BOOK REVIEWS

Fly Culture

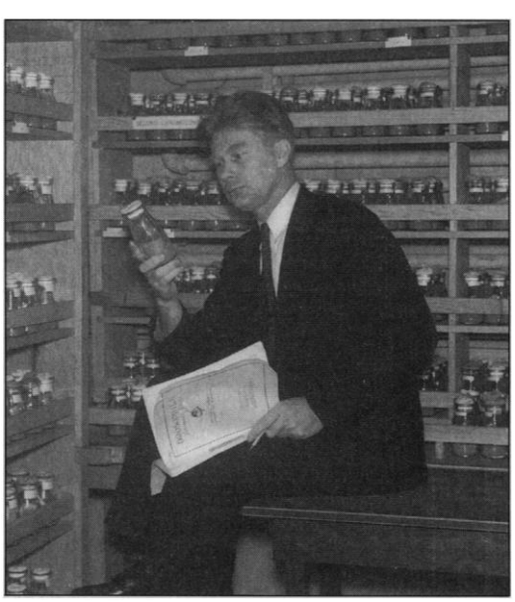
Lords of the Fly. *Drosophila* Genetics and Experimental Practice. ROBERT E. KOHLER. University of Chicago Press, Chicago, 1994. xvi, 321 pp., illus. $45 or £35.95; paper, $17.95 or £14.25.

For more than a half-century prior to the *Origin of Species*, the idea of evolution was notorious. Its proponents were nearly all intellectual and social radicals whose principal interest was in the explosive implications they believed that evolutionism would have in philosophy, religion, and politics. Established professional scientists, by contrast, dismissed evolutionary arguments as the puerile speculations of irresponsible amateurs. Charles Darwin made evolution scientifically respectable, not so much by convincing his colleagues that natural selection was the true cause of species change (few were converted) as by showing them the intricate technical problems that interest in evolutionary "contrivances" opened up. Darwin sought to push the controversial Big Questions of design and purpose to the intellectual margins.

A similar situation—if of less world-historical moment—has existed during the last two decades in the analysis of science. Sociology of scientific knowledge has become infamous in some quarters (see for example Paul Gross and Norman Levitt's *Higher Superstition*, recently published by Johns Hopkins University Press) because its proponents have used their investigations of the unruliness of scientific work to undercut traditional justifications of science's privileged access to truth and cultural authority. Biochemist-turned-historian Robert Kohler proposes to deflate this heated polemical atmosphere through a recognizably "Darwinian" maneuver. He argues that experimental practice—more specifically, the "material culture" of science—is a subject intricate and important enough to be investigated in its own right. The Big Questions of scientists' proximity to truth and distance from virtue can take care of themselves; investigation of practice opens up new problems worth the combined attention of social scientists, natural scientists, and administrators.

Lords of the Fly explores a canonically successful experimental innovation—*Drosophila* genetics as developed by the Columbia University "fly group" and their allies between 1910 and 1940. In contrast to other writers on early genetics, Kohler does not focus on the chromosome theory; rather, his watchword is "follow the fly." He recounts how *Drosophila* entered scientific laboratories, how it was reconstructed by geneticists to serve their purposes, and how its particular characteristics altered the behavior and values of the people who cared for it. Analysis of this bit of scientific material culture presents scientists as intellectual workers, concerned above all with maintaining the productivity that *Drosophila melanogaster* made possible.

Kohler emulates recent ecologically minded historians in presenting *Drosophila* as an autonomous actor following its own evolutionary script. It evolved as a cosmopolitan human commensal and hitchhiked to North America in the mid-19th century with the expansion of the tropical fruit trade. In the early 1900s it "colonized" a few American laboratories, not as a tool for studying heredity (this field was dominated by domesticated species, such as mice and peas, which already displayed noticeable variations) but primarily as a cheap means for biometric studies of variation. When drosophilas began to display their remarkable mutability to T. H. Morgan in the early 1910s, however, they rapidly displaced other species from the protected niche of the urban biology lab; instead of having to endure the multifarious hazards of life on banana boats, they found solicitous scientists who would smuggle them around the world in "cozy, protected mailing tubes" (p. 53).



