become popular because their very unpopularity lures mavericks. An interesting comment by McKenna (in discussing Melville's paper) and by Tedford (in discussing Nur and Ben-Avraham's) is that small continental blocks would soon slide below sea level as they drifted away from the rift sundering a once-united Pacifica; a mid-ocean ridge must have formed at the site of the rift, with the ocean floor sloping down on either side. Millions of years would have passed before the blocks emerged as dry land at the periphery of Panthalassa, by which time all air-breathing passengers on the blocks would have breathed their last.

In the fourth team of debaters I put those biogeographers who regard vicariance as fundamentally important but who acknowledge the existence of many kinds of vicariance events and do not, like devout vicariists, consider only the vicariance caused by drifting tectonic plates. Hallam, and also Howden, stress vicariance events caused by pre-Quaternary eustatic changes in sea level. Rising and falling epicontinental seas alternately separated and united terrestrial habitats while they simultaneously united and separated shelf habitats. Hallam presents a splendid (and believable?) table correlating stratigraphic subdivisions, age, plate-tectonic events, eustatic events, and biotic consequences (it prompts McKenna to accuse him of laying down the law). He comments, too, on the range expansions that warmth-loving plants presumably underwent in epochs of equable climate; not discussed, however, is the vegetation in high latitudes at times when atmospheric circulation continually brought warm air masses into places experiencing long, dark winter nights.

Vicariance events can be on enormously varied scales, as Solem remarks; events as small as beating a path through the bush or as great as the breakup of Pangea may cause vicariance. Haffer deals with the effects of fluctuating climate on the vegetation mosaic, and hence the avifauna, of the Amazon basin; shrinking grassland refugia in a sea of forest alternated with shrinking forest refugia in a sea of grassland; as well, erosion led to fragmentation of upland habitats. As Tattersall says, "The fragmentation of ranges into refugia is a vicariant [*sic*] event par excellence." Unfortunately nobody discusses habitat fragmentation due to isostatic sea level changes in the Quaternary. It will be interesting to see whether dedicated, card-carrying vicariists, whose basic tenet is that "general patterns of distribution exist as a result of the forces of earth history" (Schuh, p. 233), will dilute the satisfying grandeur of the concept by admitting the importance of second-order vicariance events. A demand that biogeographic conclusions be "satisfying" (Schuh, p. 231) suggests a preoccupation with aesthetics rather than scientific truth.

The fifth team are at one in their attempts to devise and apply objective tests to biogeographic hypotheses. They wrangle among themselves on how this should be done, but at least they try; thus they do more than merely pay lip service to the need for falsifiable theories in biogeography. Simberloff, Heck, McCoy, and Connor, in a joint paper, describe tests for simple null hypotheses in two contexts: (i) they derive the expected number of species common to two islands, on the hypothesis of random colonization from a common species pool; and (ii) they derive the probability distributions of distinguishably different cladograms, given various null hypotheses. Their discussants take issue with them on several points. Terborgh, discussing the first context, argues that a random-colonization hypothesis is unrealistic. This is probably true, but the trouble with a realistic hypothesis is that if a test leads to its "acceptance" (actually, "non-rejection") the probability of error is unknown. Farris makes this point clearly and emphatically. He also discusses the second context and the arbitrariness that is unavoidable when one must choose among competing null hypotheses. The discussion neatly demonstrates how strongly dependent on assumptions, as well as on data, conclusions always are. At any rate, Simberloff and co-workers make a valiant attempt to unite, if only in methods of approach, the disparate fields of island biogeography and historical biogeography.

The symposium proceedings conclude with a summary by Nelson, in which he presumes to correct "well intentioned authors who nevertheless mislead" and to instruct "well intentioned readers who nevertheless misconstrue." The condescension is breathtaking. However, dyed-in-the-wool vicariists would be wise not to make their views absolutely clear to the rest of us, for if they do they will have to give up the ploy of fending off criticism with the complaint that their critics haven't really understood them.

