planations of perceptual stability and constancy, it is clear that at the least they accept a Helmholtzian model as best fitting some of the component processes.

The remaining chapters deal with aspects of, but never directly address, what I consider to be the central question that now faces perception psychologists: What do we as scientists gain, and under what circumstances, by being able to say that X perceives Y? We had better mean more than that X says so. V. R. Carlson carefully analyzes how different instructions affect subjects' judgments and argues for example that "overconstancy" (judging a smaller, nearby object to be equal in size to a larger, remote object) occurs because experimental subjects correct their veridical perceptions to fit their biases about how things should look. I myself believe that remote objects look smaller than near ones just as often as they look equal to them. As I have suggested elsewhere, some tasks (for example, moving our eyes the right amount to disocclude a far object that is being hidden by a near one) require the former information, others require the latter. The point that we cannot simply take responses as percepts is well taken; the real question is what shall we take, and what do we gain by doing so?

According to Helmholtz's theory, the answer is clear: to say that we take our perceptions of distance into account in forming our perceptions of size is to say several powerful things. First, even though the perception of distance may be unreportable ("unconscious"), it is causal to the perception of size; the perception of size thus offers one way to give operational meaning to the perception of distance. Tadasu Oyama concludes from partial correlational analyses of subjects' judgments of such linked pairs of variables as size and distance or shape and slant that, although in most cases the two perceptual properties are independently determined by stimulus variables and no direct causal relation exists between them, in at least some cases—particularly when stimulus information is reduced—judgment of one perceptual property determines that of another.

Second, "taking into account" implies mental structure, constraints under which one percept implies another. Because normal viewing conditions provide external stimulus bases for both of a pair of percepts as direct responses, what is perceived when such information is missing, or is misleading, is of critical importance. Irwin Rock, writing "In defense of unconscious inference," reviews a variety of cases in which a negligible change in proximal stimulation leads to a change in perceived object property in accordance with the constraints that structure those properties in the physical world (for example, that, for a given a luminance, reflectance and illuminance are inversely related). Helmholtz assumed that such constraints are learned by experience with the structure of the physical world but had misgivings about the feasibility of doing the appropriate research with infants. R. H. Day and B. E. McKenzie survey the recent research on constancies in infants and conclude that infants do display shape constancy (respond to the same shape at different slants) by six to eight weeks of age but that early reports of size constancy have not been borne out.

Third, Helmholtz's theory requires that under "abnormal" viewing conditions the premises on which the inference-like processes are based will result in incorrect perceptions—not constancies, but illusions. Stanley Coren and Joan Girgus review a wide array of historical and current research on the traditional geometric illusions, with specific attention to the old proposal that such illusions occur because lines on paper are automatically treated (at least in pictorially educated cultures) as distance cues so that the consequent inference processes that would normally result in size constancy here yield misperceptions of size and shape. Although they conclude that many factors contribute to the illusions and that assumptions about inference cannot be applied in a general and straightforward fashion to either the illusions or to pictures, they find sufficient similarities between illusions and pictures to sustain a theoretical relation between constancies and illusions.

Most of these authors (and many others) attribute at least some perceptual phenomena to inference-like processes and therefore by implication to mental structure. Though I do not find most of their arguments compelling, they demonstrate that after a century of consideration the concept of mental structure remains both plausible and useful, in spite of having been repeatedly attacked. Other authors attempt to show that perception is direct. Gunnar Johansson reviews evidence that the viewer performs a vector analysis of the kinetic pattern of proximal stimulation and argues that such analysis recovers the invariant properties of the object being transformed in the moving viewer's retinal image and that the traditional problems of the constancies thus vanish when the appropriate metric of stimulus analysis is considered. This is surely more specific than the Helmholtz example of the invariant table undergoing transformation, but it does not obviate mental structure unless such responses are shown to be direct in some sense and unless all other major examples of inference-like process are similarly explained away. Identifying the neural structures underlying such responses would be the strongest argument for their directness; in his chapter Whitman Richards attempts to draw as many of the perceptual constancies as possible from the characteristics of complex and hypercomplex receptive fields. Even were our knowledge of such physiological mechanisms, and the "directness" of Johansson's phenomena, far better developed than it is at present, the mechanisms remain inapplicable to those examples of mental structure that cannot be attributed directly to stimulation because they exist only in the mind's eye. The changes that are reported to occur in the apparent relative size of the parts of models and pictures of "wire" objects when subjects perceive the distance relations to reverse, and the perception of objects that have been presented only piecemeal without any mathematical transformations to relate them to each other, stake at least some minimum claim for Helmholtzian mental structure.

If mental structure can be firmly established, exploring its origins, characteristics, and consequences is surely the most important task with which perceptual psychology can concern itself. Our tolerance of Escher-like "impossible objects" and the anomalies described in the Coren and Girgus chapter are sufficient to show that we cannot simply expect the premises of perceptual inference to reflect the structure of the physical world. The central issue of mental structure now deserves a more frontal assault. The present volume represents, I believe, the most that can be done to this point within the limits of traditional constancy research.

JULIAN HOCHBERG
Department of Psychology,
Columbia University,
New York, New York 10027

Magmatic Provinces

Les Roches Volcaniques. Pétrologie et Cadre Structural. M. GIROD and seven others. Doin, Paris, 1978. 240 pp., illus. Paper, 128 F.

