and Steinman treat in considerable depth the geological evidence leading to the conclusion that living organisms had already evolved on earth 3 billion years ago. They then discuss the history of the earth at even earlier times (4.5 to 3 $\times$ 10^9 years ago) and deduce the probable conditions existing when life began. There follow two long and detailed chapters on the prebiological synthesis of organic monomers and on condensation reactions giving polypeptides, polynucleotides, and other polymers. Clearly the authors share the reviewer's prejudice that this is the central problem at the present time. These chapters will be most useful to anyone beginning research in the area. The final chapters of this valuable book deal briefly with the evolution of more complex organization and present a general review in the form of a discussion and prognosis.

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Prospects for the State of an Art

Future Goals of Engineering in Biology and Medicine. Proceedings of an international conference, Washington, D.C., Sept. 1967. JAMES F. DICKSON, III, and J. H. U. BROWN, Eds. Academic Press, New York, 1969. xvi + 360 pp., illus. $16.

In light of recent concern with medical care and costs, biomedical instrumentation, the use of computers for diagnosis and hospital housekeeping, artificial organs and transplants, and electronic devices in general, a discussion of the present position and future direction of efforts in biomedical technology was needed. This book is a compilation of the formal presentations and discussions from a conference, sponsored by the National Institute of General Medical Sciences, at which about 45 people apparently knowledgeable on such subjects as biomathematics, prostheses, heart surgery, brain research, engineering, and systems and operations analysis were convened to "assess the start of the art in some key areas [and] identify unique opportunities . . ." for contributions that engineering sciences might make to biology and medicine. This collection of papers reflects both the range of topics that the scope of the conference entailed and the technical interests of the presenters. In the main, the papers are general descriptions of what the authors believed to be of most importance in their respective fields. Whether the authors were wise in their selections can be decided by experts in the different areas. It would be presumptuous for a single reviewer to attempt to assess the scientific or technical merits of all the papers presented. A number of ideas seem to be common to many of the papers, and these will be discussed briefly here.

Most of the speakers concluded that significant progress in biomedical engineering will occur only if multidisciplinary teams of specialists are formed and if sufficient funds are available to support the required research. Impediments to the formation and funding of such teams were noted by a few of the speakers. For example, some commented that the National Institutes of Health lack the personnel to evaluate proposals submitted to organize and support multidisciplinary teams or the projects proposed by such teams. In consequence, others suggested the establishment of one or several nonprofit organizations to evaluate proposals, allocate funds, and evaluate the results and implications of the work performed. Others suggested that NIH exert more effort to hire the required personnel or that a special organization within the government be established to manage a well-funded program. One such organization discussed, which has since been established in the Department of Health, Education, and Welfare, is the Center for Health Services Research and Development. The center will be "concerned with applying new technology in the delivery of health services and will have direct mechanisms for the demonstration of the results of research."

As might be expected, many of the speakers lamented the inadequacy of the universities in producing medico-engineering specialists. In part, I think, the rationale for this lament is similar to that of the complaints about NIH; that is, the universities also consist of enclaves of specialists who do little to encourage the development of specialties other than their own. Along the same lines, most medical schools and organized medicine seem to resist encroachments on the medical arena by nonphysicians. Clearly exceptions exist, but in the main the curricula of medical schools and training hospitals are determined by physicians oriented toward private practice. If the orientation of the schools is to be changed, some of the speakers seemed to imply that no small problem may be to encourage physicians to abandon or forego lucrative private practices for laboratory research, which all agree is needed.

To engineers interested in improving or providing instrumentation the papers presented are likely to be of little interest because the state of the art of biomedical instrumentation is not described in any detail. Indeed, the speakers seem to disagree as to which medical conditions warrant intensive research and development effort. For example, Bertil Jacobson suggests that too much effort has been and is being exerted toward correction of late pathological conditions in which irreversible changes have already occurred. (That the point is well taken is evidenced by the recent heart-transplant operations and the reported reasons for the patients' deaths.) Rather, research should be directed toward the detection and correction of the precursors of disease.

A deficiency of the book may be that some of the speakers cite no references although their presentations have provocative aspects which some readers may wish to explore more closely.

In general the book, especially the discussion section, is well worth reading because it provides an overview of the research and planning going on in some areas of biology, medicine, and engineering. For readers interested in the politics of health research, some of the flavor of the then-ongoing political discussions is imparted also. However, with the arrival of the new administration in 1969, the political orientation is likely to have changed.

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Correction. In a recent listing of Books Received, Loren Eiseley's **The Unexpected Universe** (Harcourt, Brace and World, New York, 1969; $5.75) was erroneously described as a reprint of a 1964 edition. It is a new book, of which only small portions have previously appeared. The chapter titles are: "The ghost continent," "The unexpected universe," "The hidden teacher," "The star thrower," "The angry winter," "The golden alphabet," "The invisible island," "The inner galaxy," "The innocent fox," and "The last Neanderthal."