BOOKS: HISTORY OF SCIENCE

Before the Fall of the Wall

Joachim Sauer

At a 1988 meeting in Moscow, the East German leader Erich Honecker proudly presented Mikhail Gorbachev with the first functioning model of a 1-megabit storage chip and announced that mass production of the chip would begin soon. Was this chip really "made in the GDR [German Democratic Republic]"? thus proving that an advanced level of science and technology had been achieved without any of the political reforms demanded by Gorbachev. Had the science and production structures shaped by the Communist Party paved the way to the leading edge in a key technology? Did the "socialist" university and the party's cadre policy finally succeed and create the highly motivated, highly competent specialists who achieved this success? Or was the microchip project an enterprise of prestige that consumed all investment resources of the GDR economy and, thereby, accelerated its collapse? Perhaps the chip was neither produced nor designed in GDR, but was instead acquired in the West by a special task force of the Ministry for State Security (Stasi) that was dedicated to technology transfer? What many suspected then can now be proved: The most innovative methods of the GDR computer industry were those the Stasi used to procure blueprints and samples of electronic devices.

Science Under Socialism
East Germany in Comparative Perspective
Kristie Macrakis and Dieter Hoffmann, Eds.
Harvard University Press, Cambridge, MA, 1999. 396 pp. $55, £34.50. ISBN 0-674-79477-X.

Naturwissenschaft und Technik in der DDR
Dieter Hoffmann and Kristie Macrakis, Eds.
Akademie Verlag, Berlin, 1997. 294 pp. DM 78. ISBN 3-05-002955-2.

The computer industry is one of the fields whose development in the GDR is analyzed in the contributions to *Science Under Socialism*, a collection of articles edited by the American Kristie Macrakis (a historian of science at Michigan State University) and the former East German Dieter Hoffmann (a research scholar at the Max Planck Institute for the History of Science, Berlin). Hoffmann was the primary editor of a somewhat different German edition, which was released in 1997 under the title *Science and Technology in the GDR* (*1*). The contributors focus on the period from the end of World War II through the late 1960s. We learn many details. For example, a major factor in the relative decline of East Germany's chemical industry, despite party slogans like "chemistry yields bread, wealth, beauty," was the delay in switching input materials from coal to petroleum.

Other factors surface in several chapters. Cooperation with the "big brother" Soviet Union looked smooth only in political speeches; in reality, conflicting interests raised many problems. These divergent interests contributed to the failure of such initially promising projects as a nuclear reactor and a passenger plane. The party placed great expectations on scientists who had been employed as "specialists" in the Soviet Union and who returned to Germany only in the early 1950s. The heritage of the Nazi period was ubiquitous. To limit defections to the West, the intelligentsia was treated not only with a stick (political interference) but—until the wall was built—also with a carrot (special benefits, outstanding positions). Other recurrent factors are the impacts of a centrally planned economy evident in the lack of up-to-date research equipment, the absence of technical infrastructure (which hampered industrial implementation of new technologies), and the preference for prestige projects and major investments regardless of the GDR's limited economic power. Although all these phenomena have been previously noted (and many have been emphasized in slogans), how they interact in particular situations makes for interesting reading.

Engineering, nuclear technology, and genetic and biomedical research are also examined in the English edition; the German volume includes chapters on aviation, East German computing up to the 1970s, and the careers of biologists. Besides providing these portraits of individual disciplines, the contributors aim to reconstruct the development of institutions and to place developments into a general political context. Interest in the universities' first decade under the GDR arises from the question of why the East German intelligentsia was never actively involved in political protest movements, in contrast to their counterparts in Hungary, Poland, and Czechoslovakia. The chapter about the Leopoldina (a learned society with an international membership, founded in 1652) reveals how some brave professors in Halle managed to maintain the independence and all-German character of this institution. In contrast, the Prussian Academy in Berlin was renamed the German Academy of Sciences and transformed into a "socialist research academy."

The Academy of Sciences dominated research in the GDR, but it was dissolved after the reunification. Was that the best course of action? Or could such an organization (which combined a learned society with research institutions and employed more than 20,000 people by 1989) have offered a model for a 21st-century academy? This remains an emotional question, even 10 years after the wall came down. It is emotional for those who lost their privileged positions, but also for those who, under socialism, were hindered in doing science or denied a career for political reasons. In such a situation, is there any chance of creating an objective picture of science under socialism? This is a question the editors had to ask themselves when starting their project. Some of the contributors come from the United States and presumably have enough distance. About an equal number are Germans, from both East and West, who were actors in the play they study.

The editors had good reasons not to wait with these studies. They were prompted by the opening of the party and Stasi archives, and they also knew that a valid reconstruction of

Piecemeal evidence. Visitors at a September 1999 open house look at some of the 13,000 bags of documents shredded by the Stasi in the interval before their central building was stormed by civil rights activists in January 1990.

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GDR science can only be achieved if the information found in these archives is contrasted with eyewitness accounts. The importance of interviewing surviving participants is underscored by the story of the 1-megabit chip. Friedrich Naumann's chapter (in the German edition only) about computer science and technology in GDR still identifies "the completion of the first functioning model of the 1-megabit storage chip by a collective of the combine Carl Zeiss Jena" as a "milestone" and an example for "performances that deserve unconditional respect." In contrast, Macrakis's chapter about espionage reports that "by the time the wall fell, the GDR had not produced any 1-megabit chips. It turned out the sample was just a dummy acquired from the West." Even the Stasi files lack evidence for this conclusion (which does not really surprise insiders), but it is backed by an interview with a former Stasi officer.

