "In cold fusion we find science as normal."

Should scientists read this book? It's not obvious that Collins and Pinch think so: "this view of science . . . should make very little difference to the way scientists act when they are doing their work at, metaphorically speaking, the laboratory bench." It seems to me that better sensitivity to when and where social factors enter into scientific practice could well have a positive effect on scientific progress. Collins and Pinch, on the other hand, believe that these factors are ubiquitous and inescapable, and that understanding the social view of science might even be detrimental to scientists—perhaps like the centipede who can't walk when he thinks about how he does it. It seems paradoxical but almost inevitable that, having disagreed with so many of their conclusions, I would also contest their low valuation of the potential significance of their *own* work for scientists. In any case, the book amply satisfies one key criterion for recommendation: it's fun to read.

What about the use of "golem" as title and central metaphor for science? The golem, a creature of early Jewish legend, was a clumsy monster, superhuman in physical strength but subhuman in intelligence. The implication is that science bumbles about its business, settling on answers more or less at random, and never learning from its experience how to do things better. In fact, Collins and Pinch have chosen the wrong legendary figure. What they do show clearly is that science is not Superman—it doesn't leap tall problems with a single bound, but follows an often tortuous and iterative path, *affected* (but not *determined)* by the social factors upon which they lay so much stress. For those who needed it, Collins and Pinch convincingly knock down the straw man (straw Superman?) representing a perfectly rational and straightforward scientific method. The clay man of golem science that they set in its place is far less convincing.

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