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STEVEN J. DICK, Sky and Ocean Joined: The U.S. Naval Observatory 1830-2000. Cambridge: Cambridge University Press, 2003. Pp. xiii+609. ISBN 0-521-81599-1. £90.00, $130.00 (hardback).

Histories of scientific institutions, as the author notes, are relatively sparse in the history of science. This is particularly true of nineteenth century American institutions, and especially astronomical organisations. The U.S. Naval Observatory, as the oldest of these, has perhaps been neglected owing to the routine nature of its work. It has been responsible for maintaining the Master Clock, and thus the time standard for the United States; it studies positional astronomy, and determines the parameters of earth orientation; and, it compiles sundry almanacs relating to astronomy, geodesy and navigation. Consequently this book classifies the work undertaken at the Naval Observatory as "normal science" in Thomas Kuhn's sense, and "falls largely within that category which he calls "data gathering"" [p.22]. Despite the institution's circumscribed remit, this is not a history that over-emphasises progress and order. Indeed, it attempts to represent the sometimes chaotic nature of science from the perspective of its practising scientists. Dick distinguishes his book from the majority of written history of science "which emphasizes revolutionary events and heroic figures", and identifies it as more representative of the majority of science which remains as yet unwritten.

Written over a period of 15 years at the Observatory, the book focuses on three perspectives: the history of astronomy, of science in America, and of navigation in the context of the U.S. Navy. The institution was part of a national observatory movement, and a relative latecomer in the pattern of governments supporting astronomy for the national interest. It began as the U.S. Navy's Depot of Charts and Instruments in Washington DC in 1830, following several previous attempts to found a national observatory for accurate coastal surveying. For such purposes, stellar position measurement, prediction of planetary positions and accurate timekeeping were crucial scientific activities. One of the interesting lines explored by the book is the institution's interactions between traditional 'positional astronomy' and the newer subject of astrophysics. As one of the guardians of the older tradition, the Observatory came to be seen by some as increasingly outmoded during the twentieth century, but has been rehabilitated by more recent recognition of the links between positional astronomy and modern astrometry.

A permanent American science was established during the lifetime of the Naval Observatory, and the book explores its wider interactions with individuals and organisations. It divides the history into three parts: the founding era, up to 1865; the golden era, 1866-93; and the twentieth century. During the founding period, it was transformed from a small depot for navigational data and instruments, into a national observatory under the supervision of Matthew Maury, who departed in 1861 to join the Confederate cause at the start of the American Civil War. The book explores the importance of individual actions, policy-making and political manoeuvring in establishing and expanding the

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institution. The golden era, by contrast, is discussed chiefly through the work of three scientific figures: Asaph Hall, who employed the Observatory's Great Refractor telescope to discover the moons of Mars; William Harkness, who directed the observations of the transits of Venus in 1872 and 1888; and Simon Newcomb, Professor of Mathematics, U.S. Navy and later Superintendent of the Nautical Almanac Office, whose wide-ranging work included mentoring Albert A. Michelson and their precise determination of the speed of light. The activities during the twentieth century focused on identifying new uses for the astronomy of position, and much more accurate means of measuring and disseminating time and navigational information.

The institution drew its original mandate and scope from the needs of the U.S. Navy. In this respect, it is interesting to contrast its history with later small science-centred government agencies within a large agency (i.e. the Department of Defense); one recent study that springs to mind is Jeffrey T. Richelson's The Wizards of Langley: Inside the CIA's Directorate of Science and Technology. The authority over the Naval Observatory, which was passed between six different Navy organizations over its 170-year history, illustrates the variable relationship between purposeful applied research and less tethered investigations.

This is a relatively expensive but finely produced book rich in detail about an early exemplar of American institutional science, and one that complements studies of its other nineteenth and twentieth-century counterparts very well.

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