MAN, ANIMALS, AND HABITAT AT ḤESBÂN – AN INTEGRATED OVERVIEW

ØYSTEIN SAKALA LABIANCA
Peachland, British Columbia

The importance of sheep and goat keeping at Ḥesbân,[1] Jordan, during all of its periods of human occupation (ca. 1200 B.C. to the present), was the discovery, yielded by animal-bone finds, that initially inspired the quest for an explanation of cultural continuity and divergence at Ḥesbân (LaBianca 1978a). With the aid of the cultural-ecology concepts of Julian Steward (1955), this discovery lent justification to the diverse inquiries into those environmental and cultural features which were closely related to sheep and goat raising—namely, studies of climate, water, soil, and grazing conditions, and studies of herding and husbandry practices. Furthermore, the possibility of diachronic generalizations about subsistence practices at Ḥesbân during its successive cultural periods rendered imperative other studies which could throw light on the integrity of the archaeological record, such as studies of the excavation procedures themselves and inquiries into (1) the post-depositional processes—i.e. the physical effects of natural processes on the ancient bones in the soil—and (2) present-day depositional practices of the modern villagers in disposing of their food wastes.

This preliminary account, systematizing the diverse investigations and activities of those who participated in anthropological research coordinated by the writer, describes the objectives and the process of this investigation as constituting an integrated approach to a complex problem. Findings will be reported when

[1] In this article, the name Ḥesbân will be used with reference to the modern village of Ḥesbân and the name Heshbon will be used when referring to the historical site. Ḥesbân will also be used when the reference may be to either or both.

available and appropriate. In the end the cultural ecological scheme underlying this inquiry will be assessed and modified to better accommodate future investigations.

PREPARATIONS

Preparations for the anthropological studies carried out at Ḥesbân between 15 June and 27 August 1976 were instituted at the close of the preceding campaign, during the summer of 1974. At that time the expedition director, Lawrence T. Geraty, promised his full support of an expanded and integrated effort to gather the kinds of data needed to illuminate the history of animal exploitation at Ḥesbân and to explain, if possible, the apparent continuity in sheep and goat keeping at that site.

The justification, theories, and methods underlying the overall anthropological inquiries were made explicit in advance in two articles by the writer (LaBianca 1975, 1978b) and in an overall research design (LaBianca 1976b). Furthermore, research designs for certain specific areas of inquiry were also prepared in advance, including one outlining plans for the ethnographic studies in the village of Ḥesbân (LaBianca 1976c), one for the excavation of a test square for assessing alternate excavation procedures (Crawford 1976c), and one for botanical and ethnobotanical studies (Crawford 1976b). Many less detailed research designs were prepared by individual participants during in-field training sessions to ensure that assignments were properly understood and carried out.

When the writer participated in the Symposium on Faunal Analysis in the Middle East (7-11 May 1975) at the 40th Annual Meeting in Dallas of the Society for American Archaeology, it was his good fortune to establish a personal acquaintance with Drs. Joachim Boessneck and Angela von den Driesch of the Institut für Palaeoanatomie, Domestikationsforschung, und Geschichte der Tiermedizin der Universität München. It was during this symposium that the possibility of a joint effort in zooarchaeology

at Ḥesbân during the 1976 season was conceived and tentatively proposed. This arrangement—which was subsequently completed through correspondence—ensured that the entire corpus of animal bone fragments from all five campaigns at Tell Ḥesbân would receive the added and more authoritative analysis of these foremost experts in the field of zooarchaeology.[2]

Mention should also be made of the portable data processing unit devised and developed for the August Bone Lab by Paul Perkins of the Institute for Informatics Research and Computer Design. It was slated for use in coding the anticipated millions of bits of information about the 40,000 bone fragments analyzed, and in providing instantaneous data validation. The unit—a PDP-11 central processing unit supported by a dual "floppy" disc drive; a hard copy terminal and a display terminal; and an on-line data validation program, VERIFY—was designed for compact packing and was successfully tested in the U.S. However, it was, regrettably, never put to its intended use because of difficulties in obtaining financing for shipment and the necessary customs clearance arrangements despite the help received from numerous individuals.[3]

Of the three objectives of this effort to establish on-site data processing capability, namely, (1) to devise and develop a suitable system; (2) to acquire an understanding of the complex arrangements involved in transporting the system from the U.S. to Jordan; and (3) to carry out in-field data entry and validation; the first was achieved by Paul Perkins; the second only partially, through the work of the writer and Perkins on his visit to Jordan in August,