My own conclusion after reading the book is that the vicariists have not succeeded in making their case and that an explanation for any given disjunction is more likely to be obtained by commonsense investigation than by abstract theorizing. For instance, why has the test for vicariance versus dispersal proposed by Edmunds (p. 296) been so little used? Concerning angiosperm disjunctions, he argues that associated and coevolved organisms would be expected to share a disjunct pattern if the disjunction were caused by vicariance but not to share such a pattern if it were caused by dispersal. Edmunds gives one example of each of these two types of disjunction; there seem to be few parallel examples in the literature, which is surprising.

The last word should go to McKenna. He pleads (p. 336) for greater "interchange and synthesis among the so-called subjects of botany, zoology, and geology" so that all three pursuits lead to congruent results. To that I say "Hear, hear."

E. C. PIELOU

Biology Department,
University of Lethbridge,
Lethbridge, Alberta T1K 3M4, Canada

Elementary Particles

Quarks and Leptons. Proceedings of an institute, Cargèse, Corsica, July 1979. MAURICE LÉVY, JEAN-LOUIS BASDEVANT, DAVID SPEISER, JACQUES WEYERS, RAYMOND GASTMANS, and MAURICE JACOB, Eds. Plenum, New York, 1980. xvi, 720 pp., illus. $75. NATO Advanced Study Institutes Series B, vol. 61.

In recent years we have witnessed the discovery of several new species of elementary particles and the birth of elegant field theories of weak, electromagnetic, and strong interactions. As experiments have probed smaller distances, their findings have inspired rapid theoretical progress. Now, with a new generation of very-high-energy accelerators being readied for operation, further exciting discoveries are being anxiously awaited. The proceedings of the 1979 Cargèse summer institute, *Quarks and Leptons* presents a collection of up-to-date reviews that provide good introductions to some areas of current experimental and theoretical work.

A particularly nice discussion of quantum chromodynamics (QCD), the field theory of strong interactions, is presented by J. Ellis and C. T. Sachrajda. They emphasize the perturbative high-energy successes and predictions of QCD. I found their paper basic enough to serve as a self-contained introduction for students yet detailed enough to be a useful reference for workers in the field. Additional aspects of QCD are described in the experimental papers by H. Bøggild, J. M. Gaillard, and F. Muller, which

review high-energy hadron scattering, hyperon decays, and charmed-baryon production respectively. Their lectures nicely illustrate how QCD has become the natural language of strong interactions for experimentalists and theorists alike.

Some of the most beautiful recent experimental work has been carried out at electron-positron colliding-beam facilities. Good overviews of that research are given by H. L. Lynch and J. E. Augustin. Their papers are particularly clear in explaining the extraction of useful phenomenology from raw data. On the theoretical side, R. Gastmans describes calculations of radiative corrections to high-energy e^+e^- annihilation. Although the subject matter is rather technical, it is presented in a clear and understandable manner.

The bound-state problem is discussed by D. R. Yennie and A. Martin. Yennie describes recent advances in calculations of hyperfine splittings for relativistic two-body systems that provide high-precision tests of quantum electrodynamics. Martin presents some general results obtained for nonrelativistic potential models that are very successful in explaining the observed charmonium and bottomonium spectra.

A description of neutrino scattering experiments is given by H. Wahl. Experimental specifications are clearly explained, with primary emphasis on the extraction of hadron structure functions. Radiative corrections to neutrino scattering are discussed by M. Veltman. He points out how precise measurements of such corrections may unveil properties of as yet undiscovered heavy elementary particles, an interesting suggestion.

The deep-inelastic electron-deuterium scattering asymmetry measurement performed at the Stanford Linear Accelerator Center is briefly described by M. Borghini. That beautiful experiment confirmed the validity of the Weinberg-Salam model of electroweak interactions and has become a classic piece of work.

J. Weyers reviews the problem of quark masses and attempts to relate mass scales and quark mixing angles by imposing discrete symmetry requirements. This is an interesting area of theoretical investigation that is ripe for new creative ideas.

