defined, had evolved. J. G. Hawkes, who attempts a summary of the ecological background of plant domestication, touches upon this point, but it is more fully developed in Charles A. Reed's masterly and original analysis of the environmental, evolutionary, and cultural aspects of animal domestication.

One of the traditionally most challenging questions in the field of domestication—Was domestication the achievement of a single geographic area and dispersed from there, or were there multiple hearths?—receives comparatively little attention in this volume. This question has of course been central in the wider culture-historical debate between the diffusionist and independent-though-parallel-stages schools. On the whole, the second view has been abandoned, at least in Western scholarship, which recognizes secondary and substitute domestications, which came about through the spread of domesticating cultures into areas that were unsuitable for the oldest domesticates. The customary and I think valid division between seed crop and "root" crop agriculture is no longer taken necessarily to mean at least two unrelated hearths of agriculture or the historical priority of root crop farming. The two complexes are, I believe, historically connected, and the historical priority of seed crop domestication is supported by a good many data, as these essays make clear. For C. D. Darlington there "is the decisive evidence . . . that agriculture in the Old World arose in a single connected region, a Nuclear Zone, of Anatolia, Iran and Syria . . ." and conversely "South-east Asia was not a centre of origin of agriculture." It is regrettable that no contributor analyzed I. N. Vavilov's theses, which haunt studies on domestication. The widespread identification of historical centers of domestication with Vavilovian gene (or multiplicity, or variability) centers at a time when it can be shown that even for wild plants multiplicity centers are *not* generally centers of speciation continues to bedevil research in the history of domestication.

On the whole, archeological evidence for domestication in the form of actual plant and animal remains receives greater attention than other cultural remains, even though the very authors who deal with the former often stress that the latter may be more significant. Some of the essays dealing with remains of domesticates are strikingly well paired. S. Bökönyi's essay, which centers on the statistical analysis of animal remains from the Carpathian Basin to determine their domestic status in the absence of morphological criteria, is followed by Raymond E. Chaplin's study, which analyzes some of the hazards of interpretation of the statistical method. The cursory treatment that is meted out to remains other than those of domesticates is in line with the general omission of ethnological viewpoints in this volume. The inclusion of the papers "Animal husbandry: the evidence from ethnography" by B. A. L. Cranstone and "Animal domestication and animal cult in Dynastic Egypt" by H. S. Smith only serves to emphasize the overall deficiency.

The omission of culture-historical or ethnological approaches to the problem of domestication is a more serious drawback than the one-sidedness of the archeological contributions. We can dismiss economic necessity as the root of domestication (for the same "economic necessity" operated millennia before the first domestications occurred), and can be dubious generally about utilitarian motives, these generally becoming apparent only long after domestication; all the greater importance then must be attached to ethnological analysis. A revolution in *Weltbild* may have preceded the one in economy, and there are those who maintain that its traces can be uncovered by a variety of ethnological methods.

With the exception of William C. Sturtevant's "History and ethnography of some West Indian starches" the contributors dealing with New World plant domesticates are almost severely botanical. It may be taken for granted that A. Krapovickas conclusively established the New World origin of peanuts, but the intriguing problem of possible connections between Old and New World domesticating cultures is not laid to rest —how can it be, for it was not raised in this conference.

It is regrettable that in a book of this price there are so few maps. Instead there are photographs of objects, most of them by now quite familiar to students of domestication.

Food in Antiquity focuses on the subject which is the last to be dealt with in the domestication seminar, dietary habits. One of the authors, Don Brothwell, is also represented in the seminar, and I found his contribution there (on dietary variation and the biology of earlier human populations) considerably more stimulating than his book. Perhaps the difficulty is that the book has no thesis but simply treads over well-worn paths. The series in which the book appears is not intended for the specialist, although some of the volumes have achieved a genuine distinction despite this. Perhaps the topic puts this book at a disadvantage compared, for example, with others in the series such as Tamara Talbot Rice's *The Seljuks* or Raymond Bloch's *The Etruscans*. Brothwell's subject is uncomfortably broad, and it is also one with which many people have at least some familiarity. Nonetheless, the authors have gathered a wide range of information and provide interesting tidbits. Ordinarily one would be hard put to learn that Emperor Nero ate quantities of leeks to keep his voice in trim. On the other hand, geophagy, the eating of earth, though this quite widespread behavior has interesting implications and research possibilities, is nowhere mentioned.