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[2] The writer wishes to acknowledge his indebtedness to these two gracious and eminently capable colleagues for their contribution to the expedition and to his research objectives. The financial support rendered toward the post-season "August Bone Lab" by research grants from the American Schools of Oriental Research, the Deutschen Forschungsgemeinschaft, the Earthwatch Research Associates, Human Service Information Systems, and the Heshbon Expedition Fund are likewise gratefully acknowledged. Use of the excellent facilities at the Seventh-day Adventist Secondary School in Amman and of the expedition's bus was made possible through the generous cooperation of the Seventh-day Adventist Secondary School Principal, Tawfic Madanat, and Lawrence T. Geraty, respectively. For support of the anthropological studies as a whole, the writer wishes to acknowledge his indebtedness to Geraty, without whose vision and support these investigations would not have been possible; to Siegfried H. Horn for having nourished the zooarchaeological effort from its inception in 1968; and to Roger Boraas for his efforts, during each campaign, to integrate this expanding investigation within the overall program of the Heshbon Expedition.

[3] Including United States Ambassador Thomas Pickering, Kenneth Fenske of Pan American and Alia Airlines, Munder Salah of the Royal Scientific Society, and Nabil Khairy of the Department of Archaeology at the University of Jordan.

and the third was not achieved. However, we have considerably increased our appreciation of the logistical and strategical problems, and discovered that future attempts are likely to be successful if the computer is transported by one person as hand baggage, and if customs clearance can be assured in advance by the customs authorities in Jordan.

Finally, an exhaustive list of unpublished works and published manuscripts, resulting from previous seasons' work, have contributed to the preparation of the various 1976 research projects. These are included in the bibliography and also those produced since the summer of 1976, so as to provide an up-to-date inventory of the important related documents.

ORGANIZATION, GOALS, AND PROCEDURES

The work of the members of the anthropology team at the expedition was organized so that two major purposes were served: first, to provide the archaeological staff with specialized scientific support in the areas of faunal analysis, environmental data analysis, and ethnographic observations pertinent to archaeological interpretation; and second, to assemble empirical data pertinent to the specific anthropological problem of illuminating the history of animal exploitation at Ḥesbân and, if possible, discovering the underlying principles which explain the course of that history. But the organization of the anthropological investigations is best presented, not in terms of who utilized what information, nor even in the same way as they were presented in the research designs, but in terms of problems identified and the methods employed in investigating them.

The fundamental problem, which accounts for the large array of diverse investigations reported on here, is that when one sets out to study man, animals, and habitat through time, one multiplies enormously the possible sources of errors, given the fragmentary state of most archaeological and historical data. As a result, almost as much effort is expended on ensuring the integrity of the data as is spent on drawing historical and anthropological conclusions from it.

Thus, in the case of animal bone remains, it becomes necessary to ensure against incorrect identifications or inadvertently miscoded records; to determine whether any of the bones were damaged by the excavator's pick, whether any of them might have been simply destroyed by chemical actions in the soil, whether any of them were never deposited because they were eaten by dogs or other scavengers; and finally, whether or not animal bone fragments can tell us anything at all about cultural patterning; and if so, then what?

As if these were not problems enough—given the assumption that bones have something to tell us about animals that once existed—how do animals affect the lives of people, and in turn, how do people affect the lives of animals? If we can answer this question by studying the present-day situation at Ḥesbân, what, if anything, does knowledge of the present tell us about the past in regard to these matters? These, then, are the questions with which this entire quest is concerned, and for good reasons, I think, it has taken an interdisciplinary effort to begin to answer them.

Studies of Man, Animals, and Habitat in the Present

The continuity of sheep and goat exploitation at Ḥesbân is itself a good justification for cultural ecological studies of today's Ḥesbân and vicinity. But an equally compelling reason for studying the present is that, to the extent that men 500 to 3,000 years ago were "real men of real history," to use Leach's phrase (1973:770), they were "true men like us," and presumably, therefore, capable of being understood in similar terms—that is, through many of the underlying principles which explain the interrelationship between man, animals, and habitat today. Obviously, these principles appear more clearly in the observable behavior of living peoples than they do in the fragmentary archaeological record, which attests, at best, only certain results of human behavior.

For example, one such underlying principle is the one offered

by the cultural ecological theory that holds that the local habitat of human societies constitutes a creative force in their adaptation to their total environment. Furthermore, according to Julian Steward (1955:37), those cultural features most closely related to the local habitat—namely subsistence activities and economic arrangements—are most directly affected by the local habitat.

