We consider it quite likely that *some* genes affecting *some* aspects of intellectual performance differ appreciably in frequency between U.S. racial-ethnic groups—leaving open the issue of what groups, which aspects, and which direction of difference. Thus we consider it most unwise to base public policy on the assumption that no such genetic differences exist. If someone defends racial discrimination on the grounds of genetic differences between races, it is far more prudent to attack the logic of his argument than to accept the argument and deny any differences. The latter stance can leave one in an extremely awkward position if such a difference is subsequently shown to exist [p. 240].

In the final section of the book, the authors outline ten areas of research, ranging from studies on cross-racial adoptions to studies that evaluate the effectiveness of various kinds of educational, nutritional, and other social programs, that might shed more light on the influence of environmental factors in producing differences between U.S. racial-ethnic groups in average levels and patterns of ability. Again, they believe that objection to continuing research on group differences is *not* justified if the objection is solely that it might yield an unpalatable answer.

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Intellectual Connections

Scottish Philosophy and British Physics, 1750-1880. A Study in the Foundations of the Victorian Scientific Style. RICHARD OLSON. Princeton University Press, Princeton, N.J., 1975. viii, 350 pp. $17.50.

Methodological pronouncements by scientists are notoriously difficult for historians to handle because they may have served so many purposes. At one extreme they can be retrospective justifications of investments made in a particular type of career and of work; at the other they can be a priori claims about the nature of scientific activity. As in ordinary life, they can also be statements of intentions that were never realized. Consequently it requires care and subtlety to show that methodological pronouncements are commitments that have actually been effective in helping scientists to set and to solve their problems.

Olson is therefore working in a challenging genre of history when he bases his enquiry on Duhem's venerable contention that during the 19th century British physicists relied more than their Continental counterparts on geometrical arguments and on model-making. Having shown that the Scottish Common Sense school of philosophers from Reid to Hamilton extensively considered the problems concerned with creating natural knowledge, Olson's chief thesis is that their leading notions were adopted and used by British natural philosophers, especially those who were totally or partly Scottish-trained. Much of his descriptive discussion can only be welcomed. He rightly sees the importance of Robison, Playfair, Forbes, and Rankine; and he has elevated what was previously a possibility into a serious case.

The book falls into two distinct parts. In the first Olson derives a by no means monolithic philosophy of science from the Scottish Common Sense philosophers. Though he stresses continuities he has to admit that on some key questions Reid and Hamilton were decidedly at odds. In the second part Olson examines the pronouncements and work of certain scientists in order to show their debt to the philosophers. Essentially the approach is to juxtapose arguments and bits of texts in order to establish similarities and hence indebtedness.

It is, however, at this tailoring level of the argument that difficulties arise. There is a difference between parallels and indebtedness: the latter is more than mere consonance, and its existence must be established by evidence additional to that of compatibility. For the period 1770 to 1815 there is the further difficulty that it is not clear whether the scientists were acting on ideas formulated by the philosophers or whether the philosophers were systematizing what the scientists had already done. In trying to find a major source for the methodological commitments of his scientists, Olson deliberately concentrates exclusively on Scottish philosophy; this procedure converts a possible source into the only possible one. Accordingly Olson lavishes attention on Reid, but ignores other possible sources such as MacLaurin and the Edinburgh medical men. It must also be appreciated that the method of juxtaposing texts gives a rather distorted picture of the work done by some individuals: Brewster's sustained scorn of Baconian inductive philosophy was only one of his many concerns qua scientist. That procedure also inevitably emphasizes the static components in a scientist's career at the expense of the dynamic ones. When Olson compares a student essay on analogy written by James Forbes in 1828 with the prizewinning papers on the polarization of heat published from the mid-1830's, he underestimates the evolving nature of Forbes's career and problem situations. Unfortunately Olson's argument is not helped by the many misprints of names and by some inaccuracies of detail.

In sum, this book presents a possible, an interesting, and in some ways a plausible case; but for the reasons given my verdict is the familiar Scottish one of "not proven."

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Visual Systems

The Compound Eye and Vision of Insects. Papers from a symposium, Canberra, Australia, Aug. 1972. G. A. HORRIDGE, Ed. Clarendon (Oxford University Press), New York, 1975. xviii, 596 pp., illus. $46.

The task of distilling order and generality out of the complexity of nervous systems is one of the central challenges of contemporary science. One should not be surprised, therefore, that significant attention has recently flowed to the compound eyes and vision of insects, where anatomical order is so apparent and visually evoked, modifiable behavior is available to manipulate.

This book is an outgrowth of a symposium on the insect visual system that was organized by G. Adrian Horridge and held in conjunction with an international entomological congress. One characteristic of symposium volumes that frequently limits their usefulness for the nonspecialist is the sacrifice of perspective on the altar of latest research results. Owing to the active efforts of the editor, this volume is happily an exception. Except for one inadequate and out-of-date competitor, it is the only book-length treatise devoted to the subject, and, despite the pitfalls of multiple authorship, it comes commendably close to being comprehensive. Moreover, in spite of the length of time consumed in its production, the book has avoided obsolescence. It will be particularly useful as a reference source to advanced students and researchers in neurobiology, animal behavior, and entomology who are seeking something more than a superficial introduction to the rich literature on the insect visual system.

The authors, representing research groups in nine countries, have contributed 24 chapters arranged in six sections: Receptor Anatomy, Receptor Physiology, Optics, Electrophysiology of the Optic Lobe, Behavioural Analysis, and Ocellus. Space permits only a short and assuredly incomplete mention of highlights. H. F. Paulus's chapter contains an interesting synopsis of the evolution of compound eyes, and R. Menzel's chapter on the color

receptors of the insect retina is a particularly effective review of recent work.

