strategies. After considerable effort, a simple conclusion emerges: the takeover and the follower strategies have approximately equal net payoffs to those who adopt them. Dunbar suggests that they are evolutionarily stable alternative reproductive strategies for males.

For females, dominance rank and the support of alliance partners are critical behavioral factors affecting fitness. Female gelada form linear dominance hierarchies, and a female's dominance rank is influenced by her age, her family's dominance rank, and the presence of an ally (usually her mother or daughter) who supports her in aggressive conflicts. Dunbar demonstrates that high-ranking females have higher birth rates than lower-ranking females and that females who receive support from an ally are likely to achieve higher rank than females who do not.

Dunbar addresses two related questions about females. First, how does coalition behavior evolve? Second, does fitness actually vary among females over the course of their lifetimes? His conclusions are likely to surprise many of his colleagues.

Dunbar's analysis of coalition behavior indicates that females principally benefit by increasing their personal fitness and gain relatively little through increases in their inclusive fitness. This result leads him to argue that coalition behavior has evolved primarily through individual selection, not through kin selection as many others have suggested. This conclusion rests upon several assumptions. First, alliances are assumed to impose no costs upon the participants, even though females expend time and energy in these encounters and are capable of seriously injuring one another with their canines; moreover, harassment by females apparently inhibits ovulation. Second, individual fitness is tabulated as the sum of benefits gained by a female and her daughters, whereas inclusive fitness is tabulated as the sum of benefits gained by her mother, sisters, and other female kin. These are not sensible classifications. Kin-selection theory provides no justification for distinguishing benefits gained through altruism toward mothers and daughters. If benefits gained through all kin are combined, the magnitude of the difference between the individual-selection and kin-selection components of fitness becomes considerably smaller. It is not clear how the results would be altered if the costs of coalition activities were incorporated into the model. Finally, it is evident that kinship is a critical ingredient of gelada alliances. Alliances typically involve closely related females, often mothers and daughters, and are only reciprocated over a period of many years. This is consistent with predictions from kin-selection theory and with Aoki's recent demonstration (*Proc. Natl. Acad. Sci. U.S.A.* **80**, 4065 [1983]) that kinship greatly facilitates the initial spread of alleles for reciprocal altruism. For these reasons, it seems clear that kin selection has played an important role in the evolution of alliances among gelada females.

Dunbar's analysis of female reproductive performance indicates that reproductive success is equilibrated among females over the course of their lifetimes. Though dominance rank influences reproductive performance in the short term, changes in rank that occur as females age tend to smooth out those differences. Dunbar cautions the reader that these conclusions do not necessarily apply to other gelada populations or other primate species. Such caution is warranted for several reasons. The gelada populations he studied were unusual in a number of ways. The population at Sankaber was expanding at an annual rate of 10.9 percent, food was abundant, infant survivorship was high, and predation was rare. Many of the demographic and behavioral data that were used in the analysis were collected during relatively short periods of observation. Estimates of infant and juvenile mortality, life expectancy, and female reproductive performance over the life span at Sankaber, for example, are based upon projections from cross-sectional data collected during two nine-month periods in the field. Dunbar's general conclusions will be accurate only if the behavioral and demographic patterns do not change over time.

These concerns do not diminish the value of Dunbar's work. Dunbar has presented the relevant data and outlined the assumptions of his models clearly, leaving the reader free to argue or agree with the conclusions he reaches. The models he builds can be used as a framework to explore a wide range of empirical circumstances and may some day become a useful foundation for broad comparative analyses. For those who wish to know more about geladas and for those who wish to consider cogent models of complex behavioral and demographic processes this book is essential.

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Psychobiology

The Neurobiology of Motivation and Reward. JAMES R. STELLAR and ELIOT STELLAR. Springer-Verlag, New York, 1985. xii, 255 pp., illus. $34.90.

The study of motivation has been in serious decline for a number of years. The standard work in the field, by Bolles, is now 10 years old. Although individual systems such as thirst and hunger and the biology of reward processes have been the subjects of intense investigation, somehow more general issues relating to the theory of motivation have got left out. The rat is usually presented as a collection of bits rather than as a goal-directed organism. The theorists of the past addressed both motivation and learning, proposing models of their relatedness. Today's theorists are concerned primarily with learning. Unfortunately, in contemporary learning theory both the psychologist and the rat tend to get buried in ever more sophisticated and impressive cognitions, remote from motivation.

Given this general historical context, the appearance of *The Neurobiology of Motivation and Reward* by the father-and-son team of Eliot Stellar and James R. Stellar can only be described as an exciting event. Eliot Stellar is one of the pioneers of the subject.

The book's title suggests that it will be concerned primarily with the "hardware" end of the spectrum, and indeed it is. Much of the book is devoted to electrical brain stimulation, neuroanatomy, and neurochemistry. As a review of the neurobiology of the subject, the book is up-to-date, extensive, and well written.

