BOOK REVIEWS

The Genome Negotiations

The Gene Wars. Science, Politics, and the Human Genome. ROBERT COOK-DEEGAN. Norton, New York, 1994. 416 pp., illus. $25.

On 3 June 1986 at Cold Spring Harbor geneticist David Botstein attended a session ventilating the proposals for a genome project. He suddenly rose to the podium and warned the audience, as Robert Cook-Deegan reports, "There are two components to this. One is political, and we shouldn't forget about the political, because we hope to get something, right?" However, he cautioned that "if it means changing the structure of science in such a way as to indenture all of us . . . to this enormous thing like the Space Shuttle . . . we should be very careful." Cold Spring Harbor was one of the many places where genome projects were then under scrutiny. In 1986, the origins of the Human Genome Project had not yet been traced back to the discovery of DNA structure or to the rediscovery of Mendel's laws of inheritance. The words "inevitable" or "natural" were not associated with the notion of a systematic effort to map and sequence human DNA. The genome initiative was a highly negotiated issue, and its open-endedness was both scientific and political.

Gene Wars is Cook-Deegan's account of these negotiations. His book is the story of how "scientific ideas took hold only after they were publicly aired, provoked a vigorous debate, and were then repackaged to make them politically palatable" (p. 11). As he reminisces in his first chapter, Cook-Deegan became interested in human genetics in the 1970s while attending medical school. From 1986 until 1988, he directed the team that followed the human genome project (HGP) at the Office of Technology Assessment (OTA) of the U.S. Congress. As a forefront actor, he wondered why molecular biologists who study bacteria, yeast, fruit flies, or nematodes, rather than human geneticists, set up the initial agenda for the project, why officials in the Department of Energy embarked upon a crusade for mass sequencing, and how the project should be redefined in order to achieve a consensus. Cook-Deegan's experience in Washington enabled him to get at these questions by focusing on the policy-making process, on "how a highly conspicuous decision was made in the highest reaches of government" (p. 357).

Enriched by unpublished sources ranging from personal letters and notes taken at meetings to an impressive number of phone calls and interviews, the book is a rare achievement in HGP literature. Cook-Deegan's narrative is presented with verve and clarity. He summarizes the scientific background of the initiative, then concentrates on its bureaucratic context, on the various tribes on Capitol Hill, and on the quirks of personalities that shaped the U.S. genome project. Some of his genome stories (for instance Robert Sinsheimer's attempt to secure a $36-million donation to the University of California at Santa Cruz by planning a DNA-sequencing institute) have been told so many times that they have become popular myths. It is refreshing to see them situated in context.

Cook-Deegan's approach to the origins of the HGP is unusual for a scientist. His description of the technical background suggests that the HGP was in effect already under way in 1986. Mapping and sequencing tools were not altogether satisfying, but they were at hand. Programs targeted at a systematic study of the genomes of small organisms were being run by centers like the Laboratory of Molecular Biology in Cambridge (U.K.) or research consortiums like the European Molecular Biology Organization. Single-chromosome surveys were being coordinated by the national laboratories at Los Alamos and Livermore. Sequence data were being collected and distributed by the National Library of Medicine. DNA sequencers were being developed by biotechnology companies like Applied Biosystems, which worked with Leroy Hood's laboratory at Caltech. The great promise of the polymerase chain reaction had been acknowledged by the scientists and technicians working at Cetus Corporation. Some of the instruments were on the verge of entering the market.

In contrast to the substantial list of authors who have jumped from these facts to invoke some form of technological determinism, Cook-Deegan stresses not tools and machines but the technological vision of molecular biologists like Botstein, Sydney Brenner, Renato Dulbecco, Walter Gilbert, or James Watson. Techniques fostered desires for expansion of the work, regulation of laboratories, and large-scale coordination. As Maynard Olson argued in 1987 at the meetings of the National Research Council committee on the HGP, projects—in the words of Cook-Deegan's summary—"should be considered genome research only if they promised to increase scale factors by threefold to tenfold (size of DNA region to be handled or mapped, degree of map resolution, speed, cost, accuracy, or other factors)" (p. 131).

