research and that of the Gardners.

One potentially fruitful approach to the analysis of cognitive processes is Harlow's error-factor theory, which he originally applied to the formation of learning sets. One of the few investigators who has carried on this method of analysis is Meyer, who reports his findings on the relationship between the learning of habits and of concepts by monkeys. These findings, according to Meyer, suggest that monkeys can learn and unlearn concepts (rule learning) without any apparent change in the way they learn particular habits. This view suggests that as cognitive processes for handling complex information develop the mechanisms governing habits remain stable. Meyer goes further and claims on the basis of an experiment by Betllinger *et al.* that habits, when retained, can suppress learning sets, although it is not entirely clear whether set suppression or simply interference with a particular habit has been demonstrated in this study. Meyer concludes by speculating that humans, to the extent that they show behavioral rigidity, are probably prone to similar suppression of concepts by habits. Support for this view comes from Maier's findings that insightful learning of new principles for solving problems can be impeded by old habits.

In one of his two contributions to this symposium, Harry Harlow, together with M. K. Harlow, Schiltz, and Mohr, presents data on learning abilities of monkeys raised in normal, enriched, or socially deprived environments. These findings indicate that manipulation of early social environment has no consistent effect on the learning of tasks ranging in complexity from simple discrimination learning to learning the oddity principle. Harlow and his co-authors take to task those investigators who have reported apparent adverse or facilitating effects of rearing conditions on later learning, and point out the importance of adaptation to the test situation, the interfering effects of emotional reactions, and several other factors carelessly dealt with or ignored in past studies. Harlow apparently feels quite strongly about these problems, for he contributes, along with J. P. Gluck, another chapter in which, after a critical review of the literature in this area, it is concluded that because of failure to control the factors mentioned previously inferences about the impact of early experience on later learning are unwarranted. The message is clearly stated: those who look to the animal literature for an understanding of factors controlling human learning and for guidance in forming social policy had better look carefully.

The disparity between approaches taken in these papers is matched by that of the viewpoints expressed by the two discussants. Gregg, a psychologist, approaches cognition from the computer-modeling point of view. He concludes that cognitive control occurs when an internal event selectively directs attention to particular environmental stimuli so that different stimuli generate switching operations as a function of internal states. This idea is very similar to those expressed by Sutherland and others in dealing with selective attention in animal discrimination learning. According to Gregg, if cognition is described in terms of a computer-modeled system involving elementary information processing, expressed as instructions, then cognitive processes in monkeys (the learning of rules in learning set) and in man are fundamentally the same; they both involve perceptual or attention-getting rules. Stimulus-response theorists, starting from quite different assumptions, have also attempted to understand complex problem-solving behavior of animals and humans in terms of a unified theory. One can only hope that an information-processing approach will be more successful.

By contrast, Geschwind, a neurologist, begins his analysis with the fact that the human cerebral hemispheres are unique among mammals in that they show functional and anatomical asymmetry. He points out that the dominant role of the left hemisphere with regard to language is clearly seen in cases of cerebral disconnection. Geschwind holds the view that language involves the ability to form cross-modal associations, which in turn depends upon the functions of a higher-order association area in the region of the angular gyrus. Since it is now known that chimps can learn language, he must show that this region has common features in the chimp and human brain. He must also demonstrate that it is impossible for primates with an undeveloped angular gyrus (a definition is needed here) to learn language. Since it is impossible to prove the null hypothesis, Geschwind's theory, at least in its present form, is at best difficult to test.

The editor of this volume states in the preface that "many who attended the symposium left with a clearer understanding of similarities and differences that exist in complex behavior of human and non-human primates." This claim may come as something of a surprise to the reader, who more likely would be struck by the paucity of data bearing on these issues. It is evident from what has been said that the contributors to this volume are concerned with different problems, have different conceptual frameworks, and use different experimental methods, all of which makes it difficult to interrelate their contributions. From a distant perspective, it is difficult to make out any trends emerging in the analysis of cognitive processes in primates. In fact, it appears that the study of cognition in nonhuman primates is proceeding at a slower pace than it did in the past, when such investigators as Harlow and before him Nissen, Klüver, Yerkes, Tinklepaugh, and others opened up the field. Present investigators of primate behavior seem to be more interested in social and emotional behavior or sensory processes than in cognition. It appears that a resurgence of interest in this area will have to come about before we have a clearer understanding of similarities and differences between the complex behaviors of human and nonhuman primates.

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Continuing Reviews

Current Topics in Experimental Endocrinology. Vol. 1. L. MARTINI and V. H. T. JAMES, Eds. Academic Press, New York, 1971. xiv, 294 pp., illus. $16.50.

Since this is the first volume of what is intended to be a continuing series, it is of interest to note its orientation as outlined in the editors' preface. "The purpose of this series is to provide readers with a continuing and critical review of the field [of endocrinology]. The invited authors have been offered the opportunity to discuss their field critically from a personal standpoint rather than to provide an extensive reference list. . . ."

In fact, can this series justify itself and stake out an area that is not already occupied by *Recent Progress in Hormone Research*, produced annually by the same publisher, and by the frequent endocrinologic treatises in *Annual Re-*

view of Physiology, Annual Review of Biochemistry, and others? The answer is a qualified yes, since the *Recent Progress* series contains articles of relatively limited scope, derived from the deathless yearly Laurentian Hormone Conferences, and the *Annual Review of Physiology* must serve the entire field of physiology. Affirmation here must be qualified because much would depend upon whether the editors of *Current Topics in Experimental Endocrinology* are wise in the choice of topics, as well as in their choice of authors.

