tion will weigh on the side of inertial homoiothermy, endothermy, or some other, unforeseen form of thermal behavior. In any case, this symposium will be viewed in retrospect as a milestone in the examination of this fascinating problem.

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Tectonic Evolution

The Origin of the Gulf of Mexico and the Early Opening of the Central North Atlantic Ocean. Proceedings of a symposium, Baton Rouge, La., March 1980. REX H. PILGER, JR., Ed. Louisiana State University School of Geoscience, Baton Rouge, 1980. iv, 104 pp., illus. Paper, $15.

Included in this volume are nine papers and 11 abstracts on the geologic development of the Gulf of Mexico, the Caribbean, and the western North Atlantic. Of the nine papers, seven deal with the Gulf of Mexico, one with western Colombia (by W. D. Mooney), and one with the Late Paleozoic–Early Mesozoic reconstruction of the continents based on paleomagnetism (P. Morel and E. Irving).

In his paper Mooney proposes that the Western Cordillera of Colombia represents an accretionary wedge or was formed as a result of the stacking of oceanic crust following a westward jump of a subduction zone during the Cretaceous. He proposes a similar origin for the Pacific Coastal Range, with the Atrato–San Juan basin between the Coastal Range and the Western Cordillera representing a fore-arc basin. Morel and Irving describe two continental reconstructions. The one for the Late Carboniferous–Early Permian has northwestern South America opposite the eastern seaboard of North America. The one for the Early Jurassic has northwest Africa against eastern North America. According to Morel and Irving the change from Late Paleozoic to Early Jurassic continental distribution occurred in the Late Permian–Triassic by right lateral motion between Gondwana and the northern continents.

In the papers dealing with the Gulf of Mexico, J. R. Garrison, Jr., *et al.* use rubidium-strontium data from the Precambrian granulite and Paleozoic greenschist near Ciudad Victoria, Mexico, to reconstruct the Paleozoic tectonic evolution (one of subduction) of the eastern continental margin of Mexico. The other papers deal with the tectonic evolution of the present Gulf. Although all the contributors believe that the present Gulf is due to large horizontal motions of the surrounding continents, they disagree as to the nature and magnitude of these motions. S. E. Cebull and D. H. Shurbet, for example, in their paper on the Ouachita belt suggest that the Gulf of Mexico is a Paleozoic basin that began to enlarge in the early Mesozoic to its present dimensions. The rest of the writers propose that complete closure of the Gulf of Mexico occurred at the end of the Paleozoic and that the present basin formed by sea-floor spreading in the Jurassic. Stratigraphic, paleontologic, and tectonic data described by R. Schmidt-Effing from the Huayacotla aulocogen in eastern Mexico would indicate that the rifting phase was initiated during the Hettangian and the drifting phase (continental separation) began in the Sinemurian. According to R. T. Buffler *et al.* only the deep Gulf of Mexico is underlain by oceanic crust, a crust emplaced by a sea-floor spreading episode that began during the Late Jurassic and terminated in the Early Cretaceous. According to these authors this oceanic crust is surrounded by a thinned continental or transitional crust. J. L. Walper, on the other hand, places the location of the continental-oceanic crust boundary inboard of the Texas coast. W. R. Dickinson and P. J. Coney propose that prior to the Jurassic opening of the Gulf the Yucatan peninsula nestled against the southern United States and eastern Mexico. Walper and W. A. Gose *et al.*, on the other hand, postulate that Mesoamerica prior to the Jurassic was not located in its present position and was displaced eastward along megashears. Buffler *et al.* suggest that salt deposition (Louann salt) was restricted to the thinned continental crust. Walper, on the other hand, proposes that evaporite deposition took place in the shallow epicratonic seas behind the elevated continental edge and atop the young oceanic crust. Walper also believes that the salt basin was originally continuous and was split in two as segments of Mexico were displaced eastward. Buffler *et al.*, however, suggest that the salt was deposited in two different basins separated by a median high. Later this high became the locus of sea-floor spreading that separated the basins into their present positions.

As a whole I found the book well written and adequately illustrated. To those working in the Gulf of Mexico it will be a welcome addition to their libraries. To me, however, the most striking thing about the proceedings is what is left out rather than what is included. There is no discussion of the nature of rifting prior to continental decoupling, and only in passing is there any discussion of the distribution of oceanic crust. Information on both of these subjects is needed to reconstruct the geologic history of the Gulf of Mexico.

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Genetics of *Homo sapiens*

Human Genetics. Problems and Approaches. F. VOGEL and A. G. MOTULSKY. Springer-Verlag, New York, 1979. xxviii, 702 pp., illus. $49.50.

Human genetics has suffered too long from being treated as general genetics with a few human touches. For that matter, medical genetics has itself been similarly treated by human geneticists. This book, written by geneticists, both with diversified experience and both physicians, should do something to restore perspective. It is not the first book in the field, but it is the first big book. It runs to 700 pages of small type and has some 1800 references, 400 figures, nine long chapters, and nine appendixes; the table of contents is itself 20 pages long. The graduate student who really wants to study human genetics at last has a major source and method book, one that is not divorced from experimental genetics but transcends it. The book is handsomely printed on fine paper in double columns with good quality half-tone diagrams.