Ethnography

One of the objectives of the ethnographic research at Ḥesbân, therefore, was to ascertain to what extent the local habitat constituted a "creative force," a constraining factor, in the lives of these villagers today, and whether it could account for sheep and goat keeping among today's villagers. If so, it would be possible to infer from the zooarchaeological and palaeoenvironmental evidence that the same principle accounts for the continuity in sheep and goat keeping through time at Ḥesbân.

A second objective of the ethnographic research was to illuminate the aforementioned question about how sheep and goat keeping affects the lives of animal keepers and vice versa. Again, according to cultural ecological theory, a particular subsistence pattern imposes "limits" on the general mode of life of the people" (Steward 1969:169). Thus if these "limits" could be determined through ethnographic studies of the present, they could be attributed, by inference from the archaeological evidence, to "the general mode of life" of earlier sheep and goat keepers in ancient Heshbon. This would hopefully enable us to reconstruct more completely the ways of the ancients at our particular site.

A third objective of the ethnographic inquiries was to learn more about "whether or not animal bone fragments can tell us anything at all about cultural patterning—and if so, then what" (as has been mentioned). This question, in essence, amounts to putting to the test the fundamental assumption underlying the zooarchaeological enterprise, namely the assumption that the

analysis of animal bone remains can yield information about ancient cultural patterning. As such, it was perhaps the most important problem being investigated in the present-day village.

The ethnography team consisted of eight persons.[4] Each day the individual members of the team were assigned specific ethnographic activities by the writer, who also supervised the team in action and coordinated their assignments so that the two translators, the photographer, and the graphic illustrator were available to each ethnographer. Notes were recorded daily in loose-leaf notebooks under the three headings of "observation," "commentary," and "feelings." By the end of each week, these notes were reorganized and rewritten on 5″ x 8″ index cards, assigned standardized headings, and entered in a "common card file," containing the accumulated notes of all of the ethnographers. Standardized information about the context in which the various ethnographic observations were made was recorded on a "Contextual Information Reporting Instrument for Ethnographers." These data will be summarized, using a computer, yielding aggregate analysis of hours spent with various informants, the physical and social settings of the various ethnographic interviews, the contact or referral source which led to particular interviews, etc.

Although the analysis of the ethnographic data has been merely begun at this writing, and although a complete report will be forthcoming, preliminary findings are herewith tentatively offered regarding the aforementioned three inquiries, beginning with the first.

In general, the evidence suggests that the local habitat of Ḥesbân constitutes a constraining factor in regard to the kinds of animals and plants which are found–those characteristic of semi-arid Mediterranean regions (cf. Crawford and LaBianca 1976; Boessneck and von den Driesch, elsewhere in this issue)–while it permits a considerable range of alternative subsistence and economic arrangements. Thus, within the local vicinity of Ḥesbân, there are some households whose subsistence base is exclusively sheep and goat raising, some combine sheep and goat raising with cattle raising and/or agriculture and/or horticulture, some engage exclusively in agriculture, some combine some or all of the above with extra-village employment, and still others depend exclusively on extra-village employment (LaBianca 1976a:189). Whether or not this situation is attributable to the

[4] Mary Ann Casebolt, Del Downing, Theresa Fuentes, Asta Sakala LaBianca, ethnographers; Samir Ghishan and Hannan Salem Hamarneh, translators; Pamela Butterworth, graphic illustrator; and Scott Rolston, photographer.

"creative force" constituted by the local habitat or to "historical" factors is a question which will require further analysis of the data before it can be answered.

Case studies involving five sheep- and goat-keeping households yielded evidence suggesting that "limits" on the "general mode of life of the people" are established by their dependence on these animals. Thus, it was found that the activities that herd owners carry out with regard to their own family herd–herd management–involve extensive collaboration between households and within households.

Cooperation between households ranges from agreements regarding the use of cisterns (for watering the herds) to grazing rights, to arrangements for cooperative herding, where one shepherd is utilized by several herd owners. Since most of the herd owners studied engaged in *intensive herding*–involving strict control of the herd–and *intensive husbandry*–involving diversity in the utilization of animal products (cf. Paine 1972:80) –cooperation within households was found to be essential.

Thus, general responsibility for the welfare of the herds typically lies with household heads, shepherding is the responsibility of children or men, and the utilization of the products of the herd–what the animals produce as living organisms: milk, wool, dung, etc.–and its by-products–what is yielded by the animals' carcasses: meat, leather, bone, sinew, hair, skin, etc. (LaBianca, 1976c:5)– is typically the responsibility of the women of the household.

