McLaren has himself made significant contributions.

There is extended treatment of "biochemicals" in soil, their isolation and characterization. This is followed by some excellent reviews of certain metabolic processes involving these biochemicals and some alien chemicals that may find their way into soils. A general chapter by C. C. Delwiche entitled "Energy relationships in soil biochemistry" serves as an admirable introduction to this topic. However, among the groups of compounds discussed there are some that do not relate closely to normal soil processes. S. Dagley reviews the microbial metabolism of phenols, particularly dihydroxy-phenols, and other aromatic compounds. The biodegradability of surface-active-agent detergents is examined in some detail by R. L. Huddleston and R. C. Allred. More relevant to events in soils is a concise, effective analysis by P. C. Kearney, D. D. Kaufman, and M. Alexander of the biochemistry of herbicide decomposition, which includes discussion of all the major chemical groups of herbicides. In this the authors touch briefly on the perplexing problem of the development by organisms in the soil population of the capacity to degrade organic compounds believed to be alien in structure to known soil constituents.

At the heart of soil-plant relationships are the events, physical, biochemical, and microbiological, that occur on the surfaces of roots and in their immediate vicinity within the rhizosphere. There has been insufficient recognition of the inhomogeneity of soil as a medium for plant growth and of the fact that the presence of roots introduces effects not easily ascertained by gross chemical studies. A. D. Rovira and B. M. McDougall review this topic in considerable detail. Somewhat surprisingly, Black, in his book, while portraying with clarity the ion-uptake system of roots, forms of absorption, and the carrier theory of transport and accumulation, touches only lightly on the rhizosphere environment or the implications of the presence of a zone of microbial activity surrounding roots and rootlets. Measurements of soil properties or analyses of soil constituents as yet provide little useful information about the immediate root environment.

An excellent feature of Black's book is the generous use of tables taken from original papers to illustrate points being made. Furthermore, each chapter is followed by a listing of citations complete with titles. Both the tabular examples and the bibliographies contain many entries published in the last decade, though the structure of the first edition (published in 1957) has not been changed. Essentially this is first to treat soil as a medium—soil water and soil aeration, water availability, and other factors that affect physical conditions influencing plant growth—and then to discuss the capacity of the soil to supply nutrient elements—exchangeable bases, cation exchange, soil acidity and nutrient availability, salinity and alkalinity. Finally, in three substantial chapters, the soil-plant interactions of the major nutrient elements, nitrogen, phosphorus, and potassium, are treated.

It would be easy to point to other topics that might have been included—there is no mention of the forms and availability of lesser nutrient elements, for example—but this does not seriously detract from the value of the volume, whose usefulness lies in the solid and authoritative treatment of the basic essentials of soil-plant relationships.

A. G. NORMAN
University of Michigan, Ann Arbor

Fossil Plants

Traité de Paleobotanique. Vol. 2, Bryophyta (S. Jovet-Ast), Psilophyta (O. A. Høeg), Lycophyta (W. G. Chaloner, with the collaboration of E. Boureau). EDOUARD BOUREAU, Ed. Masson, Paris, 1967. 845 pp., illus. 340 F.

This cumbersome and expensive volume is an essential reference work on fossil plants. The general impression it gives is one of conscientious and intelligent compilation by all authors. Omissions and errors are few and are of minor importance.

Jovet-Ast, a distinguished student of Recent hepatics, deserves special compliment for her foray into an area where the methodology is largely alien. In many elementary texts the comments on the fossil record of bryophytes are mainly disparaging, but this summary shows a substantial mass of records is accumulating, even if it is one that is largely deficient in sporophytes. Most students of Recent bryophytes will regret that this useful section of the volume was not issued separately. If Jovet-Ast is to be chided, it is on two points only: the exasperation that the specialist will experience in tracking down records where she gives no direct references (on pp. 102–03 for example), and the excessive tolerance she shows by including Greguss's presumed Ordovician genera *Musciphyton* and *Hepaticaephyton* so prominently. Examine the illustrations of these genera in the light of the opinion held by many prominent paleobotanists that these "fossils" are root fragments of Recent vegetation. It seems such an eminently sensible point of view. Greguss's spirited denial [*Acta Univ. Szeged. Acta Biol.* **7**, (1962)] of this interpretation is unconvincing and serves mainly to lend a greater eloquence to its probability.

As a result of renewed interest in Devonian plants we now know more about the early vegetation of the land. Relevant aspects of this knowledge are summarized effectively in Høeg's contribution. The difficulties of classification in a group of plants where significant new information is accumulating rapidly are notorious, and it casts no reflection on Høeg to suggest that it is as well to read this section of the book in conjunction with recent important abstracts by Banks and by Bierhorst [*Amer. J. Bot.* **54**, 651 (1967)]. That we may expect the Psilophytes to provide new advances of fundamental morphological importance is clear. Take, for example, *Sporogonites*, a plant of obvious interest but so little known that here in the space of one volume Høeg considers it in the Psilophyta and Jovet-Ast in the Bryophyta.

Few persons can have envied Chaloner his task of summarizing the information on fossil lycopods. They were prominent Carboniferous plants, and a large number of taxa have been described in a widely scattered literature. Some idea of the frustration involved can be gained from the observation that approximately half the genera are so poorly understood that they cannot be classified precisely within the Lycophyta. Chaloner's achievement sets a high standard for subsequent contributions to this series.

For added measure a few Sphenophytes omitted from volume 3 and the obscure genus *Crocalophyton* are also treated in this volume (by Boureau). *Crocalophyton* is placed after the bryophytes and before the psilophytes, on the assumption that it may be a genus significant in the story of vascular plant evolution. Surely the much more prosaic interpretation of these specimens as lumps of crotch wood deserves consideration.

ARTHUR A. CRIDLAND
Botany Department,
Washington State University, Pullman