Cook-Deegan is at his best when writing on the U.S. arena. He extracts from the detailed story of the negotiations that redefined the HGP several insights regarding the medical prospects. In 1987, once Charles DeLisi got a go-ahead for the genome plans from his superiors at the Department of Energy (DOE), he tried to obtain support from the Office of Management and Budget and from its authorization committees in Congress. According to Cook-Deegan, DOE's program prompted a quick reaction from the National Institutes of Health (NIH) and from biomedical scientists. The dissatisfaction of prominent molecular biologists and allies was targeted at what they perceived as a misguided bureaucratic initiative and as a potential threat to their own funding. Equally important was the absence of some of the technical elements. DOE emphasized DNA sequencing technology, computation, and physical mapping. Genetic linkage mapping, the basic tool of pathological-gene hunting, was subsidiary in its scheme. In addition, DOE paid scant attention to the study of nonhuman organisms. Cook-Deegan notes that by 1990 the genome project "was redefined so that genetic linkage maps and physical maps of model organisms and humans were accorded first priority, with sequencing to follow when (and if) it became affordable and sufficiently rapid" (p. 106). Clearly, he considers this change to have preserved the medical utility of the program. He gives credit to the National Academy of Sciences, NIH, and Watson for the achievement.

This conflict between DOE and NIH has been a fashionable topic for shop talk among students of science policy. Though he writes about opposing constituencies, Cook-Deegan is too much an insider to believe common tropes about the inevitable competition between bureaucratic agencies. He portrays the tension as the outcome of a multifactorial and circumstantial process. Meanwhile, he reminds us of some basic rules of science policy-making. Creating a program is considerably easier than burying one. So when DOE started the initiative, the best way to secure it would have been, as Cook-Deegan and OTA seem to have advocated without much result, to abandon attempts to estab-

lish a lead (or a single) agency controlling all the funding from one pot and to prepare for coordination. Moreover, policy is made in many places, and asking for crashing initiatives in Congress is not always the best strategy. Even when medical prospects are straightforward, stepwise decisions may be easier to secure. Thus NIH got a program started within the bounds of existing missions. Yet, the increment was not envisioned. Expansion resulted in redefined goals like the short-term priority accorded small organisms.

Finally, the book shows that the making of scientific consensus was not isolated from the search for political support. Though letter-writing campaigns focusing on "big science" have attracted attention, Cook-Deegan recollects more substantial issues. For instance, the argument that, in 1987, opposed Watson and Ruth Kirschstein, then director of the National Institute of General Medical Sciences, was a matter of administrative structure (investigator-initiated grants versus concerted program) as well as an echo of practical and ideological rifts within the biomedical communities (individual gene hunting versus centralized data collection). The end of the conflict as well as the medical reshaping originated in the formation of a core set of biologists who assessed the program in various places, among them the National Research Council, the NIH Director's Advisory Committee, and the Delegation for Basic Biomedical Research. Accordingly, an implicit message of *Gene Wars* is the subtext underlying the comparisons of the HGP with the moon-shoot: what was at stake was the fate of an NIH–university nexus jeopardized by governmental emphasis on biotech companies and budget deficit.