Studies of butchering practices, meat preparation, consumption practices, and carcass disposal practices illuminated the question of whether animal bone fragments reflect cultural patterning. Thus, observations of present-day butchering practices have illuminated the process whereby carcasses are divided and bones are scarred (cf. LaBianca and LaBianca, 1975:241-243). Other findings related to the aforementioned problem will be described below under "Taphonomic Studies."

Environmental Studies

Two reasons can be advanced as justification for the environmental studies carried out at Ḥesbân and vicinity. The first is provided by cultural ecological theory which focuses attention on the local habitat inasmuch as it is postulated that it constitutes a "creative force" influencing human subsistence arrangements and related activities. Alterations in the ecological balance of the local habitat are therefore deemed worthy of investigation as they may be related to alterations in the human society within it. The other justification for environmental studies is that it affords valuable data about the characteristic species of plants and animals of a region, thus providing an orientation to the kinds of plants and animals to expect from the archaeological record.

At Ḥesbân, the aim has been to study all four components of the terrestial ecosphere—climate, fauna, soils, and vegetation (Oliver 1973:5). The ultimate aim of these studies is to ascertain the nature of the changes which have taken place in this habitat during the past three thousand years. Questions which we eventually hope to answer are whether the empirically manifest changes in the fauna of this region are attributable to (1) changes in climate, (2) changes in soil and vegetation due to human mismanagement, (3) both of the above, (4) none of the above. The studies of the *present* ecosphere of Ḥesbân and vicinity will be described here, but those dealing with the *past* ecosphere will be discussed in another section.

A meteorological station for making empirical observations of the weather at Ḥesbân was made available to the expedition through the gracious cooperation of Prince Raᶜad of the Hashemite Kingdom of Jordan and Director Ghazi El-Rifai, of the Jordanian Department of Meteorology. With the aid of this station (monitored by Robin Cox), James Stirling and the writer sought to ascertain the characteristics of the local weather during six weeks so as to establish the correspondence of measurements obtained at Ḥesbân with measurements obtained by adjacent year-round meteorological stations. Having established which measurements were most like those obtained at Ḥesbân, our other goal was to reconstruct the climatic pattern for Ḥesbân and vicinity during the past 50 years, using the year-round measurements

available from the appropriate adjacent stations. The outcome of this study will be published in a separate report.

Studies of the wildlife of Ḥesbân and vicinity were carried out by Boessneck and von den Driesch. In addition to the observations made by this team in and around Ḥesbân, field trips were arranged by the August Bone Lab to 'Ain Ḥesbân, Mount Nebo, the Dead Sea, the Dibbin Forest, and Petra in harmony with this objective. An independent study of the birds of Ḥesbân was carried out by a member of the architect-surveyor team, Merling Alomía. The presence of the remains of certain migratory species of birds at Ḥesbân may possibly have resulted from flight fatigue—when birds expiring from exhaustion fall to the ground. This is the kind of phenomenon that has been illuminated by Alomía's observations. (See the two reports by these authors elsewhere in this issue.)

The soils of Ḥesbân and vicinity have been studied as an adjunct to the stratigraphic excavations at Tell Ḥesbân by Bullard (1972) and James (1976), and as an aspect of the anthropological inquiries by LaBianca (1973b:11-12), Crawford and LaBianca (1976:177-178), and Hare (forthcoming).

The study of the vegetation of Ḥesbân and vicinity was continued by Patricia Crawford (cf. Crawford and LaBianca, 1976). Thanks to the generous and expert assistance of Dr. Loutfy Boulos, taxonomic botanist from the University of Jordan, altogether one hundred species of plants have been identified, based on the specimens collected by Crawford in the vicinity of Ḥesbân during the 1976 season (a report is forthcoming).

Taphonomic Studies

The branch of paleontology which studies all aspects of the passage of organisms from the biosphere to the lithosphere is called *taphonomy* (Efermov 1940:81-93). At Ḥesbân, taphonomic studies were carried out in order to ascertain (1) what happens to animal bones before they are finally buried (depositional processes) and (2) what happens to them after they are buried (post-depositional processes). Although some previous investigation of depositional processes had been carried out in 1973 (LaBianca and LaBianca 1975:236, 241-243), more extensive studies were carried out in 1976. As explained above, an understanding of these processes is pertinent to questions about the integrity of the zooarchaeological record.