The book is directed to a readership having some familiarity with psychobiology. It opens with a brief history of motivation and the concepts of reward, traced back to the Greeks. An introductory-level discussion relates these notions to instinct, hedonism, sensory psychology, temperament, emotion, and affect. This scene-setting is well done. However, the substance of the book concerns the hardware underlying reward processes. The rewarding effects of electrical stimulation of the brain are extensively discussed. The neurochemistry of reward and brain lesions also get extensive coverage. An overview at the end of the book is based mainly on the results of studies of electrical and chemical stimulation of the brain and of brain lesions. The coverage of these subjects is excellent. My regret is that the book does not return to the more general theoretical context of motivation, as is dis-

cussed in the introduction. The attempts that are made in the book to construct bridges to the general theory of motivation are rather limited. For example, "drive" has been around for a long time. No one seems to know quite why we need the concept, but we keep putting it on display. It tends therefore to assume a variety of uncertain functions. Stellar and Stellar don't add much in the way of clarification. They write, "Motivated behavior is goal-directed behavior and is thought by most theorists to be dependent upon specific arousal or *drive* of the organism" (p. 29).

I'm not sure whether we are to accept or to abandon the Hullian notion of drive as an internal source of motivation. The term "acquired drive" is introduced in the book, but, in the light of attempts to condition eating and drinking behavior, it is not clear to me what an acquired drive is or even whether it exists.

I would like to have seen more attempt at a synthesis and more critical evaluation of the general implications of the results obtained. For example, reward needs to be central to learning theory. Although the book does justice to Cabanac's hedonic model, the opportunity to link it with Rolls's neuronal model or Bindra's incentive theory model has been missed. I was disappointed to see that contemporary studies of ingestive behavior are integrated rather little into the book. They would have provided a context for the authors' ideas.

The authors have stuck to their brief rather closely and have moved only a little way toward addressing the theory of motivation. However, even that is most welcome, and the book is to be recommended.

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Landform Evolution

Geomorphology. RICHARD J. CHORLEY, STANLEY A. SCHUMM, and DAVID E. SUGDEN. Methuen, New York, 1985. xxiv, 605 pp., illus., + plates. $30.

Geomorphology is concerned with the origin, description, and evolution of the landscape, which necessarily entails a concern with the long-term influence of tectonism and climate change. The science has its modern origins in the late 19th century, when investigators developed general models of landform evolution that could apply to landscapes having continental scale. As the authors of this book note, the measurement of geomorphic processes was avoided; the prevailing view was that landforms changed so slowly that no meaningful measurements applicable to landscape evolution could be made. Models of landform development were thus unverifiable. In the past 40 years there has been a dramatic shift toward the study of surficial processes involving the quantitative analysis of short-lived phenomena. In certain instances measurement of processes and landform change can be utilized to construct and verify models of landform development. Renewed interest in landform evolution has also been brought about by the realization that in some environments modern surface processes may only be etching the surface of a landscape inherited from an earlier geomorphic regime.

This book is notable because the authors have integrated modern concepts of landscape evolution with a comprehensive review of process geomorphology. The book has a coherent, well-defined structure. The historic development of landform models is treated by way of a thought-provoking review of the contributions of Davis, Gilbert, Penck, and King. Both the strengths of these earlier models and their weaknesses, particularly the lack of hard data on landform change, are described. The dependence of the models on the views of global tectonics that prevailed when they were developed is evident. In modern research, structure and tectonics form one of the boundary conditions for models of landform evolution. Modern theories of landscape development incorporate not only a progressive denudation chronology, inherited from these earlier theories, but also subordinate, internally driven cycles that operate through feedback and threshold mechanisms. In particular, process geomorphology has been important in identifying the nature and role of these subordinate cycles in landform evolution.

The book's treatment of structural geomorphology will provide students from outside the field of geology with an introduction to earth materials, structure, and the resulting landforms. From a pedagogical point of view this is an important consideration. In practice, however, a section of the book that discusses minerals, rocks, and sediments detracts from the continuity of the book. In future editions the section should be pared down to omit details that are not incorporated in later discussions.

The heart of the book is a review of process geomorphology in which the authors point out the major inconsistencies and gaps in our present knowledge. For example, despite nearly a century of effort, it is difficult if not impossible to make estimates of sediment transport rates and sediment budgets that can be translated into predictions of landform change. The discussion of process geomorphology will introduce the student to the complexity of the natural system.

Climatic geomorphology and the theory of morphogenetic regions are treated with caution. Such caution is warranted, for geomorphologists still do not have an adequate understanding of the manner in which climate affects landform development and process geomorphologists may have overemphasized the importance of modern processes relative to landscape inheritance from past climatic regimes in the control of landform development.

The book ends with an afterthought on the role of geomorphology in evaluating environmental problems.

Overall this is an excellent book. The level of discussion assumes some prior training in the subject. Still, the book will find wide acceptance at the advanced undergraduate and graduate levels and will be a primary reference for researchers in the field.

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Issues in Quantum Physics

The Creation of Quantum Mechanics and the Bohr-Pauli Dialogue. JOHN HENDRY. Reidel, Boston, 1984 (distributor, Kluwer Boston, Hingham, Mass.). xii, 177 pp. $34.50. Studies in the History of Modern Science, vol. 14.

Hendry begins this study of the beginnings of quantum mechanics by examining the views of Bohr and Pauli around 1922 concerning the kinds of concepts that can or should be used in a physical theory. Are all classical concepts legitimate (Bohr's view), or must theories be restricted to dealing with observable properties (Pauli's)? Are the notions of field and continuity crucial to our understanding of certain physical phenomena (Bohr), or must we work only with the notions of particle and discontinuity (Pauli)? Should energy conservation be relinquished in order to retain something like classical space-time descriptions (Bohr), or are such descriptions unimportant (Pauli)? A full chapter is devoted