"Calvin Bridges in the Caltech *Drosophila* stockroom, circa 1935, with the first issue of *Drosophila Information Service*, containing his catalogue of 'standard' *melanogaster* mutants and map locations." [From *Lords of the Fly*; California Institute of Technology Archives]

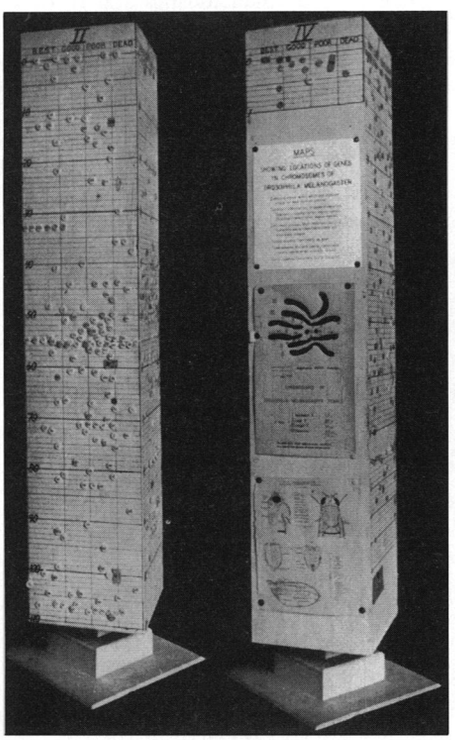
At the same time the fly was an actor in natural history, it was also a rapidly changing technology. The key event in the "construction" of *Drosophila* was Morgan's initiation, together with undergraduate assistants Alfred Sturtevant and Calvin Bridges, of the chromosome mapping project. Kohler argues that the shift from characterizing mutations in terms of the organ affected to their placement on a linkage map was less a matter of theory change than a practical contrivance to manage the flood of mutations that the flies provided. For two decades, drosophilists organized their work around the construction of standard stocks that would "conform to the ideal principles of Mendelian theory and chromosomal cartography" (p. 78). Influenced by recent studies of computer innovation, Kohler emphasizes that work on *Drosophila* was a continuous process of designing and "debugging" new bugs, each more powerful than the last for solving problems and opening new lines of investigation.

The natural characteristics and technological potential of *Drosophila* structured the behavior and values of the "fly people"—the network of scientists whose careers depended on this insect. Morgan ("the boss") and Sturtevant and Bridges (his "boys") developed a particular ethos as part of their quest for production. Their remarkable openness in recruiting new workers, exchanging stocks, and sharing information helped to spread out the work and at the same time enhanced the credibility of their claims. Poaching was discouraged. The Columbia (after 1928, Caltech) group was able to maintain this "moral economy" because they informally controlled both the flies and the papers (as indicated by the photo at the left).

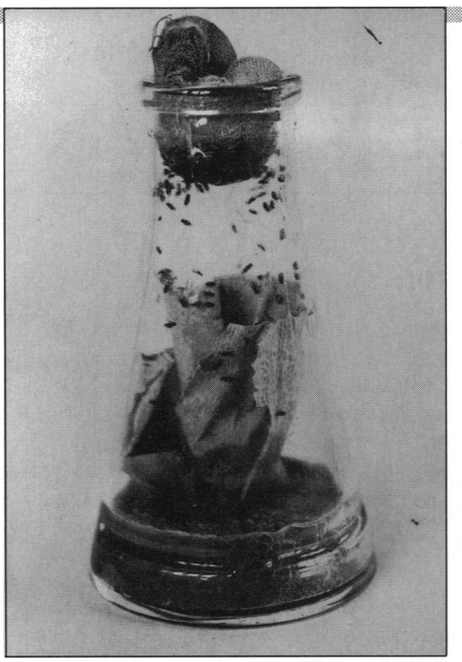
Kohler follows *Drosophila melanogaster* to the point in the late 1930s when it approached the limits of its initial burst of productivity. He describes how drosophilists' immersion in mapping prevented them for two decades from dealing effectively with problems of development and evolution and how the division of authority between "boss" and "boys" became dysfunctional as Morgan passed 70 and the boys moved into their 40s. New, truly interdisciplinary, approaches to

development and evolution did arise in the 1930s, but at considerable cost to both fly and fly people. George Beadle's work with Boris Ephrussi on the formation of *Drosophila* eye pigment led him to abandon the fly for the bread mold *Neurospora*. Theodosius Dobzhansky made a smaller shift in organism (to the wilder *Drosophila pseudoobscura*), but his novel work on the genetics of natural populations so disrupted the Caltech status hierarchy that he felt compelled to leave for Columbia. New species correlated with new species of scientific work.