Most of the studies of depositional processes were carried out by the writer and two members of the ethnography team, Del Downing and Samir Ghishan, during the period 19-30 July 1976. The first such study involved follow-up visits to the site of a

traditional *mensef*—a festive meal consisting of rice, extensively sectioned pieces of sheep and goat meat, and a sauce made from the fat of the animals—to observe what happened to the bones over a one week period. In a preliminary way, it can be reported that between 80% and 90% of the bones of six sheep and goats had disappeared from the locality of the site within the period of three days. This finding was largely attributable to the scavenging of dogs and chickens.

A surface survey of bones was carried out to determine the relationship between the kinds and quantity of bones found on the ground in and around Ḥesbân and the living animal population within the same area—based on a census of all domestic animals in the area carried out by the ethnographic team. Ten 5.00 x 5.00 m. squares and 53 15.00 x 15.00 m. squares were surveyed, yielding more than eight hundred bones. Again, in a preliminary way, it can be reported that although the relative importance of the various domestic mammals—as manifested by the census data—was generally manifest also in the bone survey data, the bones of domestic birds—chickens, pigeons, turkeys, ducks, and geese—were almost totally absent in the bone survey data, even though there were over 700 chickens alone in the census data reported by the ethnographers.

This enormous discrepancy in regard to the remains of domestic birds was illuminated by studies of dog behavior. When offered chicken bones, dogs were invariably observed consuming every one of them completely. Similar experiments were made using the bones of other animals, but these findings will be reported elsewhere.

The fortunate participation in the 1976 Heshbon Expedition by Edgar Hare of the Geophysical Laboratory at the Carnegie Institution of Washington led to the collection of selected samples of soils with bones embedded in them. These he will subject to subsequent laboratory analysis to observe the effect of soil conditions on bones. Samples consisting of bones, teeth, snails, or mollusca, in association with portions of their surrounding soil, were gathered from each of the representative strata at Tell Ḥesbân by extracting them from

appropriate balks. His findings will be important for our understanding of post-depositional processes at Tell Ḥesbân.

Diachronic Studies of Man, Animals, and Habitat

Diachronic studies of man, animals, and habitat at Ḥesbân have had their starting point in the present through ethnographic and environmental studies in present-day Ḥesbân and vicinity. These studies, along with the investigation of taphonomic processes, have illuminated considerably the attributes of the zooarchaeological record. For example, the writer's impression of this zooarchaeological record is that (1) it constitutes only a very small portion, perhaps 5 to 10%, of the deposited remains of animals that once existed; (2) it favors the remains of medium sized and large mammals; (3) it favors the strongest bones in the animal skeleton; (4) it is generally consistent with what is known about the characteristics of the fauna of this region; (5) it exhibits cultural patterning with regard to the *kinds* of animals exploited, but not necessarily with regard to the relative importance of individual species; (6) it exhibits cultural patterning with regard to butchering practices and meat preparation practices; (7) it exhibits cultural patterning, to a limited degree, with regard to other aspects of herd management practices and animal utilization practices (cf. LaBianca 1978a).

It is as our diachronic investigation passes beyond the ethnographic present into the archaeological past that it takes its place as one among many lines of investigation concerned with reconstructing the historical situation at Ḥesbân. As such, the disparate zooarchaeological and environmental studies of the historical situation described below constitute but a few aspects of the overall archaeological investigation. Clearly, then, a comprehensive picture of man, animals, and habitat at Ḥesbân in the past requires a complete synthesis of *all* the findings from all five campaigns at Ḥesbân.

Such a synthesis, however, requires a level of integration which currently is neither practical nor necessary, given the scope

of this preliminary report. Accordingly, the emphasis here will be on describing the various aspects of the archaeological operation which were coordinated by the writer by virtue of his interest in the diachronic study of animal exploitation at Ḥesbân (LaBianca 1978a).

Zooarchaeology

The objectives of the zooarchaeological investigations at Tell Ḥesbân are to reconstruct, as far as possible, the history and dynamics of herd management and animal utilization practices during each of the analytically distinguishable cultural periods at Heshbon (cf. Sauer 1976:28-62). Although the logistical and strategic aspects of the zooarchaeological operation have been detailed before (LaBianca 1975, 1978b), certain newly instituted arrangements, as well as the personnel involved, merit mention here.

Generally, the new arrangements described below were instituted for the purpose of reducing further the distorting effect of the investigative processes upon the zooarchaeological record. These improvements will be discussed with reference to the four phases of the zooarchaeological process described before by the writer (1975a:2). Whenever possible, mention will not be made of details of this operation described before.