The theories of image formation for the two major anatomical types of compound eyes, which were advanced by Exner in the early 1890's, have provided the basis for textbook accounts of how compound eyes work. Chapters by Horridge and P. Carricaburu, however, draw attention to the great anatomical diversity present among insects, the functioning of several alternative mechanisms of image formation, and the difficulties in making appropriate measurements for an understanding of how light is distributed within the eye. A recent development in physiological optics has been the application of dielectric waveguide theory to the functional properties of photoreceptor organelles. The contribution of A. W. Snyder, who has been one of the leaders in this enterprise, describes some of the consequences for spectral and polarization sensitivity. J. Palka and R. B. Pinter present an excellent account of how measurements of visual acuity are beset with artifacts unless exquisite attention is paid to the design of the stimulus. And R. Wehner's chapter on behavioral analysis of pattern recognition can be profitably read in conjunction with the chapters by R. B. Northrop, L. Kien, K. Mimura, and T. Collett and A. J. King dealing with various response properties of visual interneurons.

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Transition Zones

The Geology of Continental Margins. CREIGHTON A. BURK and CHARLES L. DRAKE, Eds. Springer-Verlag, New York, 1974. xiv, 1010 pp., illus., + plates. $34.80.

This book aims at presenting a summary and synthesis of all that is known of the transition zones separating the exposed continents from the deep oceans, that is, the continental margins. The volume succeeds to an extent beyond what most scientists would regard as admirable for a subject so controversial and covered by so many diverse studies and types of measurement.

A major factor influencing this outcome is the partnership of the editors, who have been leaders in the conduct both of individual research dealing with continental margins and of national and international projects bearing on the problem of the transition zone.

Burk and Drake presided at the Penrose Conference of the Geological Society of America that provided the stimulus for this book. It is evident that the overview of the subject they thus obtained has to a significant degree governed their selection of authors. The geographic areas covered by the various contributors are indicated in a useful map printed on the inside covers of the book. It is apparent from the map that geographic coverage of margins of the Americas and Europe is complete. To varying degrees gaps exist for the remaining continents.

The organization of the volume is a logical outgrowth of the editors' aim to offer a broad inventory and synthesis of knowledge pertaining to continental margins. Modern margins are classed as Atlantic or Pacific types depending on the absence or presence of associated earthquake seismicity. Seismically passive margins are characterized by broad shelves and relatively smooth topography. Seismically active margins are typically narrow with rough topography and tend to be bounded on their basinward sides by deep trenches. One-third of the book is devoted to area-by-area descriptions of modern margins. Rabinowitz's paper dealing with the western North Atlantic is exemplary among a number of important contributions. It gives a comprehensive account of the available data for the area and sets forth the meaning of the data with respect to the ocean-to-continent transition.

Rabinowitz points out that the compositional change from basic oceanic crust to granitic continental basement does not occur along a specific contour of the slope break of the continental shelves. The paper describes the numerous geological and geophysical lineaments that border the margin of the northwest Atlantic. Rabinowitz shows that the continuous free-air gravity high located near the shelf break is associated with a subsurface ridge defined by refraction seismic measurements. Ridge topography alone is insufficient to explain the gravity anomaly, and it follows that the ridge is related to an intrabasement density high.

It is inferred that the East Coast magnetic anomaly reflects basic intrusions into subsided continental crust. North of the New England seamounts the magnetic anomaly is associated with another subsurface ridge system the presence of which is confirmed by reflection seismic profiles. South of the seamount chain, this outer ridge is indiscernible, and the East Coast magnetic anomaly is in close agreement with the continuous gravity high and the associated subsurface ridge system. The gravity and magnetic anomalies diverge at a point east of southeastern Georgia, where the magnetic anomaly bears westward, intersecting the coastline.

Rabinowitz identifies an anomaly E within the magnetic quiet zone. Landward of this anomaly the inner quiet zone is believed to overlie subsided continental crust. Seaward of E, low-amplitude magnetic anomalies within the outer quiet zone are believed to be situated above oceanic crust formed during the Newark interval of predominantly normal geomagnetic polarity. The explanation of quiet zones as reflecting the presence of subsided continental crust has the advantage that it avoids the contrivance of calling for quiet zone formations at different geologic times all during periods of constant magnetic polarity.

In addition to areal studies such as that of Rabinowitz, the volume contains series of papers treating a number of special problems. Various aspects of sedimentation in the transition are analyzed, interactions of small ocean basins with margins are examined, and ancient margins reconstructed from the geologic record are described and discussed. Several papers contain descriptions augmented by figures presenting stacked multichannel reflection seismic profiles that make possible elimination of obstruction of primary reflections by long-path multiple reflections.

The Geology of Continental Margins is a mine of valuable information for students and researchers interested in the problems of the crustal transition zone. Most earth scientists will want to own a copy.

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Useful Magnetic Reversals

Magnetic Bubbles. T. H. O'DELL. Halsted (Wiley), New York, 1974. x, 160 pp., illus. $24.50.

In magnetic bubbles we have a technology based on the realization that "particles" can provide storage and logic in structures viable in today's computer world. O'Dell treats magnetic bubbles—highly mobile, minute magnetic reversals in an otherwise saturated magnetic film—in a fresh and interesting manner. He discusses bubble statics, bubble dynamics, materials (only briefly), bubble devices, and bubble systems. His presentation is strong in novel mathematical approaches, often drawing upon equivalences between magnetic and electric systems.

That stable cylindrical magnetic do-