ture of the executive and legislative branches for handling science affairs; and last, *de facto* science policy, including such matters as the machinery of advice, centralization versus decentralization of policy control, research and higher education, and the problem of priorities.

The author takes a Toynbee-like view of change, regarding it as a product of "challenge and response," and reviews a series of developments that were and are challenging the status quo in government-science relationships and the responses that were being made to them at the time the book was written. Among these developments are: the need for improved planning in the face of limited resources and unlimited growth potential; "big science" and institutional support; the discovery of science programs by the Congress; and the changing character of the environment within which science has been supported since World War II. The review of the general developments is followed by a detailed discussion of two specific issues: the place of the social sciences in the scheme of things (the author favors an independent National Foundation for the Social Sciences) and the changed role of the National Science Foundation (particularly the National Science Board) under the recently enacted Daddario-Kennedy legislation.

The third section of the book is devoted to the author's "prescriptive judgments after examining facts and trends" regarding "the major requirements for more effective science policy in the future." Basic to his judgments is a view that "the major reason in fact for governmental support is the *use* that government can make of science" (p. 226). On this premise, in discussing the support of basic research the author takes the view that "arrangements should be developed accordingly to maximize the feedback of governmentally supported science into government's technological programs" (p. 228). From this standpoint the existing machinery of advice regarding science activities is questioned, with particular attention to the locus of responsibility for the expenditure of government funds. Recognizing that support of academic research raises special problems, the author makes the point that the needs of government regarding the support of science are as much at stake as the needs of the scientific community—the danger is that "a rather small group of [mostly] academically oriented scientists will [by unchallenged advice] impose on government a pattern that suits the separate interests of science without sufficient regard for the interests of government and the public" (p. 232).

Various suggestions are made for legislative and executive changes to improve the policy formulation process and the administrative functions that relate to science activities, both internally and in the more general context of government affairs. These include the creation of a new legislative base for government support of science through a proposed "Science and Technology Act," accomplished by a "Joint Committee on Science and Technology" in the Congress and a Department of Research and Higher Education in the executive branch. Regarding the matter of priorities for support, the pattern suggested is as follows: first priority to those social objectives that are identified politically as most urgent and to which science can most clearly make a contribution; second, science-related educational needs at all levels; third, undirected small-scale research; and fourth, Big Science. The balance among these priorities presumably would be determined by overall science policy, at the hands of the Office of Science and Technology and the Bureau of the Budget. As a final note, the author urges that the scientific community, to further the tripartite partnership between government, science, and the public, explain itself more fully to outsiders. The relationship between government and science has entered a "consolidation period," and the future health of the relationship will, to a large extent, depend upon a broadened base of understanding among the public, the federal patron, and its beneficiaries.

If the author meant to write for the unsophisticated reader the book may be successful in that it may serve to acquaint such a reader, at a superficial level, with the wide range of issues that are involved in government-university relations in the area of science. It also may mislead him, for example, into thinking that the history of relations between government and science begins essentially after World War II, or that the problems of science and the resources to carry out its various activities are relatively independent of national resources as a whole or of the larger political system.

If the book was intended as a serious discussion of national science policy and the problems relating to it, I believe it falls considerably short of the mark. Although the author clearly conveys the notion that government-university relationships in science have moved a long way from the relatively simple circumstances that existed when Vannevar Bush wrote *Science the Endless Frontier,* he does not recognize the extent to which science policies, largely as a result of events that have encompassed social and educational issues on a broader front, have become increasingly enveloped by policies relating to higher education and other pressing domestic needs. It is within this context that the future of national science policy lies, and the future does not, at this juncture, appear to be a very happy one.

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Traveler's Account

The Indians of Texas in 1830. JEAN LOUIS BERLANDIER. JOHN C. EWERS, Ed. Translated from the French by Patricia Reading Leclercq. Smithsonian Institution Press, Washington, D.C. (distributed by Random House, New York). xii + 212 pp. + plates. $10.

In 1828–29 a young French botanist, Jean Louis Berlandier, a member of a Mexican boundary and scientific expedition, traveled widely in what is now south and central Texas. He collected biological and ethnological specimens and compiled voluminous notes on the geography, natural resources, animals, plants, and ethnology of the Indian tribes he encountered. Berlandier's Indian manuscript (now in the Thomas Gilcrease Institute of American History and Art) has been neglected or overlooked by many of those who are interested in Texas Indians, and John C. Ewers, senior ethnologist of the Smithsonian, has performed a valuable service by making this handsome translation available. Also included in the volume are 18 plates (16 in color) of watercolor paintings of various Texas Indians which were executed under Berlandier's supervision, as well as illustrations of an assortment of Indian artifacts collected by him.

