The DNA trail

THE DOUBLE HELIX: A PERSONAL ACCOUNT OF THE DISCOVERY OF THE STRUCTURE OF DNA. By James D. Watson. 232 pp. Atheneum, New York, 1968. $5.95

by Samuel Devons

By now everyone has either read, read about, talked about or reviewed *The Double Helix*. As a narrative by a leading actor in a brilliant climactic episode in a decade or two of the most dramatic scientific development, it cannot fail to capture the imagination and attention of a wide variety of readers. The impact and reactions are as wide ranging as the audience. Anything one writes now about *The Double Helix* is inevitably as much a review of reviews (or reactions), as a review.

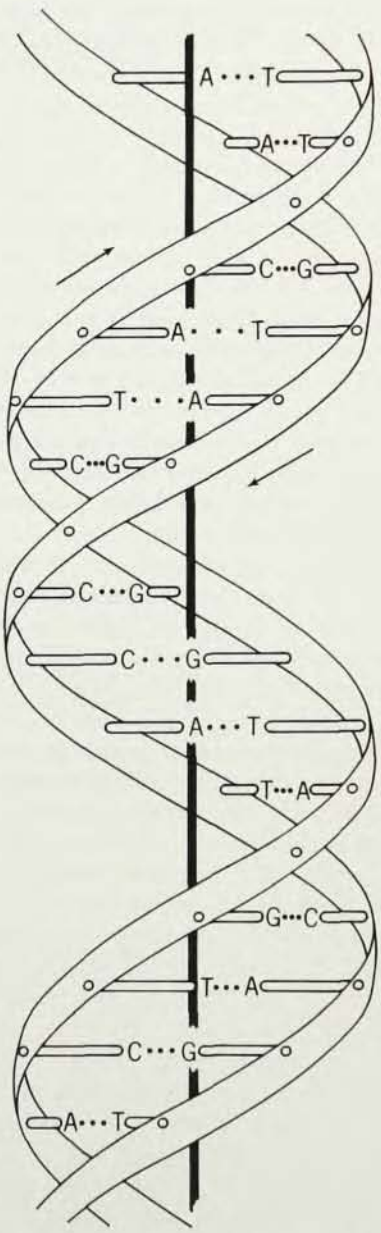
To the lay reader, it has been said, it offers a candid, inside view, one of immortal science created by mere mortals, with all their human frailties, pecadillos, ambitions and vanities. (Few practicing scientists have any illusions on this score!) Its frankness has been compared, in the foreward by Sir Lawrence Bragg, to Samuel Pepys; to others it evokes the vicariousness of a peeping Tom. To some its personal viewpoint enables it to capture the real spirit of scientific discovery; to others (including, apparently, Maurice Wilkins and Francis Crick, who shared the laurels with Watson) it is *too* personal to offer true insight into what actually took place. Perhaps the most telling, and almost teleological, description is that on the dust cover itself: "A personal account of the discovery of the structure of DNA, a major scientific advance which led to the award of a Nobel Prize."

Some scientific readers might have welcomed (as a postcript?) a fuller account of other sequels to the discovery; and the historians of science, more of the historical background leading up to the discovery. For these additions we must await the perspective of time, as well as other personal, and perhaps some impersonal, accounts of the events. All that is feasible here is some comment on features that may be of interest to the readers of PHYSICS TODAY.

What makes the history of DNA, and molecular biology in general, of particular interest is the sudden convergence of a whole host of "physical" scientists (physicists, chemists, crystallographers)—H. J. Müller, Max Delbrück, Erwin Schrödinger, George Gamow, Wilkins, W. T. Astbury, J. D. Bernal, Max Perutz, Crick, Linus Pauling, John Kendrew—on the problems of biology. That an individual and outstanding physicist might turn his hand—or his attention—to biological problems is no novelty. Hermann Helmholtz and James Clerk Maxwell are but two obvious examples. But this concerted effort, in which almost a whole new science is created, is perhaps unique. It would be wrong to suggest that in storming this citadel of biology (the gene) there were not many others, following what might well be described as the more orthodox avenues of microbiology, genetics, cytology and biochemistry, who were engaged in the attack. But in a sense they were outflanked by the exphysicist, exchemist, neomolecular biologists. Remarkably, Watson, an "orthodox" biologist by upbringing, appears as the sole representative of biology in this remarkable company of neobiologists. This fact, perhaps, explains the rather scanty reference in *The Double Helix* to the concurrent biological developments.