It should be clear that Kohler presents an account that is Darwinian in many more senses than that with which I began. His grounding of his story in ecology, his emphasis on experimenters' construction of "contrivances," and his effort to blur the distinction between artificial and natural phenomena, as well as his plethora of "just-so stories," are all intellectual tools whose use Darwin pioneered. The image that results is both socially realistic and philosophically materialistic; yet there is grandeur in this view of science, in which the most wonderful forms of knowledge are shown to have come from relatively ordinary labor processes. It contrasts sharply with the "evolutionary epistemology" advanced by more explicitly philosophical analysts; their rootless analogies and complex abstractions owe more to Herbert Spencer's modes of thought than to Darwin's.



"Calvin Bridges's 'totem pole,' a four-sided working and valuation map showing locations of mutant genes and their relative usefulness for mapping." [From *Lords of the Fly*; T. H. Morgan, *Journal of Heredity* **30**, 356 (1939)]



"Fly culture in specially designed bottle with yeasty banana pulp and absorbent paper." [From *Lords of the Fly*; courtesy of American Philosophical Society, Stern Papers]

Because of his Darwinian deflationary strategy, Kohler demurs at providing any Big Answers at the end of his story. A reader interested in the implications of his account is left hanging. How, apart from details, would the study of material culture in fact "transform" traditional accounts of science? Was "production"—the drosophilists' highest value—peculiar to them, to American science, or to the 20th century? How did the experience of "experimental life"—a provocatively ambiguous phrase—affect modern scientists' identities? Since Kohler shows that *Drosophila* genetics was produced by a quite small group of people working with an extremely versatile organism, one can question whether his story is fully representative of experimental science, and whether, as he claims, it provides an "endlessly productive" model for future historical work.

Darwin, of course, confronted similar dissatisfactions due to his peculiar strategy. While contemporaries admired his efforts to unravel adaptive mechanisms, few emulated him. At the same time, they continued to dispute the Big Questions, and they did so with relatively little attention to the specifics of Darwin's thinking. Still, Darwin made evolution respectable and thereby transformed the intellectual landscape of his time. Kohler takes a considerable step toward doing the same for the study of experimental work. If he is successful, the result will be, in Darwin's phrasing, "truly wonderful."

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Fatal Disharmonies

The Ghost of the Executed Engineer. Technology and the Fall of the Soviet Union. LOREN R. GRAHAM. Harvard University Press, Cambridge, MA, 1993. xvi, 128 pp. + plates. $22.95 or £17.95.

Loren Graham has written a wonderful book about the relationship between technology and society. He has woven together an account of the life and work of a Russian engineer, Peter Palchinsky, and an analysis of the failures of Soviet engineering projects. The result is an elegant and concise essay on the dangers of engineering which ignores human values.

Peter Palchinsky was born in 1875. After graduating from the Mining Institute in St. Petersburg in 1900 he was appointed to a commission to investigate why coal production was falling in the Don Basin. His task was to study the living and working conditions of the miners. He spent two years gathering information, but his data exposed the bad conditions at the mines, and he was dismissed from the commission.

Palchinsky was exiled to Siberia during the 1905 Revolution but escaped in 1908 to western Europe, where he spent five years as a successful consultant. He wrote a detailed analysis of the ways in which the big European ports might be improved. His basic argument was that the workers' living conditions—housing, schools, public transportation, medical care, recreational facilities—were as important as cranes, wharves, and warehouses. Productivity and efficiency depended not only on technology but on the social system in which the technology was embedded.

Palchinsky returned to Russia in 1913 and set up an Institute of the Surface and Depths of the Earth. The Institute's motto, which is just as relevant today as it was then, was taken from an ancient Russian epic: "Our land is great and rich, but there is no order in it." Palchinsky supported the Provisional Government in 1917. He was arrested by the Bolsheviks when they seized the Winter Palace, which he was helping to defend. After his release he worked for the new government. Although he disliked the Bolshevik regime, he believed that he should serve his country.

Palchinsky supported the Bolshevik goal of making Russia a great industrial power, but his conception of industrialization differed from Stalin's. He believed that engineers had a central role to play in drawing up plans for economic development and providing objective advice; he stressed the importance of realistic policy goals; and he argued for attention to human needs in