view, in placing the problem in perspective.

Unfortunately, the conference contained nothing new. The selected statistics that excite the enthusiasts still caused the skeptics to shake their heads. The variations in solar output that were described still looked like miniscule fluctuations indeed, and the depth in our atmosphere to which their effects might reasonably extend was still the thin vacuum of its highest reaches. No one, neither skeptic nor enthusiast, proposed any definitive tests in the old debate. Charles Augustus Young, the eminent solar astronomer of the 19th century, had said it all in 1895 (*The Sun*, p. 161):

> In regard to this question the astronomical world is divided into two almost hostile camps, so decided is the difference of opinion, and so sharp the discussion. One party holds that the state of the sun's surface is a determining factor in our terrestrial meteorology, making itself felt in our temperature, barometric pressure, rainfall, cyclones, crops, and even our financial condition, and that, therefore, the most careful watch should be kept upon the sun for economic as well as scientific reasons.
>
> The other party contends that there is, and can be, no sensible influence upon the earth produced by such slight variations in the solar light and heat . . . .
>
> It seems pretty clear that we are not in a position yet to decide the question either way; it will take a much longer period of observation, and observations conducted with special reference to the subject of inquiry, to settle it. At any rate, from the data now in our possession, men of great ability and laborious industry draw opposite conclusions.

It would probably not surprise the sagacious Young that nearly 80 years later almost 200 such men were still hotly arguing the same issues. What he might find heartening, however, is that since the Goddard meeting, and in part because of it, his simple recommendation that more observations of the solar output be made is at last being implemented, by NASA and other agencies. We have subsequently brought together a new definition of the total output of the sun and its variation which should serve as a baseline for the gauging of future variations (O. R. White, Ed., *The Solar Output and Its Variation*, University of Colorado Press, in press). And computer modeling efforts are bringing us closer to the day when we can determine, in theory at least, whether these measured solar changes can have any significant effects in an atmosphere such as ours. In 1977, as in 1973 and 1895, we still don't know.

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Issues in the Study of Behavior

Growing Points in Ethology. Proceedings of a conference, Cambridge, England, 1975. P. P. G. BATESON and R. A. HINDE, Eds. Cambridge University Press, New York, 1976. viii, 548 pp., illus. Cloth, $38.50; paper, $11.95.

The 25th anniversary of the Sub-Department of Animal Behaviour (University of Cambridge) at Madingley was celebrated by a conference, in which representatives of widely different fields were invited to discuss some of the issues that seem to be emerging in ethology today. The present volume is the proceedings of this conference. Because the participants included many prominent and active ethologists, because they took seriously the request to identify and discuss issues that were likely to be important, and because the conference was organized in an intelligent and meaningful fashion, its proceedings deserve to be read by every serious student of behavior.

The book contains 18 contributions that collectively cover a wide range of topics. Several, such as Peter Marler's analysis of vocal communications in gorillas and B. C. R. Bertram's examination of kinship relationship within lion prides, are highly focused. Others, such as Richard Dawkins's essay on hierarchical organizations and P. P. G. Bateson's discussion of control theory as applied to developmental data, point to new and potentially useful tools in the analysis of behavior. Several essays take a broad view. For example, N. G. Blurton Jones examines potential contributions of ethology to the social sciences, and Peter Medawar takes note of various ways in which ethology has or is likely to cast light on human behavior. In the final, and in a sense capstone, essay N. Tinbergen looks to the practical implications of ethology and asks how its present and future findings might be best employed to the benefit of society.

The essays have been assigned to sections according to their perceived relevance to what have often been described as the four basic questions that ethology asks about a given behavior. What are its immediate causes? In what ways does it benefit or harm the individual? What is its relevance to the survival of the species? How did it evolve? In no case, however, are the essays focused on any one of these questions. And because most, if not all, have been revised to take account of the discussion they generated, they have a coherence that transcends both their topical specialization and the subject matter of the particular section in which they happen to appear. Another factor that contributes to the coherence of this highly diversified set of essays is the lucid and extensive editorial commentary. This commentary along with the editors' conclusion—an essay on asking the right questions—is in large part what gives this collection its distinctive flavor.

The paper by Bertram, "Kin selection in lions and evolution," provides a good example of the thinking one encounters here. Extensive field observations have revealed that a representative lion pride contains two adult males and seven adult females. Four of the females give birth at about the same time, and they rear their cubs together. Three female subadults remain with the pride, replacing females that have departed or died. All male subadults are driven from the pride, but they remain together and eventually form their own pride. Finally, the adult males in a pride do not retain tenure long enough to father more than one batch of young female recruits.

Bertram notes that with this system the adult males are typically related to each other and the adult females are related to each other, but the adult males are not related to the adult females—hence no inbreeding occurs. He then proceeds to calculate (using certain additional information) that the males in possession of a pride, like the cubs in the pride, are related on an average by about 0.22 (that is, they are almost half-siblings) and that the female adults are related on average by about 0.15 (that is, they are a little closer than full cousins).

