Book Reviews

On a Threshold

The Galactic Club. Intelligent Life in Outer Space. RONALD N. BRACEWELL. Freeman, San Francisco, 1975 (trade distributor, Scribner, New York). xiv, 142 pp., illus. Cloth, $6.95; paper, $3.95. The Portable University. Reprint of the 1974 edition.

Prehistoric man sought intelligent beings across neighboring mountains; the ancients of Greece and Rome ventured across their central "Mediterranean" locations; the early and medieval Europeans voyaged across the New World's oceans; and so it is now that modern civilization has begun to seek out extraterrestrial intelligence across our Milky Way galaxy and perhaps across galaxies beyond.

Evolving from a common biological ancestor which arose from a complex chronology of elemental and chemical syntheses extending over billions of years, we have reached an impasse after having systematically, albeit not terribly intelligently, explored our planet for rational creatures and valuable resources. But given the nearly trillion trillion stars in the observable universe, some of which are bound to have conditions like those on Earth or otherwise suitable for the evolution of intelligent life from abiological matter, it seems almost inevitable that the universe be teeming with life. Consequently, we now find ourselves on the threshold of the next great evolutionary leap forward—gaining membership in the community of galactic civilizations.

How can we make contact with extraterrestrials? Most analysts prefer electromagnetic waves, especially microwaves, as a means, since they are completely unattenuated by interstellar debris. In *The Galactic Club*, R. N. Bracewell reviews the by now standard arguments for eavesdropping with large radio telescopes in order to initiate contact with advanced civilizations. Through rather shrewd, often convincing examples, mostly scientific but some monetary and political, he suggests that, even with an enormous orchid of 1000 or more radio telescopes (Project Cyclops), substantial difficulties would be encountered in any search or precontact phase, especially the precise choice of a radio frequency.

As an alternative to that strategy, Bracewell reviews his earlier proposals that unmanned interstellar probes constitute the preferred method of contact. Enormous amounts of information can be integrated on board messenger probes parked in the vicinity of a candidate star. Bracewell considers at some length, although nontechnically, how we might recognize such probes sent toward our Sun by distant civilizations, and how we might launch probes to nearby stars in the next millennium. Surveying the case for evidence of past extraterrestrial visitations, he does not hesitate, like all good scientists, to assault the chariots of von Däniken.

The Galactic Club is a short, entertaining book that can be read in a few hours. Lively scenarios illustrate the text, from the emergence of life in a prebiological setting to the colonization of substantial fractions of galactic real estate, and novel illustrations are interspersed. The dialogue is nontechnical, completely understandable to the layperson. Bracewell's discussions of political headaches, alien life-styles, and galactic cultures will entertain the most nonscientific minds. For the numerically inclined, there is a Reader's Guide to the more technical literature. I recommend *The Galactic Club* as a supplement for the nontechnical astro-bio courses that are currently enjoying wide popularity on many college campuses. Today's students want to know who we are, where we are going, and how we relate to the remaining portions of our universe. *The Galactic Club* attempts to place answers to these questions in proper perspective.

Ultimately, however, the prospect for contact with extraterrestrial civilizations is a direct function of the number of such civilizations present in our universe. No one's estimate of this number can be better than the uncertainties of some of the key prebiological sequences that precede the origin of life. If there are many chemical evolutionary paths from inanimate matter to more complex organic things, only one of which leads to a living system, then there may not be a galactic club—we may indeed be alone. On the other hand, if life is an inevitable consequence of chemical evolution given suitable physical conditions, then there is little question that our universe is heavily populated. With the scheduled landing of two Viking spacecraft on Mars within a year, the question whether chemical evolution is rare or inevitable may be answered. Given the latter answer, Earth's application for membership in the galactic club may be approved at any moment.

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A National Repository

A Century of Zoology at the British Museum. Through the Lives of Two Keepers, 1815–1914. ALBERT E. GUNTHER. Dawson, Folkestone, England, 1975 (U.S. distributor, Science History Publications, New York). 534 pp., illus. £17.50; U.S. price, $42.

The two keepers of zoology through whom this history of zoology at the British Museum is developed are John Edward Gray, keeper from 1857 until 1875, and Albert Gunther (the author's grandfather), keeper from 1875 until 1895. The remaining years indicated in the title are dealt with only in the briefest fashion. Both keepers contributed in individual and unique ways to the growth of zoology at the Museum and to the growth of the importance of the Museum in zoological study. This book portrays their contributions through a combination of biography and Museum history. It is at times uneven, overemphasizing one or the other aspect without clearly defining the connection, but in general the information about the family backgrounds, early interests in natural history, and education of the principals serves well in providing an understanding of their roles at the British Museum.

