

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 pabu-

lum 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