Book Reviews

The Stuff of Heredity: Discoveries Recounted

The Transforming Principle. Discovering That Genes Are Made of DNA. MACLYN MCCARTY. Norton, New York, 1985. 252 pp., illus. $14.95. The Commonwealth Fund Book Program.

Readers of Watson's *The Double Helix* might be excused for having concluded that scientific research need never be tedious, protracted, and dull provided you are smart and that long hours spent at the bench are not a necessary qualification for international honors so long as you meet the right people and have access to the latest data. If they go on to read McCarty's book they will surely be disabused of the former impression, though perhaps not of the latter. For here we are presented with a full, authoritative account of the researches carried out over a period of more than a decade into the curious change of "type" undergone by any one type of the pneumonia bacterium, pneumococcus, when injected in the "naked" unencapsulated ("rough") form into the host together with dead encapsulated ("smooth") pneumococci of another type. These types were distinguished immunologically and by the constitutions of their "sugar coats" or capsules. It was in 1944, 16 years after the English Ministry of Health medical officer Fred Griffith announced his discovery of this "transformation" of types, that Avery, MacLeod, and McCarty at the Rockefeller Hospital published their identification of the agent of transformation in pneumococcus as DNA. During the ensuing decade the candidacy of the nucleic acids as the hereditary material of genes and viruses as well as of pneumococcus was increasingly promoted, so that when the Watson-Crick model for DNA was presented in 1953 together with suggestions concerning the structural basis of its genetic functions there was no strong opposition.

Although the author is clearly an interested party, his analysis is fair-minded, and the authority of his account rests securely on his historical researches, in which personal recollections have been checked against documentary evidence wherever possible. Humor and pathos mark the vignettes of Avery, as when he shut his desk to hide the mass of unanswered correspondence or sat beside McCarty in the lab, aged, depressed, uncommunicative, and lonely.

The importance of this book, however, lies in the answers it offers to the many curious aspects of the transformation story: What were the respective roles of the three Rockefeller scientists in the work they jointly published in 1944? Why was the research carried on so intermittently, even being virtually discontinued from 1938 to 1940? How soon were they convinced that the transforming principle was DNA? Why were they cautious about the genetic implications of their work? Why was the Rockefeller protein biochemist Alfred Mirsky so cold toward them and so opposed to their conclusions? How well known was their work and what reception did geneticists give it?

Others, among them Rollin Hotchkiss, have attempted to answer some of these questions, but McCarty's book gives the clearest and most convincing answers to all of them. Although there is no trace of malice or unfriendliness, these answers are not altogether flattering to either MacLeod or Avery. From his study of the laboratory notebooks and annual reports to the directors of the Rockefeller Institute, McCarty has established that MacLeod and Avery had not come to the conclusion that the transforming principle was DNA by the time of MacLeod's departure in the summer of 1941, although they had discussed the possibility as a result of finding that their active extracts gave a positive reaction in a test for the sugar (deoxyribose) in DNA. Even in May 1941, when they observed the conversion of an active extract to a fibrous product on addition of alcohol, they did not associate this with fibers of DNA, but rather with the soluble polysaccharide derived from the bacterial capsules. The fact that this stringy extract was particularly effective in transforming cells suggested to them that the capsule-producing enzyme, which the recipient cells developed under the influence of the transforming principle, was effective only when "primed" by a pabulum of the polysaccharide itself. Effective extracts, they mistakenly concluded, required the presence of the soluble polysaccharide.

McCarty joined the hospital in the autumn of 1941. That winter he showed that the polysaccharide was not necessary and that even in its absence the alcohol extracts were stringy. When in the spring of 1942 Mirsky and Pollister gave McCarty and Avery samples of mammalian DNA extracted by their salt technique and told them how to produce a stringy precipitate that could be wound onto a rod, the conviction that their transforming principle might be DNA led to experiments directly testing the supposition. There was, recalled McCarty, no "moment of sudden revelation." Instead his account breathes serendipity, but by the summer of 1942 they were convinced.

McCarty devotes generous space to the important subject of the impact of the 1944 paper, especially on geneticists. He rejects Stent's view that the paper was poorly received because it was premature and Wyatt's opinion that their discovery did not "become knowledge" because it could not be extended experimentally for technical reasons. Curiously he does not refer to Hotchkiss's fine study of this subject in the *Annals of the New York Academy of Sciences* (vol. 325, 1979), but his recollections of the negative reaction of most of his audiences rather belie the positive significance attributed by some of us to the many occasions upon which bacterial transformation was on the program of scientific meetings.

In sum, this book deserves the attention of anyone who is interested in the development of modern biology; for those seeking to contribute to the history of 20th-century biology it is essential reading.

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The Work of Medicine

Social Organization of Medical Work. ANSELM STRAUSS, SHIZUKO FAGERHAUGH, BARBARA SUCZEK, and CAROLYN WIENER. University of Chicago Press, Chicago, 1985. xii, 310 pp. $25.

The work of medicine is changing. The classic image of the single practicing physician treating a sick patient's acute

illness, through deeply embedded in our consciousness, less and less reflects the real world of medicine. Chronic rather than acute diseases are the dominating medical problems. Increasingly, we are calling upon complex medical technologies to manage and treat these kinds of illnesses. And we rely on diversified and specialized medical teams to direct these technologies and coordinate their efforts toward therapeutic ends. This has resulted in a transformation in the social organization of medical work, at least as it is performed in hospitals.

