# Book Reviews

## A Mathematician

**Alan Turing**. The Enigma. ANDREW HODGES. Simon and Schuster, New York, 1983. xii, 587 pp., illus., + plates. $22.50.

Interest in computers and their history has prompted a host of books and articles tracing the development of the new machines. At the same time declassification of wartime documents has brought to light the dramatic accomplishments of the ultrasecret British cryptanalysis establishment. The English mathematician Alan M. Turing (1912–1954) played crucial roles both in the work at Bletchley Park, where the German code was cracked, and in the early British computer projects. Andrew Hodges's new biography of Turing explores the personal side of both enterprises and offers new insights into the wide-ranging interests and accomplishments of the remarkable Turing.

Turing's first major publication, "On computable numbers, with an application to the *Entscheidungsproblem*" (the problem of decidability), appeared in 1937, during a two-year absence from Cambridge. This work, which took on a problem posed by Hilbert, revealed Turing's mathematical talent. It also introduced the innovative and fruitful concept of a universal machine, now known as a "Turing machine," capable of executing a series of operations on sequences of binary digits. The logical question of solvability also figured prominently in Turing's influential article (published in 1939) on systems of logic based on ordinals.

The same year Turing left Cambridge and began a nine-year association with the British cryptanalysts of the Government Code and Cypher School in their attack on Enigma, the machine on which nearly all German military radio communications were enciphered. Hodges provides a lengthy account of Turing's meritorious service in this endeavor, on which depended the safety of convoys supplying the needs of besieged Britain. It illustrates how Turing's thinking about universal machines and his concern with solvability found concrete application in cryptanalysis.

After the war questions of computers occupied much of Turing's attention, first at the National Physical Laboratory, where he worked on the Automatic Computing Engine, and then at the University of Manchester, where he served as assistant director of its computer project. He was particularly intrigued by the possibility that a machine might learn, as discussed in his article "Computer machinery and intelligence," later reprinted in J. R. Newman's compilation *The World of Mathematics*. Turing continued to publish on mathematical topics in group and semigroup theory and exploited the new computing technology in calculations on the Riemann zeta-function. His long-standing fascination with mathematical pattern in nature gave rise to work on "The chemical basis of morphogenesis," in which he explored a mathematical model of embryonic growth.

Unlike previous biographers of Turing, Hodges does not skirt the issue of his subject's homosexuality: schoolboy attachments, the atmosphere of discreet decadence at Cambridge in the 1930's, Turing's 1952 arrest for homosexual activity, and the decision of the court to prescribe estrogen therapy. As a member of the gay liberation movement, Hodges discusses with considerable detail and sympathy the social, legal, and political circumstances facing Turing and other homosexuals in postwar Britain and draws attention to the American insistence that the British intelligence establishment rid itself of security risks, including homosexuals. Turing's untimely death, perhaps by his own hand, took place in just this atmosphere of suspicion.

The author, who bills himself as a historical journalist, brings training in mathematical physics and extensive research to bear on his subject. The book, nearly 600 pages long, would have profited from more vigorous editing—in particular, the pruning of metaphor. The image of America as the land of Oz, with Turing as Dorothy and John von Neumann as the Wizard, is especially jarring. Readers will appreciate, however, the care with which Hodges follows the often tangled threads of Turing's intellectual development: solvability and computability, determinism, the significance of mathematical patterns in nature. The book offers incidental, and illuminating, portraits of other notable scientific personalities, among them C. G. Darwin, Turing's boss at the National Physical Laboratory, and M. H. A. Newman, architect of the Manchester computer.

Any Turing biographer faces a trying task, not just because of the breadth and depth of his subject's interests and ideas. As Hodges puts it, "At every stage his life raised questions about the connection (or lack of it) between the mind and the body, thought and action, intelligence and operations, science and society, the individual and history." Hodges has pieced together many of Turing's cryptic answers to these questions and has depicted the complexity of circumstances in which Turing's "ruthless, raw view of science" found expression. The fundamental message conveyed by the book is one of alienation and anomaly. Turing is portrayed throughout as the solitary, eccentric, often misunderstood scientist, disinclined to provide the administrative leadership demanded by modern team research. His ideas often outraced the ability of his contemporaries to appreciate them; his rejection of social conventions brought him in direct conflict with the authorities. The subtitle of the book can thus be read both as an emblem of Turing's career and as a suggestion that Turing's inner code remains unbroken.

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## Fluvial Processes

**Rivers**. Form and Process in Alluvial Channels. KEITH RICHARDS. Methuen, New York, 1982. xii, 358 pp., illus. $35; paper, $17.95.

The study of the physical form and processes of rivers is of interest to two breeds of researcher: the river engineer and the fluvial geomorphologist. Keith Richards is a fluvial geomorphologist, but he has written a book that is of interest and use to all scientists studying rivers. This is a rare accomplishment. It is necessary to go back two decades to find a book on rivers (Leopold, Wolman, and Miller's *Fluvial Processes in Geomorphology*) that so successfully transgresses disciplinary boundaries.

*Rivers* has ten chapters. The first is an introduction setting out the broad issues and allowing the author to clarify his position on some of the unresolved questions concerning the theory of river form and process. The next eight chapters