The observations of an "insider" are enlightening but not always satisfying. Cook-Deegan's account of the role of OTA suggests that the office was instrumental in helping molecular biologists secure a large-scale initiative. Rather than assessment of the HGP, OTA was rapidly involved in its enhancement. This may explain hesitations in addressing the broader economic, and social issues that the HGP forces society to face. Cook-Deegan presents the program on ethical, legal, and social implications as a welcome addition to the HGP, but he clearly favors studies preparing for implementation and regulation of the applications of genetic knowledge. Unfortunately, the book suffers from a narrow definition of these uses. Though interesting, the patent issue is a minor one compared to changes in medical practice, if only because of the complex linkages among the politics of biological identity, attempts to reduce the cost of health care, and the increasing prospects for the diagnosis of predisposing factors. Pointing to the impossibility of a return of Nazi-like eugenicism in a democratic society or to the fallaciousness of the choice set up between genetic determinism and environmental determinism, although not mistaken, is of little help here. One may wonder if a scant interest in the problems regarding medical practice is not a price the author paid for the distinction between the HGP as political phenomenon and the HGP as science. The fate of PCR-based diagnostic techniques shows that, contrary to what Bernard Davis claimed before the U.S. Senate Committee on Energy and National Resources in 1990, biomedical research is not exactly "what we would be doing today if there were no human genome project." Five years later, these technological developments still are in need of good social studies.

Jean-Paul Gaudillière
Institut National de la Santé et de la Recherche Médicale, 75743 Paris Cedex 15, France

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Fieldwork in the North

Science in the Subarctic. Trappers, Traders, and the Smithsonian Institution. DEBRA LINDSAY. Smithsonian Institution Press, Washington, DC, 1993. xviii, 176 pp. + plates. $34 or £26.50.

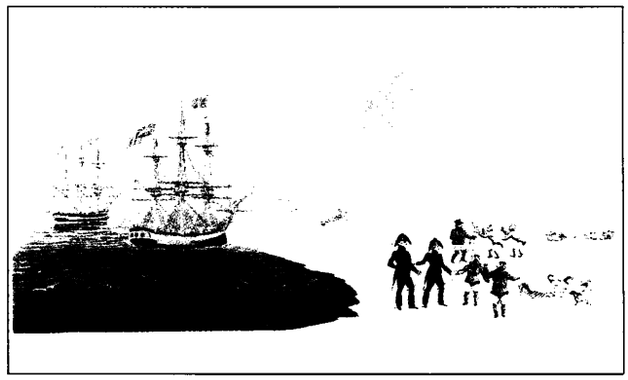
Science and the Canadian Arctic. A Century of Exploration, 1818–1918. TREVOR H. LEVERE. Cambridge University Press, New York, 1993. xiv, 438 pp., illus. $64.95 or £40.

These are decidedly not trivial books, of provincial interest only to Canadians. They involve the transformation of field sciences such as botany and geophysics during the 19th and early 20th centuries into systematic sciences. They concern the importance of organization, abstraction, and politics in sciences often wrongly categorized as merely descriptive. They are about the genesis of the support mechanisms needed for science conducted in the polar regions. They should interest historians of science, but also scientists interested in polar work.

John Rae showing map and relics of the Franklin expedition after bringing them home from the Arctic. [From *Science and the Canadian Arctic*; Byrne & Co. Photographers, National Archives of Canada]

Debra Lindsay's book examines three interlocking case studies. First she focuses on the early Smithsonian Institution and Spencer Fullerton Baird's responsibility—first as assistant secretary and later as secretary of the institution—for building a network for systematic natural history collections in subarctic North America. Baird believed that the field data available in the 1850s were inadequate for developing or testing theory. He promoted a reformation of collecting to de-emphasize rare specimens in favor of larger samples. To settle questions about geographical distribution, he stressed representative sampling techniques. He developed an early biometrics.

Lindsay's other two case studies follow the working out of Baird's collection network through the actions of Robert Kennicott, now a rather obscure figure. Kennicott recruited native residents of the Mackenzie River region and factors of the Hudson's Bay Company to collect, ultimately, over 12,000 specimens for the Smithsonian. Later, he tried to replicate this success in Russian America (Alaska). The Mackenzie River project was a great success; the Alaskan failed.



"The Royal Navy meets the Esquimaux," a drawing by John Backhouse published in John Ross's *Voyages*, 1819. [From *Science and the Canadian Arctic*; Metropolitan Toronto Library]