

How to Encourage New Heresies

By Marcia Bartusiak

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DISCOVERING

By Robert Scott Root-Bernstein.

Illustrated. 501 pp. Cambridge, Mass.:

Harvard University Press. \$35.

By Marcia Bartusiak

SEEING that science, with its exponential growth, has blossomed a millionfold since the 1600's, why are we not witnessing a millionfold increase in the number of fundamental discoveries, Robert Scott Root-Bernstein wonders in "Discovering." Scientific revolutions, the kinds of upheavals that dramatically alter our view of nature, spring up at a rather constant pace, he claims. Where are the thousands of Newtons, Darwins and Einsteins that should now be walking the earth? The modern publication explosion in science has arrived without a commensurate explosion in astounding revelations. Has science, in all its manifestations, now become so bureaucratic that it ends up sabotaging those who would discover?

At the age of 27, Mr. Root-Bernstein, a biochemist and historian of science, received a MacArthur Prize in 1981. It enabled him to search for the blueprint to scientific discovery, a venture he believes is too unconventional to have won financing from customary sources. The 19th-century British biologist Thomas Huxley once noted that new truths in science often begin as heresy, advance to orthodoxy and end as superstition. Mr. Root-Bernstein considers how we can encourage new heresies, especially in the face of institutional grant systems that tend to fund exploration of the orthodoxies. Investigators confident of their own notions of how science is done will likely dismiss the book's approach as foolhardy and superficial. They will have a point: while refreshingly frank, Mr. Root-Bernstein has a chip on his shoulder, which makes it difficult to trust some of his assessments. Others, though, might judge the book as bold and imaginative, for it is far from the dry, scholarly tome one expects on such a subject.

Mr. Root-Bernstein unveils his propositions and counterarguments through the voices of six fictional professionals who take part in a colloquium on discovering that extends over six Saturday mornings. Ernest, a biologist and scientific gadfly, better known as Imp, is the instigator of the project. "In matters intellectual he's like a child with a newfound toy," according to his wife, Jenny, a historian of French culture. Then there is Hunter, a down-to-earth chemist and history of science buff; Ariana, an endocrinologist, who as a photographer and amateur cellist brings her artistic predilections to the debate; Constance, a patent attorney and historian of science; and Richter, Imp's colleague, who serves as the resident curmudgeon and traditionalist. This group attempts to determine whether discoveries are inevitably unpredictable stumbles and sudden flashes of insight, as commonly assumed, or the result of reproducible methods or a bent of mind that might be taught and applied. They seek this elusive algorithm in the childhoods, educational backgrounds, correspondences, hob-

Marcia Bartusiak, the author of "Thursday's Universe," is writing a book about how astronomers discovered the composition of the heavens.

bies and laboratory notebooks of celebrated scientists.

Anecdotal evidence does suggest that certain creative habits can be acquired. J. J. Thomson, the discoverer of the electron and a recipient of the Nobel Prize in Physics, trained nine Nobel Prize winners, 32 fellows of Britain's Royal Society and 83 professors of physics. And Mr. Root-Bernstein marshals good arguments that many mythical chance discoveries were not lucky breaks at all, but more like unanticipated detours in well-designed research efforts. In this regard, "Discovering" is a good detective story. Take the case of Alexander Fleming. As the legend goes, a stray penicillium mold lands on a bacteria-filled petri dish in Fleming's laboratory. About to discard the dish, Fleming suddenly notices that the mold has dissolved the bacterial colonies. *Voilà!* Antibiotics. But Imp deduces from circumstantial evidence that Fleming merely noticed at first the errant mold's mild antiseptic properties; only after deliberately culturing the mold did he clinch that the bacteria were being wiped out. "Fleming clearly experimented with anything he could lay his hands on, wherever he found it," Imp points out. "That was part of his research style. Playing." Good scientists seem to design experiments that will yield surprises; they foster the conditions. Examinations of a host of notable achievers in science show them to be broadly educated, with more than a passing interest in art, music, poetry and literature. Often making their mark in previously unfashionable or neglected areas of research, they retain a childlike curiosity about the world.

Does this book's fictional approach succeed? Yes and no; the device wears thin after a hundred pages. That the author has done his homework cannot be doubted. But the characters spew forth nuggets of wisdom in machine-gun fashion. Perhaps only Mr. Spock could carry this off with élan. Moreover, the reader can never really be sure where Mr. Root-Bernstein himself stands. Richter calls Freud a charlatan and relegates computer science to mere number crunching, apparently dismissing the seminal work of John von Neumann and Alan Turing. Are these the

author's own thoughts, fanciful comments or opinions he has heard in the scientific community?

As a historian, he overromanticizes the lone scientist arriving at profound insights with third-rate equipment. "The atom was split by Otto Hahn in 1938 using apparatus that fit on a desktop," it is noted, suggesting that the best science is nearly always this simple. More disturbing is the air of cynicism that pervades the book, evidently springing from Mr. Root-Bernstein's personal battles with "Big Science." A running subplot, overly technical and incomprehensible to the nonspecialist, has Imp attacking molecular biology's most cherished dogmas; the footnotes reveal that Imp's challenge is based on the author's own biological research. From off-the-record comments I hear among researchers, the scientific bureaucracy indeed seems to need shaking up, but the author's digs at the workaday scientist may alienate the very audience he must persuade.

It is only in the last quarter of the book that Mr. Root-Bernstein convinces. Coherence finally replaces frantic fact-tossing. His findings are billed as controversial, but I do not find them as far removed as he does from past explorations of this issue. He presents an evolutionary model of scientific development: Ideas in science are selected or retained through a form of natural selection. As new species often arise in regions of geographical isolation, so too are many great discoveries made on the peripheries of science. A scientific revolution's "paradigm shift" (a concept introduced in 1962 by Thomas Kuhn in his "Structure of Scientific Revolutions") could then be viewed as the sudden emergence of the new species on the broad plain of science. All too short, this 25-page section should really be extended into a more standard work. Mr. Kuhn cannot be effectively challenged in a fictional setting.

THE author concludes with a long list of prescriptions for encouraging discovery. He recommends no less than a complete overhaul of how science is funded and taught. Demolish the system of students marching lockstep through a succession of prerequisites, he says; the diversity necessary for scientific advancement is lost with such cloning. And fund people, not projects. Of course, this strategy raises many problems. How will grant givers differentiate between the self-deluded and a bona fide visionary? Someone in the end will have to make the decision, creating a whole new form of Big Science. Mr. Root-Bernstein is certainly not the first to make many of these statements on cultural evolution and the revamping of funding procedures, and he does credit his predecessors. What he adds is a cry of urgency: "Could Darwin carry out his twenty-year program to restructure biology within the present academic system? . . . Would anyone read Einstein, publishing from a patent office? . . . I say that unless we start making provisions for such rare and valuable scientists now — for learning, thinking, and doing individually and eccentrically; for the disorganization of science — we'll have no great scientists in the future, and no great scientific breakthroughs, either."

"Discovering" is sometimes frustrating, chaotic and, in several places, obscure, but it is also surprising and thought-provoking. Perhaps it could be a much-needed catalyst for discussion. The odds are astronomical against one book's sundering the entire bureaucratic structure of science. But Mr. Root-Bernstein has lifted his hammer high to try for a good slam. □