For Bertram the significance of these calculations lies in the fact that it has often been observed that animals that are directly related are more cooperative with one another than with unrelated members of their species. In the case of lions, competition with conspecifics and killing of young that are not members of the pride are not unknown. Within the pride, on the other hand, one sees tolerance on the part of an adult male toward all the cubs, whether its own or its half brothers'. Moreover, a female will readily suckle cubs other than her own, and competition for an estrous female is seldom observed. Bertram shows how each of these observations can be explained in terms of the kinship that exists within a representative pride.

By focusing on the social and ecological setting in which a given behavior occurs (in this case the behavior is cooperation) and by seeking the genetic relation-

ships that accompany it, Bertram's paper not only illustrates the traditional approach of the ethologist, it exemplifies one of the new directions ethology is taking. A traditional ethological interpretation of the observed cooperation within a pride might have settled for a description of its function—namely, to ensure the survival of the individuals within the pride. Bertram goes beyond this by identifying a factor (kinship) that seems to mediate within-pride cooperation. Clearly, in doing so, he provides an exemplar of a relationship that is likely to transcend the particular species he is studying. That this is the case is revealed in the paper by T. H. Clutton-Brock and P. H. Harvey on "Evolutionary rules and primate societies." These authors provide a detailed discussion of a variety of primate social behaviors in which kinship relationships appear to play an important role. The evidence they cite indicates that in primates (as in lions) feeding tolerance—along with a number of other beneficent behaviors—varies directly as a function of the degree of genealogical relation between the individuals involved.

Of course one could, if one chose to, pick any of the other essays to illustrate the unique flavor of this outstanding collection. Suffice it to say that the book contains more than 500 pages showing some of the best minds in the field interacting on issues that are certain to shape the future of ethology and, perhaps, society as well. There are ideas here whose influence will be felt for many years to come.

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The Maghreb Neolithic

The Later Prehistory of Tangier, Morocco. ANTONIO GILMAN. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Mass., 1975. x, 182 pp., illus. Paper, $15. American School of Prehistoric Research Bulletin No. 29.

Throughout much of the mid-Holocene, when agricultural settlements flourished in southwestern Asia and cattle pastoralists roamed the Sahara, the inhabitants of the Maghreb (northwestern Africa) apparently remained hunter-gatherers. To an essentially unchanged Epipaleolithic tool kit and subsistence adaptation they added only ceramics, a few new stone tool forms, and perhaps certain domesticated animals. This traditionally accepted view of the Maghreb Neolithic is based largely on research (much of it inadequately published) completed before the Second World War, at a time when the present emphasis on prehistoric economies was still nascent and most explanations for variability in the archeological record relied on diffusionist models rather than examination of localized adaptive patterns.

Gilman's monograph, an edited version of his Harvard Ph.D. dissertation, is an attempt to right the balance for the Maghreb Neolithic. Using collections excavated by the American School of Prehistoric Research between 1936 and 1947 in three caves at Cape Ashakar near Tangier, Gilman attempts a functionally oriented culture-historical analysis and interpretation of the Neolithic in this region. His work is thoughtful (for example, he continually cautions the reader about the limitations of his data) and precise. Prehistorians working in the western Mediterranean will find his careful comparisons of Maghreb and Iberian ceramic assemblages particularly useful. The monograph is well written and illustrated, and there is a wealth of tabulated data and statistical correlations to bolster some of the interpretations.

I do not find Gilman's reconstruction of subsistence patterns and adaptive systems very satisfactory, but the fault lies with the limited data available rather than with the author. I am intrigued by his interpretation of the goat and pig mortality curves at Mugharet al 'Aliya as demonstrating the latter animals to have been domesticated and the former (evidently imported from outside the Maghreb) feral. The proof is not conclusive to my mind, but it certainly suggests that the adaptive patterns were more complex (advanced?) than has previously been thought.

I am in complete agreement with Gilman's thesis that variability in ceramic assemblages from Maghreb sites indicates regional stylistic differences due to geographical separation of cultures as well as intersite differences due to differences in function (reflecting, for example, seasonal occupations). While the differences in function must remain hypothetical until more data are available, the model is in substantial agreement with the one my colleagues and I have proposed for the immediately preceding period in eastern Algeria (see Lubell *et al.*, *Science* **191**, 910 [1976]).

Gilman marshalls his data effectively to show that the Neolithic of Iberomaurusian Tradition should be replaced by his Mediterranean Neolithic. The latter is composed of three geographic facies in the western Maghreb which differ in artifact assemblages and economic practices while retaining a distinctive North African character. Gilman carefully and effectively argues against the importance of external connections (without denying their occasional presence), noting that "accounting for the nature of North African assemblages in terms of outside influences or lack of them diverts attention from the functional considerations which must underlie any adequate explanation of their variability" (p. 6). In fact, he views the present work as "a necessary first step in considering the Neolithic cultures of the western Maghreb as adaptive systems" (*ibid.*).

It is a good first step, and I hope Gilman and others will continue in this direction. While I cannot entirely agree with the characterization of Maghreb prehistory as uneventful and isolated (p. 132), the demonstration of cultural and economic continuity from the Epipaleolithic through the Neolithic and the unimportance of external influences during the latter (although one wonders about those imported caprines) clearly makes this an ideal region in which to investigate some of the current models about the transition from Paleolithic to Neolithic economies.

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