A detailed theoretical overview of weak, electromagnetic, and strong interactions is presented by M. K. Gaillard and L. Maiani. They cover a variety of interesting topics, the most exciting of which is proton decay. This exotic possibility arises as a very solid prediction of grand unified theories. Experimental searches for proton decay are now under way around the world. If the proton lifetime is in the range 10^{30} to 10^{32} years, as predicted by theory, we should have experimental verification within the next year.

The proceedings conclude with speculations on the future of elementary particle physics by S. L. Glashow. After nicely summarizing the status of theory, he suggests experiments for the future. A novel suggestion to look for neutron-antineutron oscillations has motivated several new experiments, which are now getting under way. As usual, Glashow's ideas are interesting, entertaining, and thought-provoking.

In total I found *Quarks and Leptons* to be a useful, well-written collection of reviews. Its papers provide clear exposés of some of the most interesting topics currently being investigated by high-energy physicists.

WILLIAM J. MARCIANO
Department of Physics,
Northwestern University,
Evanston, Illinois 60201

Interferon

Interferon and Interferon Inducers. Clinical Applications. DALE A. STRINGFELLOW, Ed. Dekker, New York, 1980. xii, 330 pp., illus. $39.50. Modern Pharmacology-Toxicology, vol. 17.

The first flowering of interferon studies occurred in the late '50's and early '60's. During this time the basic biological properties of interferons were elucidated, they were hailed as general antiviral agents with therapeutic potential, and they were shown to be involved in natural recovery of animals from some primary virus infections. Gradually the enthusiasm generated during this period subsided, possibly because not enough interferon could be obtained to carry out significant clinical trials in humans. Studies of interferons seemed to become a backwater of virology.

The second flowering interferon studies are now undergoing was generated by several remarkable findings. Cantell's group in Helsinki developed methods for obtaining sufficient amounts of human alpha interferon from leukocytes to carry out a small number of significant clinical studies. These demonstrated that interferons might be useful in the therapy of respiratory virus, herpes virus, and chronic hepatitis B virus infections in humans. With methods developed in studies pioneered by Paucker, large quantities of human interferons can now be purified, and these purified interferons possess a remarkable specific biological activity—a concentration of $10^{-15}M$ has the ability to inhibit virus growth.

Interferons are induced proteins that have distinct messenger RNA species that are produced in response to many viral or chemical inducers. The mechanisms of interferon action have been partially elucidated; they involve the induction of intracellular enzymes apparently also active in several biological systems other than interferon. In addition to their antiviral properties, interferons have marked inhibitory effects on cell growth and act as regulatory factors in many phases of the immune response. Three immunologic types of human interferon have been described: alpha, beta, and gamma. The genes for human alpha and beta interferons have been cloned in bacteria, and the amino acid sequences of the alpha and beta interferons are now known. The alpha interferons are a group of proteins produced by distinct but closely related genes. Gamma interferon, which seems to be produced only by T lymphocytes in response to mitogens, or to secondary exposure to an antigen, is an intriguing substance that may well be very important.

It is therefore an appropriate time to consider a book such as *Interferon and Interferon Inducers*, which attempts to review "many promising approaches that may lead to the fulfillment of interferons' potential as effective chemotherapeutic agents." The volume contains an introduction to interferons together with ten chapters that stress possible clinical application of interferons. Unfortunately, because of the small number of studies that have been carried out in humans to date, it is difficult to say much that is definitive about the clinical application of interferons. Moreover, the book is not particularly useful as a general reference on interferons. An overview chapter by Stringfellow is too brief to cover the gaps in the volume on such topics as the mechanisms of action of interferons.

A chapter on the production, purification, and properties of human interferons by Berg, Osther, and Heron contains an excellent discussion of interferon production by leukocytes; however, much of the chapter has unfortunately been left behind by already published work on cloning of human interferon genes and by changes in nomenclature. Thus, rapid progress in the field has taken a toll on the usefulness of the volume.

A chapter on stability and pharmacokinetics by Greenberg, Harmon, and Couch is a useful compilation of diverse