Test Square: One Square in Area C was excavated for the purpose of obtaining exhaustive and continuous samples of bones, seeds, pollen, snails, mollusca, dung, insects, and soil through the intensive use of sieving and flotation procedures. The stratigraphic operation in this square was supervised by the Area C supervisor, Tom Parker (whose report in this issue discusses the finding). The square supervisors included Patricia Crawford, environmental archaeologist, and Michael Toplyn, zooarchaeologist, both members of the anthropological team.[5] An important benefit of this

[5] Assistance with sieving in this square was provided by Helen Shafer and Paul Vance, Earthwatch volunteers assigned to the team.

operation was the insights it provided into the excavation process itself, as far as it impinges on the question of how bone and environmental data are affected by the unearthing process. For example, this operation yielded a much better picture of the *thanatocoenosis* of the *tell*—the assemblage of small mammal, reptile, and bird remains.

Pre-analytical Phase: This preliminary work was begun on the *tell* under the leadership of Patricia Tyner. Helping her in the bone tent on an intermittent basis were all the members of the ethnography team and others.[6]

A major alteration in the pre-analytical procedure was the decision to save *all* animal remains. Furthermore, a more comprehensive system for counting and weighing "cleaned" and "uncleaned" bones was instituted and facilitated by the use of a specially designed data-collecting instrument. According to the tallies thus kept by Tyner, altogether 41,673 bones weighing 180.785 kg. were collected. Of this amount 22,571 bones weighing 33.464 kg. were not cleaned or labeled because they were too fragile or too small, but were saved in plastic bags which were labeled with the appropriate findspot information. The remaining 19,102 bones were all cleaned and labeled by Tyner with the intermittent help of her assistants.

Analytical Phase: This phase had two parts: the activities at the in-season lab in Madaba, and thereafter the post-season August Bone Lab in Amman.

Under the leadership of Esther Benton, the daily routine of the bone readings—conducted mostly by Michael Toplyn and intermittently by the writer—was streamlined considerably. In addition to supervising the laying out of the bones to be "read," the sorting and labeling, and the restoring of damaged bones, she also obtained contextual data for every bag of bones from the

[6] The available Earthwatch volunteers, including Sissie May; Robin Cox, who also was responsible for the meteorological station and for cataloguing incoming geological samples; two members of the photography team, Kay Barton and Mitchell Tyner; and Saud Daud, a villager from Ḥesbân.

square supervisors using a specially designed "Contextual Data Information Form."

The Contextual Data form recorded information on (1) the findspot or provenience unit of each bone bag; (2) the content of the bag in terms of the number of bones representing each species as given in the bone reading; (3) the dating of the bones, based on associated pottery and artifacts; (4) the cultural context of the bones, i.e. floor, garbage heap, cistern, etc., and (5) a locus description summarizing the salient stratigraphic information.

This information was collected so that it could subsequently be matched, using the computer, with the taxonomic, anatomic, physical, and cultural data which the August Bone Lab analysis would make available for each individual bone fragment, thus linking every bone to its particular provenience unit. The sorting into locus assemblages, restoring damaged bones, and verifying of labels was done for the bones from the current season, as well as from the 1973 and 1974 seasons, in preparation for the August Bone Lab.

August Bone Lab: The post-season (1-27 August) phase aimed at completing all the tasks of the analytical phase so that only computer-oriented coding sheets containing all pertinent bone data would need to be taken out of the country of Jordan, except for certain rare or otherwise unusual specimens requiring further study abroad.

To this end, all species and element identifications were carried out by Boessneck and von den Driesch. Categorization of the elements thus identified according to anatomical, physical, and cultural characteristics were carried out by the writer and Mike Toplyn, although their categorizations were routinely verified by either Boessneck or von den Driesch. Coding of the data was done by four Earthwatch volunteers.[7] Generally, coding was carried out according to the system described before (LaBianca 1975a:5), using "data tickets" and specially designed codes and coding forms, and, in addition, by checking each coding form against its associated "tickets" and correcting any discovered discrepancies or illegible codes (see also LaBianca 1978b).

[7] These volunteers were Elizabeth Horner, Lori LaValley, Julia Middleton, and Maryanna Swartz. Asta Sakala LaBianca and Maryanna Swartz cooperated in preparing meals for the participants.

Only the 19,102 bones which had been cleaned and labeled were passed through this analytical procedure, since to do so they had to be separated from their archaeological contexts into the analytical categories yielded by the identification by species and the categorization according to anatomical, physical, and cultural characteristics by the processes described above. The 22,571 bones which had not been cleaned—consisting for the most part of splinter fragments—were separated from their associated labeled bones following species identification and weighing. Weight measurements of the aggregated bones of each individual species from each locus were taken by Boessneck and von den Driesch, after which further analysis was possible only for the 19,102 labeled bones. It should be noted that whenever further analysis was deemed necessary for uncleaned bones, they were promptly cleaned and labeled by the coding staff.