It would seem that in their first venture they have been quite successful, and we may hope that future volumes are as well executed.

The volume contains eight essays on widely diverse subjects. There is a highly useful discussion by R. P. Ekins of the principles underlying "saturation analysis techniques," which to the endocrinologist means the recently developed techniques for measurement of minute quantities of hormones at low concentrations in body fluids by radioimmunoassay or by various specific binding procedures. The fringe areas of endocrinology are served by a review (by A. L. Goldstein and A. White) of the thymic factor or factors involved in conferring immunological competence in lymphoid tissues, and by a discussion (by J. D. Flack, P. W. Ramwell, and J. E. Shaw) of the roles of prostaglandins in endocrine responses.

The five remaining reviews deal with more conventional topics, some of which have been adequately reviewed elsewhere recently but perhaps in a less conveniently available format. They include an article on steroid hormonal evoked differentiation of the nervous system (B. Flerkó) and one on the subcellular phenomena in which ovarian hormones engage at the target tissue level (E. V. Jensen and E. R. DeSombre). There are more conventional reviews on the "posterior pituitary" by T. Chard, on calcitonin by J. T. Potts, Jr., H. D. Niall, and L. J. Deftos, and on long-acting thyroid stimulator by D. S. Munro.

On the whole, this will probably become a useful series for the harried endocrinologist who cannot keep up with the impossibly abundant flow of endocrine literature, and for the student seeking a recent summary of a particular field.

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Histamine Research

Biogenesis and Physiology of Histamine. GEORG KAHLSON and ELSA ROSENGREN. Williams and Wilkins, Baltimore, 1971. vi, 318 pp., illus. $21. Monographs of the Physiological Society, No. 21.

This monograph is an account of experiments in histamine physiology carried out by Georg Kahlson's laboratory in Lund over a period of more than 20 years. This laboratory, together with that of R. W. Schayer, has dominated research into histamine physiology ever since Schayer and his colleagues developed specific and sensitive isotopic methods for quantitating various parameters of histamine metabolism in the early 1950's. This record, therefore, is valuable not only because it presents Kahlson's publications under one cover but also because it must reflect, regardless of the authors' intentions, the dominant patterns of histamine research over this period.

The number of original observations made by Kahlson's group is impressive by any standards. Prominent among these have been the demonstration of the astonishing changes in histamine metabolism which occur during pregnancy in rodents, the regulation of histidine decarboxylase in gastric mucosa by gastrin, and the occurrence of high levels of histamine formation in a variety of rapidly growing tissues. These are the main topics covered in the book.

Research into the role of histamine has suffered badly from isolation. An overview of the period covered by this volume would suggest that it has been one of first-class observation rather than insight. For too long histamine research has consisted of a series of monologues often unconnected with and largely uninfluenced by developments in associated fields. As M. A. Beaven once put it, "we need to appreciate biology more" if the biological role of histamine is to be unraveled. This is apparent in the section on the role of histamine in gastric acid secretion, and nearly a quarter of the book is devoted to this controversial topic.

In 1964, Kahlson and co-workers published their now classic paper demonstrating the release of mucosal histamine and stimulation of histidine decarboxylase when starved rats were refed or given an injection of gastrin. From this was developed a model defining the relationship between histamine and acid secretion. A temporal similarity between two events is not proof of a causal relationship, and the discussion is never pursued with the vigor demanded. Indeed, a comparison of this chapter with a recent review in *Gastroenterology* by L. R. Johnson on the same subject entitled "Control of gastric secretion: No room for histamine?" is illuminating in suggesting why so little real progress has been made following the initial observations. This book testifies, therefore, to a series of remarkable and sometimes brilliant discoveries even if, as a signpost to the future, it leaves one frustrated and intellectually dissatisfied.

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Protozoa

The Biochemistry and Physiology of Tetrahymena. DONALD L. HILL. Academic Press, New York, 1972. xii, 230 pp., illus. $12.95.

Tetrahymena pyriformis is undoubtedly the most studied of the 6000 named species of ciliated protozoa. Thousands of papers have been written about it, the majority in the last 20 years. Since the first report of its axenic cultivation by André Lwoff in 1923 and of its cultivation in a defined medium by George W. Kidder and Virginia C. Dewey in 1951, it has been an extremely popular subject for biochemical and genetic work. It occurs commonly in fresh water throughout the world, its generation time is short, and it multiplies readily in the laboratory. There are other species of *Tetrahymena*, a few of them even being parasitic, but they are not nearly as well known.

Hill has performed the tremendous task of pulling together all the literature on the biochemistry and physiology of *Tetrahymena*. He discusses carbohydrate, lipid, energy, amino acid, protein, purine, pyrimidine, and nucleic acid metabolism, biochemical genetics, vitamin and inorganic requirements, effects of radiation, drugs, and hydrostatic pressure, and evolution.

Like other protozoa, *Tetrahymena* is an animal, but it has many plant-like characteristics. It is motile, it ingests food, it has no chloroplasts, it has the same amino acid requirements as man and rats and has similar vitamin requirements, it synthesizes and stores glycogen, and it has hemoglobin. These