Some of the other idiosyncrasies of the book are not so easy to fathom, particularly for someone not well versed in the biology of the period (roughly 1945–55). There is so much here that is extraordinary and dramatic but clearly incomplete. What are we actually reading? An account of a great discovery? An account, as it now appears, by someone who was right in the thick of things, and played a leading part? Or an account of events as someone would have them appear to us? Is it history, or diary, or autobiography, or drama constructed out of all these with some artistic license to heighten the effect? These questions are germane to any attempt to glean from this book some appreciation of the general question of how, and how far, physical measurements such as x-ray diffraction contribute to an understanding of biological function. On this question Watson's ambivalent attitude is quite puzzling.

In 1951 it would have been extra-



DOUBLE HELIX. The two sugar-phosphate backbones twist about on the outside with the flat hydrogen-bonded base pairs forming the core. With these base pairs as the steps the structure resembles a helical staircase.

ordinarily sanguine, as the author occasionally avows, to expect that knowledge of structure, that is, three-dimensional conformation as distinct from chemical structure and bonding, could make more than a very limited contribution to understanding the operation of biologically interesting materials. The long and intensive x-ray studies of the three-dimensional structure of proteins are an example in point. On the other hand, by 1951 the key genetic material had been *chemically* identified as deoxyribonucleic acid, and many of the *essential* features of its structure had been surmised by the organic chemists (see page 53). The letters "DNA" were not just the label of some genetic "stuff," notwithstanding Watson's contempt for "boring chemical facts" and the "chemists who never provided anything incisive about the nucleic acids" (page 31). That the genetic material was a particular nucleic acid appears to be a pretty incisive fact! Moreover there was the strong clue in Erwin Chargaff's observations (1950) of the base-pairing ratios. What then was the significance of the great chase for the "structure," with the dominant recurrence of the helical theme, the heightened suspense of the far-away threat from Pauling (the pioneer of the helix) and the comings and goings between Cambridge and London?

Intuition? Perhaps; but it was hardly foreseen that the helical structure, per se, would be almost irrelevant, except insofar as it—or any other structure—could provide some clues and checks as regards the precise nature of the chemical structure and bonding? The earlier double-stranded models with the central sugar-phosphate backbone and Mg^{++} ion bonding (page 87), whether compatible with the helical structure or not, had no hint of the complimentary base pairing that was to be the outstanding feature of the Watson–Crick model. And the subsequent diversion into tobacco mosaic virus RNA (now known to be a single-stranded molecule!) clearly reveals the obsession with the helix itself (page 114).

The most direct impact of the x-ray studies appears to have come from the work of Wilkins and Rosalind Franklin with the newer B-conformation, which not only left little doubt about the helical structure (page 169), but much more specifically revealed that " . . . the meridional reflection at 3.4 Å was much stronger than any other reflection. This could only mean that the 3.4 Å-thick purine and pyrimidine bases were stacked up on top of each other in a direction perpendicular to the helical axis" (page 175). Since this juxtaposition of the purine and pyrimidine bases (about which the new B-pattern gave such a strong clue) is at the very heart of the *essential* feature of the Watson–Crick model, it is surprising to find, in the later letter to Delbrück, the x-ray information was treated rather slightingly.

We are given the impression that this "homing-in" on the DNA "structure" was a goal-directed operation from the start. It's the old story of *post hoc ergo propter hoc.* This situation has been for a long time a troublesome matter for biologists: What some have seen in evolution to be a goal-oriented process, most regard as the result of random mutation and selection. But it is surprising to find a leading molecular biologist with such teleological propensities!

Scientific developments apart, there are other singular features of *The Double Helix.* The description of the cozy atmosphere of English (in contrast to American) science and its implication of different shades of ethical behavior is convenient but hardly convincing. There is also throughout a curious duality—even a contrast—between the deliberate brashness of what is related and the intermittent urbanity of style. There is a candor that is at times difficult to equate with accuracy, and an ambiguity that makes it difficult to know whether an impression is being recalled or created.

A strong breeze certainly blows through these pages, but with it comes whiffs of insalubrity; and as the chase and the narrative race on, there is sometimes left behind the lingering scent of an obscure trail. Perhaps one should read *The Double Helix* as a thriller—which it certainly is—although there is no doubt about whodunit!

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Helium, the stuff of cryogenics

THE PROPERTIES OF LIQUID AND SOLID HELIUM. By John Wilks. 703 pp. Oxford U. Press, London, 1967. $24.00

by Ralph P. Hudson

Helium, surely the most interesting of all the elements, has not been with us very long—although it is and has been familiar to the great majority of this planet's physical scientists, which is, perhaps, more significant. Its existence has been known for 100 years, its identification on earth occurred 80 years ago, and its first liquefaction took place in 1908. It is, of course, in its condensed state that helium manifests its unique properties and, with superconducting metals, exhibits quantum behavior on a macroscopic scale. And through its agency all other matter

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