book reviews

staffed, under-financed government outposts set up to promote productivity and integrity play scant roles in scientific affairs. Government itself has receded to a junior partnership in the research economy, providing about 25% of national R&D expenditures.

The misconduct follies played out on Capitol Hill in the 1980s — the so-called Baltimore case and the contention over Robert Gallo's role in identifying the AIDS virus — were the pet project of one powerful House member, John Dingell, and did not come from a groundswell of political concern. Few other legislators seemed interested in scientific misconduct. After the Republicans took control of the Congress in 1995, misconduct disappeared from the legislative agenda. It has reappeared with the recent outbreak of concern over ethical corner-cutting in gene-therapy trials. The Office of Research Integrity in the Department of Health and Human Services has been headed by an acting director since 1996 — scarcely a sign of political approbation for its work. Whistle-blowing is not conducive to career advancement, empowered or not.

As for the social contract, it can just as easily be argued that it never existed, or that, if it did, it persists to this day relatively intact, perhaps even expanded from its original terms. Ironically, these are particularly congenial and trustful times in science–government relations compared with the presumed nirvana of the pre-1980s. Congress today is gung-ho over a rapid doubling of the budget for the National Institutes of Health, based largely on naive faith in that agency's productivity.

Guston's use of language falls victim to academic opacity: "the dissemination model of the second period of Devine, *et al.* remains predicated on the univariate nature of the appropriability model of the first period." Nonetheless, a dogged reading yields fresh insights into the complexities of the American experience in the relations between science and government. ∎

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Turning the key to an adolescent talent

In Code: A Mathematical Journey
by Sarah Flannery, with David Flannery
Profile Books: 2000. 292 pp. £14.99

John L. Casti

Sarah Flannery is a teenager in County Cork, Ireland. She is also the creator of a coding scheme for information transmission that dramatically extends our ideas of how best to compress information. How could a completely typical Irish teenager astound the world of mathematics in this way? *In Code* is a first-hand account of the answer.

Sarah's father, mathematics teacher David Flannery, plays the Henry Higgins to Sarah's Eliza Doolittle. The Flannery household, rather ordinary by most standards, is quite unusual in one way: the presence of a large blackboard in the kitchen, on which Flannery senior would write challenging mathematical puzzles for his children to ponder. So, from the time she was a toddler, Sarah was continually exposed to logical thought processes and the thrill of discovery. That's one piece of the answer to her success, a mathematically friendly home environment where the fact that she is a child and a woman played no role in discouraging her from developing a native talent for mathematical thinking.

As Sarah's story continues, we find her taking educational enrichment courses taught by her father at the local college. By the account given in the book, these courses are rather extraordinary in the way they challenge the students to think through the logic behind various mathematical problems. Thus, the principles involved in finding answers are arrived at in a kind of Socratic process of dialogue and discovery.

During the development of her novel coding scheme, Sarah takes the reader through a sequence of science competitions, first in Ireland, then abroad, at each stage of which her project wins a major prize. The ultimate project is a code that improves upon the standard RSA coding scheme used around the world to compress and send information. Sarah's scheme, the technical details of which are not presented in this book, provides an alternative that is considerably faster than the RSA procedure, and thus has the potential to send information far more efficiently — and cheaply — than previously thought possible.

The success of Sarah's coding method in science fairs around the world brings her fame, minor fortune and lots of publicity — including a front-page write-up in *The Times* of London. It also brings innumerable offers from entrepreneurs, software houses and others of that ilk, who promise riches beyond her wildest imagination if she will enter into a commercial arrangement with them to further develop and market her work. To her credit, Sarah refuses all these blandishments, and tells the world that she intends to present her work publicly, essentially giving the code away for free.

But there is a fly in the ointment. As mathematicians scrutinize Sarah's work, they discover a security flaw in the scheme. While the flaw in no way invalidates the mathematical basis of the code, it does prevent it from being used as a public-key cryptosystem. This, in turn, destroys the code's commercial value. *Sic gloria transit mundi*. Sarah remains undaunted by this development, and we read of her admirable aplomb in shrugging off the tarnishing of her achievement by this

Just follow the instructions

Open Here: The Art of Instructional Design (Thames & Hudson/Stewart Tabori & Chang, £17.95/$29.95) by Paul Mijksenaar and Piet Westendorp contains an assortment of visual instructions designed, with varying degrees of success, to help us get through the obstacle course that is everyday life.

blemish. 'Who cares?' she seems to say. Much mathematical work is less than perfect. But it is still regarded as a contribution to progress.

In Code is a wonderfully moving story. While at times it reads a bit too much like a gushy teenager's diary (which it is), the book contains a wealth of interesting information on mathematical puzzles, coding methods, elementary number theory and algebra. It is also well worth noting, however, that it can be profitably read by anyone; no knowledge of mathematics, codes, number theory or anything else is needed. In fact, the book does an exemplary job of walking the reader through a set of graded puzzles aimed at developing mathematical intuition, followed by a first-rate, gentle introduction to codes, deciphering and cryptosystems. So don't be put off by the fear that this is a book on some mathematical genius that you won't understand. It is just the opposite; it's a book about the thrill of the mathematical chase, and how it is a game that anyone can play.

The book also gives a fascinating account of how a gifted teacher like Sarah's father, David, can help nurture and develop the mind of a very bright — but far from genius-level — teenager such as his daughter, and inspire that mind to creative heights one would believe possible only of bona fide geniuses. Sarah's story should serve as an inspiration to all young people, especially young women, who might be contemplating a life in mathematics. I recommend it highly as summer reading not only for teenagers, but for anyone interested in the human spirit and its boundless capacity for innovation and imagination. ∎

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