ignore or misrepresent strong evidence indicating that the length of the period of sensitivity greatly depends on the nature of the young bird's experience.

Curiously enough, the assertions about the uniqueness of imprinting are preceded in the book by sections containing much of the evidence incompatible with those claims and many of the criticisms of the way Hess has drawn strong conclusions from inadequate data. Indeed, the literature survey strikes me as remarkably fair and can be criticized only for mild inaccuracy and for incomplete coverage. The "personal view" which characterizes the rest of this book is almost absent in these review sections; they might almost have been written by somebody else. Hess has further accentuated the isolation of the literature survey from the main theme of the book by dealing with his own findings separately from those of other experimentalists. Disarmingly he justifies this separation on grounds of his own distinctive "theoretical bias." It could be argued, however, that just for this reason he should have presented all the evidence relevant to a controversial issue in the same place.

When Hess does eventually attempt to deal with his critics he accuses *them* of "theoretical bias." Because of their blinkers, he argues, they have failed to appreciate that they have been studying, not imprinting, but other quite different processes such as "socialization" or "ordinary learning." They obtained evidence incompatible with his claims because, for example, their birds were much older than his. Whether all the damaging evidence can be dismissed quite so easily is seriously open to doubt; and it must be stressed that most people currently working on imprinting have accepted the need for fresh thinking in order to cope with the complexities uncovered by experimental analysis. Hess can, of course, still defend the purity of his original conception of imprinting by postulating more and more processes superimposed on what he regards as the genuine article. The net result, however, is an increasingly unwieldy assemblage of unrelated explanations, and the enterprise begins to look like a desperate attempt to prop up a tottering and elderly edifice built on sand.

But if he has not updated his thinking, Hess has made a determined effort to change his methods in recent years. The final chapter of his book describes how, after a lifetime of working in the laboratory, he has started to investigate what happens under natural conditions. I am sure he is right about the insights which such studies can bring and also agree with him when he emphasizes the perceptual constraints on imprinting and the strong predispositions of the young birds to learn certain things at particular stages of development. He attributes the development of such internal control to "genetic programming," but these ideas are vague and, by modern standards, unsophisticated, and Hess never develops them to the point where they could be tested. Analytical thinking is not his strong suit. His gift is as a vivid expositor, and he undoubtedly writes in a way which catches the imagination of the uninitiated. So even though much of his book is misleading and its theoretical arguments are stale, it may, nevertheless, stimulate many people to find out more about the striking phenomenon it describes.

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Sub-Saharan Mathematics

Africa Counts. Number and Pattern in African Culture. CLAUDIA ZASLAVSKY. Prindle, Weber, and Schmidt, Boston, 1973. xii, 328 pp., illus. $12.50.

Africa Counts explores two interrelated topics—the kinds of mathematics used by sub-Saharan peoples in their everyday lives and the way in which African social organization has influenced the development of African mathematical knowledge. Relying almost exclusively on secondary material collected from an impressive range of sources, Zaslavsky has produced a book that should prove extremely useful to professional anthropologists and educators. Anyone interested in mathematics or African cultures will find it attractive and readable.

Zaslavsky demonstrates repeatedly the error of the general notion that mathematics plays so small a role in African tribal life that "Africans could only count 'one, two, many.'" She does this by providing detailed analyses of the number systems of several African tribal groups and describing systems of time reckoning, measurement systems, and architectural principles. In a chapter devoted to the construction of African number systems, we learn of base 5, base 10, base 5-10, and base 5-20 systems that have been in use for centuries. The Yoruba base 20 system (which includes number names to 1 million) operates on a subtractive system that is mind boggling to this naive reader: 45 is expressed as "five from ten from three twenties." Other chapters contain interesting examples of the application of mathematical principles in a variety of practical and recreational contexts (including logic puzzles similar to the missionary and cannibals problem but with other casts of characters).

For reasons of trade, Europeans made it their business to know local African currencies, and Zaslavsky is able to draw upon several scholarly works concerning this aspect of African mathematical knowledge. Here we encounter complex systems for calculating equivalences across monetary systems (in the year 1500, 0.15 ounce of gold was worth 1200 cowrie shells in Mali). We also find consistent sets of units within a system (among the Igbo, 6 cowries equaled 1 unit of money, 60 cowries equaled 10 units). Here too we encounter the most telling evidence in support of the author's thesis that the level of mathematical sophistication is a function of social conditions, not of inherent "mathematical capacity." The point is made quite generally in contrasts between groups like the Yoruba, who have long engaged in trade, and the bushmen of the Kalahari, who trade almost not at all; the former have a complex number system, the latter do not. The same conclusion is urged on us in a unique way by an "experiment of history" perpetrated by avaricious Europeans. Discovering in the 16th century that many African groups preferred cowrie shells to gold as a medium of exchange, the Portuguese and other traders imported boatloads of cowrie shells in their trading ships. The debasement of cowrie currency led to a well-documented corresponding increase in the complexity of tribal number systems!

As Zaslavsky points out in her preface, African mathematical knowledge is a vast field awaiting investigation. Her attractively produced and lively summary should help draw scholarly attention to this interesting and potentially important topic.

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