Bones that had been stored in Amman following the three previous seasons, 1971, 1973, 1974, were gone through by Boessneck and von den Driesch in order to find and measure all measurable bones and to sort out rare or unusual fragments for subsequent study abroad. Such rare or unusual fragments were likewise selected from the 1976 season's bone corpus; and at present all the bones from previous seasons now in storage in the United States are being shipped to Boessneck in Munich for additional study as well. This means that the entire bone corpus from Heshbon comprises about 70,000 bones. Completed studies of portions of this material are cited at the end.

The fish remains from Tell Ḥesbân are currently awaiting analysis by Johannes Lepiksaar of the Naturhistoriska Museet in Göteborg, Sweden. Similarly, snails and mollusca are awaiting analysis by Patricia Crawford in Boston, while the small mammals are in the hands of G. Storch of Frankfurt/Main, Germany.

Palaeoenvironmental Studies

The objectives of the palaeoenvironmental studies are akin to those of the environmental studies described above, except

that the nature of the data requires the application of different methods: stratigraphic excavation, use of sieves and flotation devices (Crawford, LaBianca, and Stewart 1976), pollen sampling, zooarchaeology, geology, and local history. These are some of the avenues pursued in order to ascertain the characteristics of the climate, fauna, soils, and vegetation of Heshbon during each of its analytically distinguishable cultural periods.

In addition to the environmental materials collected by Crawford in the test square, extensive sampling was also carried out in other stratigraphic operations on the *tell*. (The resulting materials are presently in transit from Jordan to Boston where they will be studied by Crawford; see Bibliography.)

As with the zooarchaeological studies, these studies too have their starting point in the present. In fact, to date—apart from the zooarchaeological evidence which shows considerable changes in the fauna through time (see Boessneck and von den Driesch, in this issue)—the best clue we have to the characteristics of the ancient environment is the present one. However, the changes in the fauna do invite a conjecture about the palaeoenvironment given the systemic interrelationship of climate, fauna, soils, and vegetation (Oliver 1973:6); alterations in one component—in our case in the fauna—would mean that alterations could presumably be expected in the other three components. It should be clarified, however, that changes in the climatic component would apply principally to *microclimate* (cf. Geiger 1950), i.e. the climate near the ground. But as Geiger points out (1950: 480-481), even slight changes in the microclimate in the past can have substantial effects on vegetation of the past—a situation which, indeed, seems to be true for the particular region of Transjordan in which Ḥesbân is situated (Reifenberg 1953, 1955; cf. Whyte 1961:98-100; see also LaBianca 1977 for a more detailed analysis of the changes in Ḥesbân's habitat).

REFLECTIONS ON MAN, ANIMALS, AND HABITAT

Perhaps the central thesis of the concept and method of

cultural ecology is the thesis "that cultural ecological adaptations constitute creative processes" (Steward 1955:34). As Hawley has written, "each habitat not only permits but to a certain extent necessitates a distinctive mode of life" (1950:190). In the case of Ḥesbân, therefore, the problem has been to ascertain the amount of latitude permitted by the habitat for alternative modes of life.

As was observed earlier, the ethnographic findings are that a wide range of alternative subsistence and economic arrangements are manifest among the inhabitants at Ḥesbân. As a result, it seems unwarranted, given the available zooarchaeological evidence, to attribute to earlier inhabitants there a mode of life where sheep and goat raising was the predominant subsistence activity. As in the present, alternative modes of life were very likely the case at ancient Heshbon as well—a conjecture which I believe will be substantiated by future analysis of the data (see LaBianca 1977).

The continuity in sheep and goat exploitation at Heshbon, manifest by the zooarchaeological data, cannot, therefore, necessarily be attributed to continuity in the mode of life of the populations at Ḥesbân from ancient times to the present, but at best to continuity in the modes of life of *certain members* of the populations through time. Even this conclusion must be qualified by the possibility that the specific arrangements for herd management and animal utilization were substantially different from those observed in the modern village.

However, to the extent that there *is* continuity in terms of the *kinds* of animals exploited at Ḥesbân the habitat, as an extracultural influence, may constitute a causative or even a creative factor. But how are we to explain the diversity in the modes of life at Ḥesbân? To answer this question it is necessary to examine further some of the presuppositions of cultural ecology.