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Ecological Archeology in Iran

Prehistory and Human Ecology of the Deh Luran Plain. An Early Village Sequence from Khuzistan, Iran. FRANK HOLE, KENT V. FLANNERY, and JAMES A. NEELY. University of Michigan Museum of Anthropology, Ann Arbor, 1969. xvi + 440 pp. + plates. Paper, $8. Memoirs of the Museum of Anthropology, No. 1.

Prehistoric archeologists are still a long way from fully understanding the processes which in both hemispheres led some human groups to change from hunting and collecting to food-producing and to go on from there to urban life and civilized society. We think we know when and where it happened in the Old and New Worlds, and some of us in our optimistic moments imagine that we know why. For some time now the main emphasis in research on the earlier stages of this long process in one undoubted center of evolution, southwestern Asia, has been on the upland regions, where presumably the plants and animals to be domesticated were found in the wild state in late Pleistocene and early Holocene times. This is still a tenable hypothesis, but for some years it has been realized that the lowland regions also could throw a great deal of light on the mechanisms

of adaptation to the new methods of subsistence. One of the most interesting of such lowland regions is the Deh Luran Plain in the province of Khuzistan in southeastern Iran at the head of the Persian Gulf. This plain, which is really an extension of the lower Mesopotamian alluvial zone, is today a generally arid steppe desert, but for at least 4000 years it supported prehistoric populations based initially on small marginally farming villages and eventually on minor towns. In *Prehistory and Human Ecology of the Deh Luran Plain*, Hole, Flannery, and Neely trace the main lines of human adaptation to this environment after domesticated plants and animals had been introduced, presumably from the upland regions, sometime late in the 8th millennium B.C.

This is primarily a description and interpretation of results gathered in two prehistoric mounds on the plain (Tepe Ali Kosh and Tepe Sabz) where the authors excavated during about four months in 1961 and 1963. An immediate consequence of their work was to push back the prehistory of the region by several thousand years and to establish a long and fairly continuous sequence of events from the 8th to the 4th millennium. The strategy was that of human ecology and the examination of indigenous adaptive evolution to explain change and variability through time. The results are presented as a "developmental model" based on the cybernetics principle involving innovations which initiate self-reinforcing or positive-feedback situations to explain the internal dynamics of prehistoric Khuzistan; the sequence is seen in terms of man's exploitation of, and gradual disharmony with, a number of local biotypes. Implicit in the model is the concept of human cultures as systems, though this is not overtly stressed in the argument.

The publication succeeds in providing a vivid picture of how men lived, and especially how they ate, over 4000 years in what even then was a difficult environment. Perhaps as early as 7500 B.C. (the radiocarbon determinations here are ambiguous) a small group built simple mud-brick structures and subsisted on wild plants and game as well as on small quantities of wheat, barley, sheep, and goats, which had already been domesticated elsewhere. In the next few millennia the domesticates increased in importance, pottery was introduced, and, perhaps in the 6th millennium, simple irrigation techniques were used. New villages were settled as the population expanded. But even at this early date man's activities were upsetting the equilibrium of this marginal region, and as salinity reduced the productivity of the soil Tepe Ali Kosh was abandoned and Tepe Sabz occupied. The occupation of Tepe Sabz saw further increases in population and important adaptive shifts in subsistence, in part the reflection of events taking place in more favored parts of the lowlands. By the 4th millennium, when life on the Deh Luran Plain was running down and Tepe Sabz in turn was abandoned because of excessive soil salinity, large urban centers existed elsewhere in lower Mesopotamia and the steps toward a more complex social and political life than the Deh Luran Plain could support had already been taken.

