and that the structure of the genetic covariance matrix places real constraints on selection. They have convinced me. We certainly do not need simply to measure more genetic covariances. We do need to see what relation their plasticity has to phenotypic plasticity, what mechanisms lead to pleiotropy and place limits on the general structure of covariance matrices, and how covariance matrices change under the application of environmental stress. Genetics is certainly necessary and useful, but it is not sufficient, for evolutionary theory.

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Plant Metabolism

Cellular and Subcellular Localization in Plant Metabolism. Proceedings of a meeting, Ithaca, N.Y., Aug. 1981. LEROY L. CREASY and GEZA HRAZDINA, Eds. Plenum, New York, 1982. x, 278 pp., illus. $37.50. Recent Advances in Phytochemistry, vol. 16.

The eight papers in this book of symposium proceedings demonstrate that there have been substantial technical advances in the isolation of cell types and organelles from plant tissue, which has allowed parallel advances in knowledge of organelle function and interactions between cells at the biochemical level. Being the result of a symposium, the book covers selected topics in some depth rather than providing a general comprehensive view. For most subjects, the current state of knowledge is discussed and aspects needing further research are noted.

Chapters on vacuoles, peroxisomes, and chloroplasts describe functions of the organelles relative to metabolic processes in other parts of the cell. Other chapters, such as those on guard cells and C_4 leaf photosynthesis, deal with specific functions of cell types.

At the organelle level, scientists interested in vacuoles should find a paper by Wagner useful with respect to techniques of vacuole isolation, pitfalls in methodology for determining distribution of material between vacuole-extravacuolar space, and specific substances or enzymes found to be located in vacuoles from a variety of tissues. Examples are given with various plant tissues where material is found located in vacuoles or appearing exclusively in the cytoplasm. Some views are given on metabolite transport, but, considering that plant vacuoles were isolated in good yields seven years ago, there has been relatively little progress on this subject. Though it is not stressed by the author, it is the opinion of this reviewer that the low percentage of cytoplasmic space relative to vacuole space (1 percent or less in some tissue, for example in plants that utilize Crassulacean acid metabolism) makes it extremely difficult to determine whether a compound is exclusively located in the vacuole and what the relative concentrations are between the vacuole and extravacuolar space. Also, in transport studies it is not clear if all methods used in preparing vacuoles from protoplasts will result in preparations free of the plasma membrane (hence the need for specific plasma membrane and tonoplast markers).

In a paper on plant mitochondria, Siedow notes unique features of plant mitochondria, in particular the alternative (cyanide-insensitive) pathway. The review brings out an important subject for future research, since the identification of components of this pathway and its function in most instances remain uncertain.

The book contains a thorough review by Huang of higher plant, algal, and fungal peroxisomes. There appears to have been little new information on higher plant peroxisomes over the past few years, with the result that the paper treats peroxisomes from the lower plants at somewhat greater length. The author's emphasis on the need to understand transport of reductive power between peroxisomes and the cytoplasm, the permeability of peroxisomes to various metabolites, and the properties and functions of peroxisomes in C_4 and Crassulacean acid metabolism plants is well deserved.

A paper by Huber on chloroplasts reflects, in part, the progress in using different plant species to study photosynthetic carbon metabolism. Emphasis is placed on how factors outside the chloroplast, such as pH, P_i (inorganic phosphate), Mg^{2+}, and K^+, may regulate carbon metabolism in the chloroplast.

From studies of functions of various cell types made over the last decade, Outlaw analyzes carbon metabolism of guard cells, giving particular attention to evidence for malate fluctuations in guard cells and the associated metabolism. Campbell and Black review a progression of studies on carbon, nitrogen, and, most recently, sulfur metabolism in the two photosynthetic cell types of C_4 plants. In a review by Cutler and Conn of the biosynthesis of cyanogenic glycosides, a discussion of the use of "channeled enzyme complexes" to compartmentalize and confine intermediates of a pathway to a particular part of the cell is particularly interesting.