The study of volcanic rocks used to be just a small branch of geology, consisting in observing and recording active volca-

noes. Now it is a vast endeavor including the physics and chemistry of active volcanism and paleovolcanism, and it is all the more important these days with the realization that the ocean floors are pretty well entirely volcanic and that many industrial raw materials are volcanogenic. This book does not cover all aspects of volcanic rocks; as its subtitle indicates, it deals only with petrological and structural aspects. It achieves what no other book on volcanic rocks has done; it gives a thorough analysis of the geochemistry, mineralogy, and petrology of volcanic materials in plate-tectonic terms. Breathtaking accounts of Mount Pelée and Vesuvius are not part of this book.

The book has an air of refreshing simplicity, and the numerous informative maps, tables, and graphs give clear evidence of the thoroughness of the authors. A curious exception is figure VII-6, where western Africa and the eastern United States have swapped symbols and several black blobs appear without explanation, one intriguingly having a large question mark by it.

The first half of the book is the best part of it. Girod begins by saying the book is intended to fill the gap between the primary publications in journals and the general reviews found in many textbooks. It fills that gap well.

Girod has written three of the nine chapters himself and has done an excellent job of coordinating the others. Most of the chapters are written in a clear and straightforward style, and there are plenty of headings to help locate the topic one is chasing. Most of the book is given over to the distribution, geographical and geochemical, of the tholeiitic, calc-alkaline, alkaline, and shoshonitic series in relation to plate tectonics. This is well discussed, with a fund of geochemical and other data being brought to bear. The petrogenetic schemes for magmas within plates, along major fractures, and at accreting and subducting plate margins are neatly documented. A. E. Ringwood's opinions are well expounded by the contributors, but I am sorry that R. W. Johnson's recent authoritative opinions on Australasia's volcanism could not be included. There is a good account of the vital role of experimental petrology, putting phase diagrams, thermal barriers, effects of pressure, and all the principles of silicate phase relations in a French nutshell. And there are useful compilations of the distribution of the rare earth elements, isotopes, and mantle-type nodules. It is a pity that all the pyroclastic rocks are not covered; instead only the ignimbrites are described, and in detail. A novel but not too successful account of magmatic contamination is also included.

The index is rather weak, which is surprising considering the thoroughness of the rest of the book. The book has its omissions. No reference is made to the recent work on Etna and Vesuvius, or the moon, but what is really disappointing to me is the almost total lack of mention of the Hebridean province. It does not seem to find a home in the "cadre structural."

Les Roches Volcaniques is well printed in clear type on good-quality paper. The pages are sewn and the book should hold together for years even though it is a paperback.

I cannot think of a better book on magmatic provinces, which to me are the key to modern petrology. The book should have a world market and be read by all students, but its being entirely in French may cause difficulties. Despite the effort, it is well worth reading, and all my students will be encouraged to do so.

M. J. LE BAS
Department of Geology, University of Leicester, Leicester LE1 7RH, England

Surface Physics

Photoemission and the Electronic Properties of Surfaces. B. FEUERBACHER, B. FITTON, and R. F. WILLIS, Eds. Wiley-Interscience, New York, 1978. xviii, 540 pp., illus. $48.

Photoemission spectroscopy has enjoyed a tremendous growth in the last two decades yet there is no book that approaches definitive coverage of the subject. The very richness that makes photoemission such a productive and popular subject of research makes a unified view of the subject hard to reach.

Under these circumstances, several aspects of the book under review make it particularly valuable. The book, which is a collection of 17 chapters by 29 authors, gives a many-faceted view of the subject, and, by emphasizing the use of photoemission to study the electronic properties of surfaces both clean and with sorbed atoms, it remains tractable in size. In addition, sufficient coverage of bulk photoemission is given to bring its rather close relationship with surface photoemission into proper perspective.

The strongest aspect of the book is in the collection of theoretical chapters (constituting approximately half the book). This group of chapters alone makes the book essential for any student of or researcher in photoemission. The prospective reader should be warned, however, that a good knowledge of quantum mechanics is necessary for complete understanding of these theoretical papers, although the authors generally do a good job of explaining their results in physical as well as mathematical terms.

Unfortunately, only five chapters are directly concerned with experimental results of photoemission related to surfaces. This is simply insufficient space to treat such a large body of work and to give proper perspective. The chapters that are most useful are those in which the authors discuss their own work without attempting to cover a whole field. I was particularly struck by the chapter by Smith and Larsen, in which they present experimental data on angle-resolved photoemission from $TaSe_2$ and discuss a succession of models with which they and others have attempted to explain the data as they became more complete.

In contrast, the chapter by Gudat and Eastman attempts to give the reader a comprehensive view of photoemission from semiconductor surfaces, a demanding and broad subject that is impossible to cover adequately in a 40-page chapter. The chapter also gives evidence of haste in writing. For example, the work of Harrison and co-workers is mentioned but Harrison is not an author of either reference cited. And there is no discussion of the work of Bauer *et al.*, which gives new perspective on the final states in the surface excitons that are discussed at length by Gudat and Eastman. In fact, the large amount of work in which core states and synchrotron radiation are used is very poorly covered.

Several omissions or misconceptions are repeated with sufficient frequency that they should be mentioned. Although the excellent work of Gobeli and Allen is often recognized in the book, the equally important contemporary work of Scheer and van Laar is ignored. Too often, the photoemission is assumed to come from within only the last 5 or 10 Å of the solid, whereas that is the case only in restricted energy ranges. At high energy, a one-to-one correspondence is drawn between photoemission yield and optical absorption. As has been shown, this is a special case, not a general one.

Despite these rather understandable shortcomings, this is probably the best single treatment of photoemission available. Certainly, it is the best treatment centered on surface studies.

W. E. SPICER
Department of Electrical Engineering, Stanford University, Stanford, California 94305