By the time Berlandier visited Texas, native peoples had been exposed directly and indirectly to Spanish civilization for three centuries. Its impact had been devastating: some natives, such as

the Coahuiltecans, had been virtually wiped out; others, such as the coastal Karankawas and the inland Tonkawas, were much weakened shadows of what they once had been. On the other hand, the originally distant Comanches had benefited from the unintended gift of Spanish horses and had invaded Texas, driving before them the Plains Apaches. In the first quarter of the 19th century the Comanches were at the peak of their power, and, not surprisingly, a preponderant part of Berlandier's account deals with them. Ewers does not place Berlandier's journal within such historic perspective either in the introduction or in his generally splendid footnotes. The result is that readers who are unacquainted with the Indian history of Texas are apt to receive a distorted impression. The Comanches loom too large, other tribes pale to insignificance, and such distortion is not helped, for example, when such people as the remnant Tonkawas are referred to as "notorious" (p. 8).

Specialists will want to return to Berlandier's original manuscript, since the translation leaves something to be desired ("indios bravos," for example, is translated as "Indian braves," p. 55, whereas "wild Indians," in contrast to mission or other "tame" Indians, was intended, and other inaccuracies might be cited). But in general, the publication of such an obscure manuscript is to be greeted with applause and with the hope that other such materials also will now find their way into print.

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Thermally Stable Substances

High Temperature Resistant Polymers. A. H. FRAZER. Interscience (Wiley), New York, 1968. xiv + 338 pp., illus. $17.50. Polymer Reviews, vol. 17.

This book is a well-written, invaluable but not critical summary of much recent literature directed toward the development of high-temperature-resistant polymers. However, a more accurate title for the book would have been "Aromatic and Miscellaneous Polymers, Some Having Inorganic Structures," since it reviews some of the least stable as well as some of the most stable materials, while essentially omitting some older polymers of comparable thermal stability. Most of the materials reviewed have not been characterized appreciably, or indeed sufficiently to establish that they are polymers. Often the depicted structures are not entirely accurate and represent only part of the actual structures. Incomplete condensations are highly probable in many of the synthetic situations described. This is not the author's fault, since the field tends to foster the pot-boiling approach and most of the substances tend to be nonsoluble and intractable.

One difficulty in discussing the field is the lack of consensus on the definition of "thermal stability" and the mercurial usage of the term in the literature. The author makes a valiant and reasonable attempt at clarification, pointing out the distinction between deterioration of physical properties and deterioration of chemical structure. The reviewer prefers to measure thermal stability by the rate of disappearance of the original chemical structure. Thus in my opinion "rearrangement to more stable structures" is a decomposition and not a factor contributing to thermal stability.

A chapter is devoted to so-called ladder polymers, an ill-conceived though imaginative name for multibonded structures often aromatic and often essentially char. The author does not clearly elucidate that there are two extreme situations for the decomposition of ladder polymers, one trivial and one of substantial importance. If one doubles the number of bonds that must be broken to achieve a given conversion in a given process, will the preexponential factor be halved, or will the activation energy be doubled? For sequential bond rupture the former would occur, and for simultaneous rupture of two bonds the latter.

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Chemoreceptors and Behavior

Olfaction in Fishes. HERMAN KLEEREKOPER. Indiana University Press. Bloomington, 1969. viii + 224 pp., illus. $12.50.

Increasing exploration and utilization of aquatic environments, particularly the recent emphasis upon the world's fisheries for the alleviation of human nutritional deficits, have pointed up many serious gaps in our understanding of the biology of fishes. The operation of their chemical senses is an outstanding example. Specialized chemoreceptors play an important role in feeding and predatory behavior, sexual and social behavior, and the orientation and migration patterns of fishes. The range of pertinent research problems is correspondingly wide, and for obvious practical reasons summaries generally deal with only a few of them. In this case, attention is concentrated strictly upon olfactory organs and behavioral patterns demonstrably related to their functions.

Approximately two-thirds of the book is devoted to the morphology of the olfactory organ in fishes. The remainder is divided, about equally, between electrophysiological and behavioral studies. In making many of the older anatomical findings more conveniently available, the book renders a valuable service. Modern electron-microscopical studies of the olfactory receptor cells are also well represented and illustrated, although for lack of many appropriate data on these receptors in fish there is considerable reliance upon findings in amphibia and mammals.

Kleerekoper's attempt to relate structure and function inevitably suffers from the shortcomings of physiological data and theory. Application of electrophysiological techniques, which dominate the recent physiological approaches to olfaction, is hampered by the smallness of these receptor cells and by the difficulty of obtaining stable recordings from single units in the olfactory epithelium. Again, many of the data cited are from studies on amphibia and mammals, but the controversial aspects of their interpretation are sketched only briefly. Concerning such questions as the exact interpretation of electroolfactograms or the role of pigments in the olfactory epithelium, readers will have to seek other, more extensive treatments in the literature.

The discussion of olfaction and behavior is more detailed, including a review of the studies made by Kleerekoper and his collaborators on the localization of prey by the lamprey. An appendix describing a method of monitoring the locomotor patterns of fishes should be useful to anyone planning such experiments. All in all, this volume will probably be most valuable to specialists, for whom its anatomical and behavioral coverages will be particularly useful.

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