According to Steward, "human beings do not react to the web of life solely through their genetically-derived organic equipment. Culture, rather than

genetic potential for adaptation, accommodation, and survival, explains the nature of human societies" (1955:32). The presupposition here is that although "cultural patternings" are not "genetically derived" (1955:32), they nevertheless constitute responses to the natural environment, the implication of this being that culture is *systemically* or *mechanistically* related to the local habitat, and thus within the realm of things governed by natural laws—hence Steward's remark that cultural ecology "introduces the local environment as the extracultural factor in the fruitless assumption that culture comes from culture" (1955:36).

But this mechanistic presupposition about the articulation of culture with environment has been challenged on several grounds in recent years. In particular, it has been faulted as being inadequate for explaining culture change. Thus Edmund Leach, in his concluding remarks to a group of archaeologists concerned with the problem of culture change, made the rather unsettling statement that "the proper analogy for human behavior is not natural law—of a physical kind—but a game of chess. The field of play and the rules of the game are laid out in advance, but the way the game is played is unpredictable" (1973:763).

Leach's contention is that human intentionality and creativity are usually overlooked by archaeologists who—because of their mechanistic presuppositions—tend to focus on substantive identities among similar phenomena rather than looking for systematic relationships among diverse phenomena (1973:763-764; cf. Geertz 1966:56). Equally interesting and apropos is Schneider's recent article in the *American Anthropologist* in which he argues that the appropriate genetic model for the basic mechanism of culture change, namely innovation, is not the *linear* "hybridization model" suggested by Barnett (1953:181), but the highly *non-linear* mutation process (1977:12). According to Schneider, therefore, the predominant processes in culture change are of the *non-linear* kind resulting in cultural divergence, rather than of the *linear* kind resulting in cultural parallelism (1977:13).

It is apparent, then, that in order to account for human diversity at Ḥesbân, it is necessary to take into account human creativity and intentionality. In other words, it is not merely a matter of introducing the local environment as the extracultural factor from which culture comes; but rather, innate human capacities must also be reckoned with.

The possibility of reckoning with innate propensities in man as a means for understanding his seemingly infinite capacities for originality has received much attention in recent years from psycholinguists—thanks to the pioneering work of Noam Chomsky. According to him, the acquisition of a natural language by young children cannot be explained simply in terms of behavioristic or

mechanistic processes (as the psychologist B. F. Skinner has argued in his book *Verbal Behaviour*, 1957; see Chomsky 1964a). Writes Chomsky:

> The only substantive proposal to deal with the problem of acquisition of knowledge of language is the rationalist conception that I have outlined. To repeat: Suppose that we assign to the mind, as an innate property, the general theory of language that we have called *universal grammar*. This theory . . . specifies a certain subsystem of rules that provides a skeletal structure for any language and a variety of conditions, formal and substantive, that any further elaboration of the grammar must meet. The theory of universal grammar, then, provides a schema to which any particular grammar must conform (1972:88).

It is only when such an "innate schematism" is attributed to the human mind that it is possible to explain "the central fact to which any significant linguistic theory must address itself" (1964b:50, cf. 1975a). That central fact is the "creative" aspect of language use, whereby

> having mastered a language, one is able to understand an indefinite number of expressions that are new to one's experience, that bear no simple physical resemblance and are in no simple way analagous to the expressions that constitute one's linguistic experience; and one is able, with greater or lesser facility, to produce such expressions on an appropriate occasion, despite their novelty and independence of detectable stimulus configurations, and to be understood by others who share this still mysterious ability (1972:100).

That this creative aspect of language use is "closely related to creativity in non-verbal forms" has been recognized by a number of anthropologists, including Leach (1973:763), Tyler (1969: 1-23), and Levi-Strauss (1967:67). Geertz, in fact, seems to share Chomsky's conception of man as having an innate schematism for organizing the data of experience. He writes: "For man, what are innately given are extremely general response capacities, which . . . make possible for greater plasticity, complexity, and . . . when everything works as it should, effectiveness of behavior" (1966:58).

On the basis of what has been said, then, future efforts to explain cutural continuity and divergence at Ḥesbân must be based on a model which not only reckons with the extracultural factor constituted by the habitat, but which also reckons with man's innate creative propensity—which, according to Chomsky (1975b: 13, 35), is the product of the interaction of innate faculties of the human mind, such as the language faculty, with the internalized data of experience. Culture, and culture change, would then be seen not merely as a mechanistic response by man to his environment, but as the inevitable outcome of the dynamic interaction which results when "man the innovator" (cf. Bell 1973: 390) intervenes with animals and habitat—and all other data of experience—reshaping it in accordance with his purposes.

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