Particular contributions to the development of the zoology department of the Museum are described in some detail. Among those of special interest are Gray's emphasis on the need for detailed catalogs, for adequate space for collections and for staff, and for qualified staff, and his concern that the Museum should serve as a place for popular education as well as scientific study. Gray emerges in this study as a museum curator whose first concerns were his curatorial duties and Gunther as a scientist whose researches were his princi-

The Great Zoological Gallery of the British Museum, with royal portraits, Easter Monday 1845. [Reprinted from the *Illustrated London News*, 11 October 1845, in *A Century of Zoology at the British Museum*]

pal contribution to the Museum. The overall roles of the two men are not, of course, as clear-cut as this. Gray made significant contributions through his own scientific researches and Gunther furthered the development of zoology at the British Museum through his curatorial procedures. Among other things Gunther established the principle that as a national museum the British Museum was the proper repository for natural history collections gathered at national expense. Both men were important figures in 19th-century British zoology.

This book was not written as a formal or full history of the zoological activity at the British Museum. Its purpose, to present that history as related to the lives of the two keepers, is adequately fulfilled, but the reader will find many questions posed by the account and will wish the book had gone further in answering some of them. For example, Richard Owen, the leading mid-19th-century zoologist in Great Britain and the superintendent of the natural history departments of the British Museum, is discussed in his relations with Gray and with Gunther, but the effects on the Museum's collecting policies and procedures of differences or similarities in the ideas of the three men are not explored in any depth. Many questions concerning the influence of the scientific community on Gray and Gunther and of the British Museum on scientific activity in general occur, but most are left unanswered. Both men disavowed evolution, but it is not at all clear just what effect this had on the Museum.

The fact that such questions occur to the reader may be one of the best aspects of this book. The book brings an important aspect of 19th-century science to the fore and should encourage deeper inquiry into the many questions it leaves unanswered.

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Neuroendocrinology

Neurosecretion. The Final Neuroendocrine Pathway. Proceedings of a symposium, London, 1973. FRANCIS KNOWLES and LUTZ VOLLRATH, Eds. Springer-Verlag, New York, 1974. xii, 348 pp., illus. $48.40.

In this book, the initial chapter by Sir Francis Knowles paints in warm colors the history of the study of neurosecretion. The chapter was written as an introduction, but will remain as an epitaph for the man who was called the ambassador of neurosecretion, since Knowles died while the book was in press.

The book is the proceedings of the sixth in a series of international meetings on neurosecretion that began in 1953. An unusual feature is the presence of not one but three summary chapters, each reviewing and synthesizing an aspect of the meeting. Another feature is selection of only some of the papers that were delivered at the meeting for full publication, with the remaining represented by abstracts. The section headings indicate the orientation of the editors. One section is called Peptidergic Neurosecretion, and this is subdivided into two parts, one on classical neurosecretion and one on hypophysiotropic neurosecretion. There is an additional separate section headed Aminergic Mechanisms in Neuroendocrine Control. Many of the chapters are so short that their value is limited, but some contain information of appreciable significance. For example, Cross's chapter is an excellent summary of data on the electrical properties of vasopressin- and oxytocin-secreting neurons. The chapter by Björklund and associates, which is a good review of the anatomy of the dopaminergic neurons in the hypothalamus, points out that the posterior lobe as well as the median eminence has a dopaminergic innervation and that there are appreciable numbers of dopaminergic neurons in the hypothalamus in addition to the tuberoinfundibular system. Overall, the coverage of the field is broad, and the book is of value in providing references and some synopses of active areas in neuroendocrine research.

A reviewer would be remiss, however, if he did not challenge the title the editors have chosen for the book. The term "neurosecretion" was coined over 40 years ago, when it was discovered that certain neurons had the morphological characteristics of endocrine as well as neural cells. Since that time, considerable effort has been expended at each symposium on neurosecretion to update the term so that it remains consonant with new discoveries in the burgeoning neurosciences. The definition finally espoused by the editors of this book has three components. They view neurosecretory neurons as peptidergic neurons that secrete their product into the bloodstream and serve as the final link by which the nervous system regulates the endocrine system. However, there is reason to believe that peptidergic neurons end on other neurons as well as blood vessels in various parts of the nervous system. Furthermore, the neuronal products entering the circulation are not all peptides. Most of the circulating norepinephrine comes from sympathetic nerve endings, rather than from the adrenal medulla, and there is considerable evidence that the hypothalamic prolactin-inhibiting hormone is dopamine secreted into the hypophyseal portal vessels by the tuberoinfundibular neurons. The final neuroendocrine pathway is peptidergic in some instances, but in others it is clearly aminergic or cholinergic. Examples include the adrenergic innervation of the renal juxtaglomerular cells, the adrenergic innervation of the pineal gland, and the adrenergic and cholinergic innervations of