After a short historical review (with just a little too much ancestor worship for my taste) the authors lead off with chromosomes—a tribute, one supposes, to the traditional primacy of morphology. Unexpectedly, sketches of abnormal phenotypes are widely used in place of photographs. There follows a long chapter on genetic analysis that contains all those cardinal matters that tend to be neglected in doctoral programs in human genetics. As one might imagine, the treatment is most assured in the classical segregation analysis, but there is extensive discussion of methods for the study of twins, and the authors do heroic battle (although in strictly orthodox terms) with the much less coherent field of quantitative genetics. The fourth chapter covers gene action in some detail; it is largely concerned with the genetic biochemistry of enzymes, protein polymorphisms, antibodies, and pharmacogenetics, with concern for clinical applications. The chapter has a novel

section on mechanisms of dominance. (I would have been happier if this chapter had been a little more closely tied to analysis in the previous chapter. There are serious insights into that languishing field quantitative genetics to be pointed up from the coagulation cascade and from interlocking metabolic pathways, both of which are discussed in chapter 4. But I am riding a hobbyhorse here.) There is also an unusual, but welcome, emphasis on genetics of embryogenesis.

The next chapters cover the three closely related topics of mutation, population genetics, and evolutionary genetics. Tastes differ, but I find the way in which these subjects are developed a little strange. The first of the three chapters treats point and chromosomal mutation together. But their dynamics and the means of detecting them tend to be very different, and estimating the rate of point mutation is heavily dependent on equilibrium arguments, which have their natural place in the following chapter. However, one cannot discuss everything at once, and I have never found an unexceptionable order of exposition. Inevitably in such a book, the treatment of analysis is deterministic (drift being dealt with in isolation in a separate section), and, while this is not altogether satisfactory, the most innumerate student cannot complain at any stage of being taken into deep waters. It is appropriate that the least reputable field of all, evolution, is treated separately.

In the last two chapters human genetics comes into its own. Chapter 8 deals with behavior, for once with attention to lesser animals in mazes appropriately subdued. Racial and cultural factors are addressed in a commendably low key. The last, all too brief, chapter deals with clinical and social issues concerning humans, now and in the foreseeable future. The nine appendixes deal with technical matters, mostly ancillary information on methods of analysis. The index is excellent.

As to my own field, mathematical genetics, I would not use the book to teach a course in the subject, although it would be a sound source for classical methods. I would have liked to see a somewhat more fundamental (not necessarily more technical) approach to problems. (For instance, map distance is *defined* in recombination fractions; there is confusion between linkage, which is a matter of assortment, and detailed gene assignment, which is anatomical; the careless reader is apt to overlook the authors' unobtrusive comments about the assumptions underlying the statistical tests used, which are widely misapplied.) There would also have been something to be said for presenting quantitative genetics not as a smooth and finished science but as one which has barely been started. It is encouraging to see the way the authors deal with noisy Mendelian traits, for instance; and they do an admirable, if compressed, job on the Galton-Fisher and Falconer models. But what if the effects of the components are not additive (as they are not in coagulation or where the law of mass action operates) or not even monotonic? There is little sense here that quantitative genetics is, or at least should be, a rapidly growing science. But these are minor flaws in a textbook as comprehensive as this one.

As to the areas I know almost nothing about, I shall keep them *in pectore*. But I have learned much by browsing and hope to learn much more.

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A Theory of Perception

The Ecological Approach to Visual Perception. JAMES J. GIBSON. Houghton Mifflin, Boston, 1979. xvi, 332 pp., illus. $18.95.

James J. Gibson had the breadth, insight, and stamina to mount and maintain a 50-year-long challenge to the establishment view of visual perception and offer a new vision in its place. Gibson was usually alone in his views and was rarely taken seriously by the establishment; his theories were often not even included in courses. His own rhetoric made it easy to brand his work as lacking in empirical relevance. And he was truly blind to the limitations of his theories, so he continually claimed more for them than he should have. But what he could properly claim is nothing short of revolutionary.

Gibson, who died last December at the age of 75, was at the height of his creative powers when he wrote this book, and it is a culmination of 50 years of research and theory building. It goes well beyond his two earlier books, frequently revising or updating central arguments of those works. Gibson's message concerns the laws of the science of perception and the way scientists have to understand them.

At a philosophical level, Gibson's ecological approach is a demand that those who study perception take into account both in their research and in their theories the natural visual environment in which perceivers live. While Gibson admits that our current theories might just barely be adequate to explain the perceiver's plight in the sterile visual world of the laboratory, he is forceful in showing how dissimilar the laboratory view is from the richness of information available in the real world. At the very best, from such study we might learn how to read during a lightning storm.

Gibson's most important criticisms are directed against the core of contemporary perceptual theory: that the retinal image as a two-dimensional display is the initial representation of information for perception of the visual world. The late Renaissance discoveries in optics, and especially the invention of the photographic camera, provided the model of light imaged on the retina just as it is in a camera. Given such a model, the problem then posed for perceptual theory is how this two-dimensional patterning of light can be transformed by a perceiver into a perception of three-dimensional space. Gibson shows that because the retinal image is not a picture there can never be reasonable answers to any of the important questions concerning perception when the problem is posed this way. He shows that we must focus our theoretical attention on the continuous stream of light coming to the retina in order to provide a proper description of the information being conveyed about the visual world. The fact that a frozen slice of the optical pattern of light bears some resemblance to a two-dimensional reflectance pattern of a surface reflecting light is a coincidence that must be ignored. Such resemblance is not even useful to explain perception of flat, two-dimensional surfaces such as pictures. Once one is willing to ignore this resemblance, or even to grant the possibility of ignoring it, the rest of the argument falls into place.

If information about the visual world is not contained in a pictorial image on the retina, then what are its sources? In answer to this question Gibson moves beyond philosophy and commentary on other theorists' work and specifies concrete and testable hypotheses. He provides both a detailed analysis of the way perceivers normally explore their visual environment and an analysis of that environment itself. Taken together the analyses comprise the ecology of the ecological approach to visual perception. Gibson's goal is to provide a description of all the sources of information about the layout of space as they are available to normal perceivers moving in their typical environments.