of models as indistinguishable, even though the same ducklings (at the same age) do distinguish the models in a maze (*8*). We have as yet no clues as to the significance of these curious differences in what is learned. "The Skinnerian assumption that all discriminable stimuli can become discriminative stimuli . . . is unfounded" (*9*).

Another aspect of the context of behavior is its neural substrate. Neurophysiologists tend to believe that there are a limited and specific series of changes occurring within the central nervous system when an act is performed or learned, although they differ as to the nature of those changes. Growth or multiplication of synaptic end-bulbs, changes in synaptic cleft width, and quantity of neurotransmitter are but some of the mechanisms that have been proposed to underlie learning, for instance. Yet, is it not entirely reasonable that any response, an act entailing a color discrimination, for instance, may involve two different mechanisms in two different individuals, or even in the same individual at two different times? Resistance to extinction, ease of recall, generalizability, and other parameters of learning might then be expected to vary (*10*).

In short, the contexts of behavior range from the molecular to the ecological. Depending upon the graininess of the investigator's perceptual field, the degree of detail with which he is concerned, a given contextual element may become more or less important for him to consider, but this bears little on its significance to his subject. This implies that acts cannot be understood independently of the animal and the context in which they occur. Especially important, it implies that similarities in acts cannot be the basis for assuming the acts to be homologies (*11*). New actions, as Langer claims, rarely arise from older processes that serve the same ends.

Langer does not dispute that the normal procedures of scientific inquiry necessarily entail simplification. The fewer the variables assumed to be important to a given phenomenon, the more readily one can devise and test "explanations" for the phenomenon. It is a method at once elegant and powerful. Yet there often remains a residuum of unpredictable variance which implies either that the explanatory model is incomplete or that there is an imperfection in the system being explained. The next step is generally to consider an additional parameter and to see if thereby the residual variations disappear. Sometimes they do, often they do not. If the various factors that "explain" or "cause" or "influence" some phenomenon do not act in an additive fashion, if their interactions have a Gestalt character (which then becomes the context of the phenomenon), an approach that entails the accretion of variables is not profitable. Another mode of analysis is required. A similar point is, I believe, entailed in the fact that a sequence of seemingly trivial and identical movements (for example, of the gill covers of two Siamese fighting fish, *Betta* species) will suddenly take on a signal function. The point after which the movements have ceased to be trivial is clearly recognizable; the point of transition itself may well prove as elusive as the position of atomic particles whose velocities are being measured, unless a holistic mode of analysis is devised (*12*). Though this is not the consensual view, neither is it a radical one. Hence it is puzzling that Langer argues it with such aggressive zeal.

Toward the end of her lengthily annotated argument, Langer presents her answer to the query, "How did speech and human mentation arise?" The order is not insignificant—speech first, then mentation. If we accept the conclusions she has drawn, we are no longer bound to assume that behavioral convergences are indicators of more basic similarities. Then, we need not regard speech as having evolved as a communicatory mechanism. Indeed, Langer questions the very existence of communication among nonlinguistic forms, but this is a secondary (though important) issue. The motive for human vocalizations, she argues, was most likely communion, a vicarious form of tactile contact. Only subsequently did meanings attach to sound and a communicatory function evolve.

This last is, indeed, an original (though she acknowledges older sources) and interesting conception. It would be a pity if it were overlooked because of the superfluity of the other arguments.

One minor complaint must be registered. Creative writers may be permitted eclecticism in the sources they cite, but in a work of systematic philosophy some rationale for the selection of sources may be expected. For all of Langer's many pages on problems of convergence, no reference appears to G. Bateson; and how can one discuss the relation between language and concept formation and ignore Whorf? or animal communication and language and forget Sebeok? The problems of stimulus salience have attracted several prominent psychologists, yet none of them are named. The omission of references to most of the youngest generation of ethologists is curious, too, in the face of the copious footnotes adorning most pages.

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Geoscience of Islands

Island Arcs. Japan and Its Environs. A. SUGIMURA and S. UYEDA. Elsevier, New York, 1973. viii, 248 pp., illus. $23.50. Developments in Geotectonics 3.

This book is a review and a synthesis; the primary subject is the Japanese island arc, but some space is devoted to problems of island arcs in general.

The task of writing it must have been a large and difficult one because of the wide variety of subject matter—virtually all aspects of geology, geophysics, and geochemistry—that bears on island arcs. Some 600 references are cited, and the authors perform an important service for those who do not read Japanese by including results from important papers written in Japanese. The book is clearly, concisely, and authoritatively written and reads well.

There are but three chapters. The first brings together information on geophysical and geological features of modern arcs and includes topics ranging from hot springs and surface faulting to crustal and upper mantle struc-

ture and from topography to electrical conductivity and seismicity. The second chapter focuses on the geological history of the Japanese arc, primarily during the Cenozoic era, with greater emphasis on the more recent events. In the last chapter, the authors discuss processes under island arcs, proposing a central hypothesis of descending flow beneath the arc. The authors had formulated this hypothesis, and apparently written parts of the book, prior to the advent of plate tectonics and the discovery of sea-floor spreading. They have attempted to incorporate these new concepts into the book, and in most cases have done so smoothly and successfully.