A striking feature of large hospitals today is the tremendous amount of equipment they contain. There are machines that are used for diagnosis, for therapy, and for monitoring. Hospital administrators and staff pride themselves in having the most, newest, and best equipment. The widespread utilization of this machinery has profoundly altered the way medical work is structured, not only for doctors but for nurses, technicians, patients, and kin as well.

Anselm Strauss, Shizuko Fagerhaugh, Barbara Suczek, and Carolyn Weiner present us with a rigorous and detailed analysis of how work is accomplished in highly technologized hospitals. On the basis of several years of field observation and interviews by a team of observers in a variety of hospitals, the authors clearly illuminate the complexities of chronic disease and medical care organization. By using *the work itself* as a focus of analysis, they insightfully show how complicated, varied, and often unrecognized the actual "work" is.

In presenting their analysis—and this book is truly an analytic piece, going well beyond "mere" description—the authors use "illness trajectory" as the central concept. This is a refinement and clarification of an earlier conceptual development by Strauss. Eschewing notions like "course of illness," which they suggest are too narrow to comprehend what happens with chronic illness, they see a trajectory as referring "not only to the physical unfolding of a patient's disease but the total *organization* of work done over that course [of illness], plus the impact on those involved with the work and its organization" (p. 8). Trajectories can be seen "in terms of *clustered sequences of tasks* that constitute the details of trajectory work" (p. 30).

The bulk of the book is given to detailing the myriad of types of work that go into managing and shaping illness trajectories. There are chapters on clinical safety work (a central feature of medical care), comfort work (reducing patient discomfort caused by disease and medical interventions), sentimental work (interactional, emotional, and supportive work), articulation work (coordinating, revising, and implementing other work), and patient work (much of it invisible and unrecognized). The sociological lens Strauss and his associates use to examine and disaggragate hospital work, especially that surrounding medical technology, allows us to see the amount and complexity of activities that constitute medical care and forces us to begin to see "work" where we did not recognize it before. I was particularly taken by the authors' descriptions of patient and kin work, a central but seldom noticed or acknowledged part of medical care.

The book includes intermittently a number of long but interesting illustrations of specific examples of the work involved in shaping and keeping trajectories under control (a key medical goal) and a specific examination of how actions in the intensive care unit and intensive care nursery affect the hospital structure and vice versa.

This book is excellent in examining the tissue of medical work in technologized hospitals. However, the authors tell us much about the what's and how's but little about the why's. There is a stylistic penchant here for cataloguing types of work (four types of monitoring, eight kinds of comfort tasks, seven types of sentimental work, and so on) and presenting us with long lists (of properties of medical machines, or monitoring, or safety limits). Such an analysis often paints a static rather than a dynamic picture of medical work. Strauss *et al.* tell us a great deal about the impact of technology on medical work but do not analyze the professional fascination with medical technology or explain the sources of the expanding "technological imperative" in medicine. Since the authors promise us three more books from the project, one hopes they will broach these issues elsewhere.

In sum, this book presents a unique contribution to the sociology of work and to our understanding of the human effects of technology in hospitals. In light of the apparently unceasing growth of medical technology, the types of work examined here are bound to become more evident and central to medical care. This well-grounded and precise study will likely remain significant for years to come.

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Oscillating Chemical Reactions

Oscillations and Traveling Waves in Chemical Systems. RICHARD J. FIELD and MÁRIA BURGER, Eds. Wiley-Interscience, New York, 1985. xxii, 681 pp., illus. $85.

Chemical curiosities—this was the label often attached to oscillating chemical reactions. Nowadays, however, such reactions are the subject of active research by scientists in widely different disciplines. It is recognized that chemically reacting systems provide some of the best-characterized examples of nonlinear dissipative systems. Such systems, in the far-from-equilibrium regime, not only display complicated periodic motions but sometimes behave chaotically as well. Complicated temporal behavior is not the only possibility; spatial structures can form as a result of the interplay between chemical reactions and diffusion.

The phenomena exhibited by these chemical systems are worthy of study in their own right; they provide physical examples of dynamical behavior whose mathematical basis is often unknown. They also serve as paradigms for more complex biological systems, which are often poorly characterized.

This book contains an account of oscillatory behavior and spatial pattern formation in chemically reacting systems. It begins with a description of some of the principal results in bifurcation theory; this is surely appropriate since bifurcation theory permeates the analysis of most of the experimental studies presented later in the volume. Roughly speaking, the remainder of the material in the book may be divided according to whether the focus is on the chemistry of the process under consideration or on the general character of the bifurcation structure exhibited by these systems. In those parts of the book devoted to chemistry, an attempt is made to understand the origin of the oscillatory behavior from an analysis of the mechanism of the chemical reaction. There are chapters devoted to the Belousov-Zhabotinskii reaction, everyone's favorite, as well as to a number of other liquid-phase and gas-phase reactions. "Well-stirred" chemical reactions can be modeled by sets of ordinary differential equations and thus are amenable to study by the use of the techniques of dynamical systems theory. The focus is not on the chemistry leading to a particular model but rather on the variety of possible behaviors given a particular class of models. Some chapters have this focus, but those that do are