At the moment this publication is the most detailed account we have in southwestern Asia of the sequence from early Neolithic to the dawn of urban life. All archeologists working on such problems, and not only those involved in this region, must be indebted to the authors for presenting so many useful data so soon after the sites were investigated. Flannery's studies of the animal bones and Helbaek's (incomplete) analysis of the plant remains recovered are extremely valuable contributions. The unheard-of quantities of carbonized seeds and grains found, both wild and domesticated, add a new dimension to our understanding of the long and gradual processes of cereal domestication. The report is written in an easy style, and stimulating ideas are liberally scattered through the pages. Chapter 21 is a fine example of pulling together the various strands of archeological description and argument and integrating these with the data provided by the specialists in other disciplines (Helbaek on paleobotany, C. S. Smith on metals, C. Renfrew on obsidian, I. W. Cornwall on the fauna from an Iraqi site). Whether or not one accepts developmental models consciously derived from cybernetics as having anything more than metaphorical value, the use of such a model here and the presentation of some very interesting demographic data are an index of the encouraging trend in much of modern American archeology to explore the dynamics of past cultures by unorthodox means. I found the estimates of population density at various periods of Deh Luran occupation most valuable, in spite of their admitted imprecision, and my main criticism in this respect is that the authors don't do enough with these data. I suspect that they could have presented a much more productive model had they chosen to regard changes in population growth and density not simply as variables dependent on technological and subsistence innovations (which is how most archeologists have regarded them since the 19th century) but, rather, as being at times independent variables generating changes in land use and technology with direct repercussions on the cultural content of the archeological phases described here. In other words, it might have brought them closer to discerning the causal factors involved.

This book calls for a split-level review: as the exposition of an archeological approach with its subsequent hypotheses, and as a descriptive excavation report. It is a pity that in the process of illustrating how productive and stimulating an ecological approach can be in archeology the authors have written a rather less than satisfactory excavation report. Indeed, the defects shown here raise some important questions concerning archeological technique, theory, and strategy. The real trouble is that the report fails to present all the information one expects to find in a modern and final description of several important sites. Researchers who wish to consult it for certain kinds of information, or from viewpoints somewhat different from those the authors have considered important, will find the work unnecessarily difficult or even impossible.

The nature of archeological research prevents us from easily duplicating our colleagues' observations, as can be done in an experimental discipline. Since archeologists must rely on very detailed descriptions and presentations of all the data observed which enter into the investigator's interpretations, it is necessary for final reports to be as exhaustive as is humanly possible. Unfortunately the present report too often presents us with *faits accomplis* with no recourse short of going back to the original collections (which, I believe, are now divided between the United States and Iran).

For one thing, the stratigraphic distinctions offered are not fine enough. They have divided the sequence in the sites studied into seven cultural phases (which they equate with periods). Al-

though most of the phases are further subdivided into several "stratigraphic zones," each zone may comprise a number of occupation levels or floors, as the published profiles clearly indicate. Unfortunately in this publication the materials are presented not by successive floors but by phase groupings or by stratigraphic zones which do not necessarily correspond to floors or occupation surfaces. There is thus no way to check the precise vertical distributions or associations of materials. Similarly, it is nearly impossible to find out the horizontal distributions and contexts of most of the artifacts described or illustrated. Indeed, there are times when even the gross descriptions of materials by subdivisions of phases is not consistently followed even when it might have given a certain amount of information. Thus I wanted to know for my own purposes more about the distribution of obsidian in the lowest or Bus Mordeh phase. In the absence of any finer distinctions it would have been helpful to know whether obsidian occurs in greater or lesser frequency in the earlier or C_2 stratigraphic zone as compared with the later or C_1 zone; but this information, presumably noted during the excavation procedure, is not given in this publication, which shows only the total quantity of obsidian from each phase.

