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BOOK REVIEWS

The Hydrology of the Nile. J.V. Sutcliffe and Y.P. Parks, 1999. Wallingford, England: International Association of Hydrological Sciences, IAHS Special Publication No. 5, 179p. £34.00, ISBN 1-901502-75-9.

This volume, focusing on Nile river flow, is of timely interest to coastal specialists. The Nile is the longest river in the world (~6700 km, 4°S to 32°N) and, until recently, it was the single most important source of river water released into the Mediterranean. Currently, however, it only discharges to the sea about 10% of its former (c.1900) flow, changing eastern North African and Levant coastlines significantly. This tale of flow change along its northward course is aptly told by this experienced duo. For over 50 years the senior author, J.V. Sutcliffe, has been closely involved with the hydrology of the Nile and, as the photo on page 62 in this volume shows, he truly has "drunk the waters of the Nile." He and Y.P. Parks have rendered a service not only to hydrologists, but also to geographers and climatologists by compiling a technical, yet readable, book that highlights the links among all major tributaries, from the source in Lake Victoria in central Africa to the end of the Main Nile fluvial 'pipeline' in Egypt. Hydrological and climatological data are presented in a fashion that clearly shows how each of the major tributaries of the Nile basin differ from each other and how each plays a significant role in overall flow of this system. In their scheme, the Nile is viewed as one long interconnected hydrological entity, with each tributary superimposing a seasonal fluctuation derived from the hydrological characteristics of the immediate region.

Systematic hydrologic study of the Nile system began early in the 1900s. Until now, investigators seeking information on this basin have customarily been directed to the comprehensive sixty volumes plus supplements of *The Nile Basin* series published in Egypt from 1931 to 1978 by H.E. Hurst and his collaborators. As might be expected, not all volumes of that encyclopedic collection are readily available, and some of the high-quality data has been superceded as a result of marked climatic and human-induced changes during the past half century. New dams have been built and canal and irrigation works initiated. Moreover, some stretches of the Nile—spread over ten countries—are now even more difficult to access than in the past (*e.g.* Rwanda, Uganda, Sudan). Compounding difficulties, some hydrologic equipment has been neglected or destroyed in recent years, and political tensions in some regions have resulted in suspension of hydrological work. The present volume updates hydrologic information gathered through the end of the 20th century.

The Nile basin, with a catchment area of nearly 3 million km^2, is extremely varied in topography, climate, vegetation and river flow. Early in the book, the authors outline the roles of rainfall and runoff, evaporation and vegetation in determining inflow-outflow balance. This introduction is followed by a review of early investigations on Nile flow. It is apparent that compared with the size of its basin, the total flow of the Nile is relatively small. Rainfall, distributed between two seasons, is high in the East African Lake region. Effects of this precipitation, however, are not recorded by the Nile below Lake Victoria, where flow is hampered by large marshes that cause blockage and where water loss by evaporation prevails. In contrast, heavy rainfall occurs within a single season in the Ethiopian highlands, and this rain flowing swiftly across rugged topography in the Blue Nile and Atbara sub-basins gives rise to high concentrated runoff and sediment loads.

Nine chapters summarize the specific Nile tributaries and their sub-basins where aspects of water levels, inflow-outflow balance and evaporation are discussed. The story begins in the Lake Victoria basin and surrounding highlands, with emphasis on rain clouds above the lake which control seasonal water level fluctuations and consequent lacustrine outflow contributions to the White Nile downstream. Direct rainfall on Lake Victoria and East African lakes below it (Albert, Kioga) attenuates flow to the upper White Nile. A particularly fascinating section of the book describes the Sudd wetland region and area at the confluence of the White Nile and the Sobat. Here the links between hydrology, vegetation and evaporation are quite dramatic. Recognition that as much as half the inflow is lost in the Sudd wetlands resulted in formulation of engineering schemes, including construction of the Jonglei Canal to allow the White Nile to bypass the Sudd, reduce water losses and supplement low flows on the Blue Nile. Construction of the canal was begun in 1978, but, although 2/3 completed, work was suspended in 1983; the waterway would have shrunk the wetland and adjacent grazing areas, but increased much-needed downstream flow to Sudan and Egypt. Very fortunately, at least for the time being, a natural rise of Lake Victoria since 1964 has tripled the Sudd areas of permanent flooding. Below the Sudd, the Bahr El Ghazal is unique among Nile tributaries in that its outflow to the White Nile is almost negligible; the Bahr El Ghazal swamps, as those of the Sudd, play a major role in inflow loss by evaporation. With needs for Nile water increasing continuously, it is a safe bet that we have not heard the last of projects to artificially bypass wetlands, and thus save water in this region.

Farther along its northward flow, the White Nile reaches the Machar marshes where flow doubles as a result of input from the Sobat. This tributary captures runoff from the Ethiopian mountains and, in fact, contributes about a sixth of the entire Nile flow. While obviously significant, the Sobat basin remains an area much in need of exploration: it straddles a difficult-to-access sector near the border between Sudan and

Ethiopia. Not surprisingly, as the White Nile crosses the eastern Sahara between the Sobat and Khartoum it experiences additional evaporation losses. It is at Khartoum, however, that the Blue Nile provides the major contribution ($\sim$ 60%) to what becomes the Main Nile flow. During flood, the highly seasonal Blue Nile flow, unlike that of the White Nile, carries significant sediment down steep basin slopes that are relatively sparsely vegetated; the resulting erosion accounts for the bulk of sediment fed to the Main Nile. The Atbara, flowing into the Main Nile north of Khartoum, is the most seasonal of the Nile tributaries. North of the Atbara, no substantial tributary feeds the Nile as it crosses hundreds of kilometers of harsh desert. By the time the Main Nile is trapped in Lake Nasser reservoir behind the High Aswan Dam, the river has lost a large proportion of its original water by evaporation. Although the High Dam (completed in 1964) remains controversial, most people agree—especially the 65 million or so living in Egypt—that water storage at Aswan has successfully created a much-needed predictable mean annual flow between the Sudan border and Mediterranean coast.

The volume's greatest value is its emphasis on the interdependence of each Nile tributary and influence of each fluvial segment on subsequent downstream river flow. From this interconnection it follows that, taken together, changes in rainfall and construction of new dams and water diversion projects in the different countries traversed by the Nile will inevitably alter the present flow balance. The much-needed water supply will likely diminish in some areas. Increased effects of erosion along the Nile delta, Sinai and Israeli coasts, due to much decreased Nile discharge, are already quite evident. More ominous are human-induced "domino effect" water shortages along the Nile system that could cause serious controversy, if not conflict. Reading this book reinforces my hope that collaborative efforts to equitably share Nile water now be intensified by all ten countries that are directly involved.

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