Though the book covers research developments in the last decade on selected aspects of subcellular metabolism, the reader will find some aspects (for example, peroxisomes and photosynthesis) more extensively developed and understood than others (for example, compartmentation of biosynthesis of natural products, the role of microtubules in cellulose biosynthesis, and the mechanism-function of the alternative pathway in plant mitochondria).

What is notably missing in the book is studies of specialized function of cells within the vascular tissue and their significance relative to intercellular transport. Perhaps this reflects a lag in development of techniques for isolating and studying these cells relative to development of those for studying other tissues.

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Antarctica

Antarctic Geoscience. Papers from a symposium, Madison, Wis., Aug. 1977. CAMPBELL CRADDOCK, JANET K. LOVELESS, TERRI L. VIERIMA, and KATHY A. CRAWFORD, Eds. University of Wisconsin Press, Madison, 1982. xxviii, 1174 pp., illus. $35. International Union of Geological Sciences Series B, no. 4.

Antarctic geology is fascinating not only in its own right but also for its key role in the study of Gondwanaland. Most readers of this volume, like the reviewer, will never have set foot in Antarctica and are unlikely to do so. But all students of the geology of other parts of Gondwanaland will find it a truly valuable source of information. It is a well-edited and arranged compilation of about 150 papers contributed by workers from 15 countries, and, although it has taken five years to bring the book out, the great majority of the contents does not appear in any way out of date. The geographical terms of reference are interpreted generously, and there is substantial coverage of the Scotia Arc and southern South America and oceanic islands as far north as Bouvet and Amsterdam as well as of Antarctica proper. All the major fields of geology and geophysics, including marine geology and geophysics and glaciology, are represented, as is the subject of meteorite hunting.

The volume is divided into 12 subject sections, most of which start with a review. One point of immediate interest is the polite but firm anti–plate-tectonic position adopted by certain of the Soviet authors, though other Soviets are as happily "mobilist" as most of the rest of us. Some of the reviews are a mixed blessing, particularly those that take a large topic applicable to all of Antarctica (such as the lower Precambrian, metamorphism, or Cenozoic vulcanism) and dispose of it in six or seven pages. These are indigestible catalogues of data and conclusions with no space left for real discussion of evidence. Other reviews are of greater value. The opening review has a fine historical sense, and in another that particularly appealed to me the author uses such phrases as "for the reasons mentioned above I no longer believe in" and "my current belief is that." This is the profitable way to discuss science.

As for the body of descriptive geoscience that makes up most of the volume, one is constantly reminded that the dating of geological events lies at the heart of many geological problems. Paleontology flourishes as a stratigraphic approach in this part of the world, and included papers range from one on the faunas of Seymour Island to one on the palynostratigraphy of the Transantarctic Mountains. Isotopic dating methods are slowly unraveling the complex evolution of the late-Precambrian to Phanerozoic orogenic events in the Transantarctic Mountains and West Antarctica and are beginning to paint an intriguing picture of circum-Pacific subduction and accretion (unless of course you take the viewpoint of some of the nonmobilist reviewers mentioned above). The picture in the cratonic areas of East Antarctica still seems somewhat cloudy, and one can only hope for more isotopic investigation in the future. One wonders, for example, why the 4000-million-year date published by Sobotovich and others for rocks from Enderby Land tends to be cited only by Soviet authors.

On top of everything is the ice, and several papers consider the age and development of the ice cap, a relative newcomer to the continent. There are also 20 or more papers on geophysics, a substantial fraction of which are concerned with trying to unravel subglacial features of the continent. As one author put it, referring to that particularly enigmatic area, the Byrd subglacial basin, "the difficulties in tectonic classification of this region are caused by an acute lack of information rather than uncertainties in the available data." An understatement, if anything, but one that does highlight the role of geophysics as a discipline that may yet to some extent save the day.