For another, the principles on which the phases or periods are based may lead to some confusion. These phases are defined by breaks in the continuum corresponding to "adaptive changes" in economic and social life, together with "non-adaptive" changes such as the appearance of "an easily recognized new complex or assemblage of styles and/or artifacts." Priority in definition is given to the adaptive changes, but in those cases where the economy remained relatively unchanged for long periods artifact complexes were mainly used. There is not space here to discuss in detail the arguments for and against this approach, but in effect it means that the earlier phases of their sequence are defined primarily on the basis of adaptations and the later ones on the basis of style. One consequence is that it may be difficult to correlate the earlier phases at these two sites with phases or levels in other sites where there may not be the same conditions of preservation of seeds, bones, and other organic materials as at Ali Kosh. It might have been better to use the two sets of criteria separately and to create a column of phases or periods defined by artifact changes and a column of stages defined where possible by adaptive changes. As it is, the definitions of some of the phases (for example, Bus Mordeh, Ali Kosh) are perhaps premature, since only one occurrence for each is so far known, and these from very small exposures in the lower parts of the Ali Kosh site. This in turn raises the problem of adequate sampling and the interpretations based on the sequence outlined here. In view of the relatively small proportions of the sites which were excavated, and especially of the restricted areas of occupation surfaces exposed, there must remain a question as to whether the variations noted from phase to phase, especially in floral and faunal remains, are functions of time to the exclusion of other variables.

A third criticism is that the presentation of the illustrated artifacts by types rather than by phases makes it difficult for the researcher who is interested in comparing any particular phase of the Deh Luran sequence with any one of his own phases or levels. To get a visual impression of the artifacts it is necessary to search through the descriptions in the captions under each figure. Although the contents of each phase are also given in the tabulations of each class of artifact (pottery, stone, and so on), this is not always a convenient way to present the data if the types created are broad. Thus I find the categories for many chipped stone artifacts, based on their alleged functions (sickle blades, reamers, and so on) are too broad to be very useful for detailed comparative purposes; workers using finer categories will find it hard to identify their own types in the tabulated breakdowns.

The book is pleasingly free of typographical and other technical defects, and the illustrations are generally good. The presentation would have been greatly improved, however, if a chronological table had been included to show not only the estimated correlations of the phases excavated in Deh Luran with sites in the rest of Khuzistan (given in very parsimonious form on p. 9) but, even more important, the correlations with sites in other parts of southwestern Asia which are frequently discussed in the text. A more detailed map showing the distribution of sites than that provided by fig. 1 would also have been helpful.

A colleague who has read this book argues that its defects are inherent in research which is oriented to a single approach. I don't agree with him. Much in this book is good, and the weaknesses were avoidable.

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In the Absence of Stimuli

Sensory Deprivation. Fifteen Years of Research. JOHN P. ZUBEK, Ed. Appleton-Century-Crofts, New York, 1969. x + 526 pp., illus. $9.50. Century Psychology Series.

If ever a subject has accumulated an enormous literature in need of a comprehensive and critical review, it is sensory deprivation. There are some 1300 items in the bibliography of this book. Even before the publication of the first findings on the "effects of decreased variation in the sensory environment" (Bexton, Heron, and Scott, 1954), word had spread far and wide about the experiments at McGill in which normal college-student subjects, kept isolated and deprived of perceptual experiences, experienced vivid hallucinations, body-image disturbances, and thought disorders. Rumor exaggerated both the conditions of the experiment and the "psychotic" manifestations, but the first published report—a rather short and modest paper, quite tentative in tone, in the *Canadian Journal of Psychology*—easily captured the imagination of serious investigators, who quickly put together their own experimental setups (sound-deadened room, respirator, or water tank) to see for themselves. These early investigators—John Lilly at the National Institute of Mental Health, Jack Vernon at Princeton, Philip Solomon at Boston City Hospital, and a handful of others—were essentially exploring the range and limits of this new experimental technique. Soon both the specialized journals and the popular press were filled with discussions of per-