Because of the speed with which the subject of plate tectonics is developing, any book that discusses the subject is, in some regard, out-of-date when it is published, and this book has this shortcoming. However, it is by far the most modern and most comprehensive book on the subject of island arcs, and all but the most recent developments in plate tectonics are covered.

The book may be used by specialists and generalists as a source of information or of references. It might also serve as the text for a seminar, particularly one in which there are students with a variety of backgrounds.

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Electrons, Holes, and Monsters

The Fermi Surface. Its Concept, Determination, and Use in the Physics of Metals. A. P. CRACKNELL and K. C. WONG. Clarendon (Oxford University Press), New York, 1973. xii, 566 pp., illus. $48.

Everyone knows what a metal is and can describe many of its characteristics. It is safe to say, however, that few people would define a metal as "a solid with a Fermi surface." This may nevertheless be the most meaningful definition of a metal that one can give today; it represents a profound advance in the understanding of why metals behave as they do.

With this quotation from A. R. Mackintosh, Cracknell and Wong open the preface of this timely and well-written book. They lead the reader into the path of "Fermiology," one of the most actively studied subjects in modern solid state physics. The origins of Fermiology go back to the early days of quantum mechanics, when the basis of the Fermi-Dirac statistics for electrons was formulated: put in simple terms, it is that no two electrons can occupy the same quantum state. When the quantum states are defined in a perfectly periodic structure, they are defined or labeled by a wave vector (also called quasi-momentum) $\vec{k}$ which can be considered a continuous variable. In this highly idealized k-space, at very low temperatures, there should be for a metal a well-defined surface which separates occupied from empty states. Such surface is the Fermi surface, the subject and protagonist of the present book.

In the early days of the 1930's, the Fermi surface existed only in the minds of theoreticians, who thought of it as a collection of beautifully symmetric spheres or at most slightly distorted ellipsoids. Nature, however, decided, as usual, to give us more variety and almost endless complications. When the experimentalists could grasp the ins and outs of the Fermi surface—through a richness of experimental methods that were developed only in the 1950's and '60's—the subject of Fermiology became extremely active and full of twists, surprises, and unexpected physical effects.

In order to describe our present knowledge of the Fermi surface of metals, Cracknell and Wong have written this well-constructed book. In the first chapter, they start with the basic foundations of the electron theory of solids, which can be found in all standard textbooks on solid state physics. The concepts are presented clearly in such a way as to unify notation, properly define terms, and introduce the neophyte to the jargon of the field. Chapter 2 is devoted to the calculational methods employed by the theorists in determining Fermi surfaces. Such methods are many and sometimes not clearly related to one another: they have polarized the theorists in such a way as to create separate schools of band structure and Fermi surface "calculators" which sometimes are at odds with one another. In the book, the various methods are clearly presented and their common ground and significant differences then discussed. Chapter 3 gives a beautiful synopsis of the experimental techniques that yield information on those properties related to the Fermi surface. Here is the *real* physics, and here is where Fermiology becomes a reality susceptible of measurement.

The next two chapters are descriptive in character; they contain a detailed survey of the known facts about the Fermi surface of the metallic elements. The topological, geometrical, and differential properties of the many Fermi surfaces included in the text take the reader through a fantasy world of rather incredible creatures which bear whimsical given names such as hole surfaces, monsters, cigars, coronets, and crowns.

The last two, rather succinct, chapters examine briefly the validity and theoretical foundations of the hypotheses made originally, and the possible paths that must be followed when strong interactions are present in the electron "gas" or when periodicity of the crystal is destroyed by alloying.

Although monographs and review articles are by no means lacking in the field, this book is by far the most coherent and complete presentation on the subject. It assumes on the part of the reader a general basic knowledge of solid state physics in addition to a well-founded knowledge of basic quantum mechanics but requires no previous acquaintance with the complexities of Fermiology. The list of references is extensive, and the illustrations are many and very good.

My most serious complaint about this well-edited, well-printed, and well-presented book is the outrageous sum that the interested reader (or fund-starved library) will have to disburse to acquire a copy. Even the high price of gold these days does not justify such a sum for its Fermi surface.

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The Cyanophyta

The Biology of Blue-Green Algae. N. G. CARR and B. A. WHITTON, Eds. University of California Press, Berkeley, 1973. x, 676 pp., illus. $32. Botanical Monographs, vol. 9.

There has long been a need for a comprehensive text devoted to the general biology of blue-green algae. Whereas eukaryotic algae and other prokaryotic microorganisms have been the subject of numerous texts, information on the Cyanophyta has been either dispersed through other texts or confined to books dealing mainly with morphology and taxonomy.

This book will serve advanced students and researchers very well, for the editors have succeeded in their stated objective, "to give an account of most