Nevertheless, it is the backbone of solid field geology throughout the volume that I think I enjoyed most. These people see exposures such as the rest of us only dream about. Ninety-five percent of their land surface is ice and snow, but the other 5 percent makes it all worthwhile. The editor and all the contributors are to be congratulated, but especially those who did the fieldwork.

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Processes in the Deep Ocean

The Environment of the Deep Sea. Papers from a colloquium, Los Angeles, April–June 1979. W. G. ERNST and J. G. MORIN, Eds. Prentice-Hall, Englewood Cliffs, N.J., 1982. xii, 372 pp., illus. $36.95. Rubey Volume 2.

Virtually all of what we know about processes in the deep ocean has been learned in the last 20 years or so. The symposium proceedings at hand brings us up to date. There are 14 papers covering aspects of geology, paleoceanography, benthic mixing, oxygen metabolism, pollution, carbonate sedimentation, manganese deposition, bacterial ecology, deep-sea communities (structure and evolution), and physiology of fishes and invertebrates. The papers are divided into a physical-chemical section and a biological section. There are two dozen authors, most of them recognized authorities in their respective subdisciplines. The book has no overview or introduction to the subject, a serious omission in an interdisciplinary book aimed at a wide audience.

The first paper, by Heirtzler, brings out the difficulties involved in making detailed observations in this remote environment and the progress made in the last decade by projects such as FAMOUS. This chapter can be profitably read by an intelligent high school student, but the next one, on isotopic paleoceanography, is strictly for the cognoscenti. The review is competent, for sure, but too much of what is presented is in a state of ferment. A paper by Cochran on radionuclides in benthic mixing and in growth-rate studies succinctly summarizes the important recent contributions on these subjects by Turekian's group at Yale. I found intriguing the differences in mixing rates obtained from different radiotracers. Not enough is known about the chemical behavior of these isotopes to make flat-out statements about mixing depths and mixing rates without reference to supporting evidence from sedimentology and biology.

Following two papers in the style of journal articles (on NO_2 distribution and on $\delta^{34}S$ as a pollution detector) we find two solid reviews of broad topics, by Heath on manganese nodules and by Berner on biogenic matter on the sea floor. The century-old question about the source of the manganese—continents or volcanism—seems on the verge of being resolved: ridgecrest thermal activity may tip the balance in favor of Baron von Gümbel's pet hypothesis. The ramifications of manganese nodule growth for deep-sea ecology are manifold. For one, nodules provide minipatches of hard substrate for deep-sea epifauna over enormous regions otherwise characterized by unlithified sediment. The nodules are much like tiny reefs in an ocean of clay, with all that that implies for habitat diversification. Berner's paper is really four in one; it deals with principles of diagenesis, organic matter decomposition, carbonate dissolution, and silica dissolution. The four sections are a bit brief for depth, but they constitute concise introductions. Berner devotes some space to pushing his hypothesis that 50 percent of the carbonate falling to the deep ocean floor is aragonite. His calculations are based on sediment data in which (I think) winnowed material is systematically overrepresented (winnowing concentrates pteropod shells, in places). Thus, a compilation of recent sediment trap data would have been more convincing.

On the whole, the second section of the book (on the biological environment) seems more balanced than the first. Each of the seven papers is written at roughly the same level, as an in-depth review of the chosen topic. Bacteria, the unseen catalysts of deep-sea chemistry, rate two papers packed with information vital for deep-sea ecologists and sedimentologists ("the total bacterial surface area in seawater is about a factor of 10 greater than that of all other organisms combined," according to Nealson). I would have liked to see more information on the hot topic of bacterial ecology of hydrothermal systems, however.

A chapter on community structure starts out in a somewhat esoteric vein but soon gets down to the familiar business of describing distributional patterns (species, sizes, feeding strategies) and the plethora of hypotheses vying for relevancy in explaining the patterns. Jumars