Science is made by people, and the books gain another dimension through their biographical chapters. One describes the singular story of Robert Havemann. As a communist and resistance fighter, he was sentenced to death by the Nazis. He later became a stalinist and reached a very powerful position in the GDR during the 1950s, but turned into a dissident in the 1960s. The life of the psychologist Kurt Gottschaldt is less known, but no less peculiar. He managed to adapt his career (and his science) to the rise of the Nazis and the later political change to socialist Germany. After conflicts with his institute, the party, and state officials, he left in 1962 for West Germany, where he finished his career. The German edition also includes a chapter on Friedrich Möglich, who lived and worked through the Nazi years and in the GDR until 1957.

The books are most fascinating where they report facts precisely, compare developments, and reveal connections. The emerging picture—though far from complete—is compatible with what I witnessed as a student in high school and university and as a researcher in the academy. The various authors provide different degrees of interpretation from different points of view. Much effort is made, not least by Macrakis, to be fair: "nor did we follow the well-worn thesis of the adverse effects of authoritarian political ideology on science." One author warns that "the very fact that the GDR as a state came to an end can seduce a historian into viewing its history teleologically." All these precautions and warnings do not help. After having read chapter after chapter, no reader will escape the conclusion that this political system—with the way it ran science and the economy and the way it wasted human resources—is bound to fail when high technology becomes a necessity.

Someone trained in Marxist dialectics would conclude that the GDR's system collapsed from its own antagonistic contradictions. This conclusion emerges even from the facts reported by an author who views the reforms of the science system in the 1960s as a "failed reform experiment" and who still believes that the GDR could have been saved had only "the opportunity to initiate and implement substantial reforms...as a means of transforming society" not been missed. I do not think that anybody who reads these books would wish to participate in another "laboratory experiment" of this kind.

References and Notes

1. Besides differences noted elsewhere in the review, the U.S. edition includes an introductory chapter that offers an interpretive analysis of GDR science, while the German volume has a prologue that provides a short overview of the chapters. An account of computers and politics is restricted to the English version, and the German book contains an extensive bibliography (current to mid-1997).

BOOKS: PHYSIOLOGY

Wondrous Senses

Richard Gregory

The variety of sensory systems that provide signals beyond human experience stretches our imagination, and the search for explanations of how such systems function challenges our most sophisticated technology. Among these systems are the sonars of bats and dolphins, the recognition of patterns of polarized skylight by bees, the magnetic compasses that contribute to global migration by birds, and the use of electric field distortions for orientation and prey detection by fish that inhabit murky waters. Many of these abilities are also linked to communication, as in the waggle dance of bees (which signals the direction and distance to nectar by reference to the sun).

Sensory Exotica
A World Beyond Human Experience
by Howard C. Hughes
MIT Press, Cambridge, MA, 1999. 359 pp. $26.95, £16.95. ISBN 0-262-08279-9.

Sensory Exotica is a journey into how surprising discoveries have been made; the contributions of key individuals are described with sufficient, though not overwhelming, technical detail. Hughes, a professor of psychology at Dartmouth College, writes with the enthusiasm of a gifted amateur (in the best sense) whose search of the scattered literature has found so many treasures to share that he enthralls the reader. He offers a personal account of his search (rather, perhaps, than research), but he sticks to the known facts, and his occasional speculations and comments on the nature of science itself are not intrusive. The author's discussions are further enriched by the attractive and informative illustrations.

Hughes relates, with appropriate detail, the remarkable ability of bats flying in complete darkness to avoid fine wires even in the presence of a thousand other bats using sonar at the same wavelengths. He also discusses the ability of bees to navigate when the sun is not visible. His account (which assumes almost no basic knowledge) starts with the physics of polarization, describes how light is polarized by atmospheric particles, and leads to a summary of the special adaptations exhibited by the receptors of the honeybee's eye. Particularly intriguing is how the bee achieves what looks like complicated computing to use the sky-polarization patterns. Computing in the brain is avoided because the eye's anatomy solves this special problem in an analog way. This surely has lessons for artificial intelligence and how we should think of neural processes of the human brain: specialized analog modules that avoid computing seem to be very important. (The pattern recognition and adaptive learning capabilities of tiny insect brains also challenge artificial intelligence because man-made computers can now simulate appropriate numbers of active neutrons.)

These themes are not, however, developed in the book, which has little on the central integration of signals or how they may be read in terms of behavioral needs. It might be said that "simple" animals have complex senses designed to avoid high-level signal processing; whereas our eyes, for example, are far less sophisticated because our brains can handle—and need to, for our greater range of behavior—relatively raw unprocessed data to deal with a wider range of selections. Although the author does not explore the processing required for behavioral demands or the relations between the kinds of signals available from senses, he offers plenty to think about.

The wondrous capabilities that Hughes discusses are only beginning to be understood. One obstacle to progress has been the need to isolate overlapping senses when several are used to complement one another. (This is a particular problem for bird navigation, in which different senses are used when one or more are inoperative.) But the challenging questions could attract anyone with a sense of curiosity and skills in biology or information technology (some knowledge of both would seem important). *Sensory Exotica* may inspire budding scientists to pursue this rich field of inquiry.

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