ANIMALS, CLIMATE AND PALAEOLITHIC MAN

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The animal remains found in the midden material of Pleistocene habitation sites may be described and analyzed for two principal and somewhat different ends. The first uses them to reach an understanding of the composition of the animal community or communities which existed at the time or times man was also present and what kind or kinds of environments were present, including the climatic factors. The animals and the climatic inferences derived from them may be useful for establishing or supporting relative chronologies, and these may then be compared with similar chronologies for other regions.

The second purpose seeks to understand those aspects of human culture which are reflected in what kinds of animals were killed and how the remains were used. The two purposes are clearly not incompatible; in fact, they overlap extensively and prehistorians have long been aware of them. The first kind of study has certainly been the more frequent and reflects the concern of any sound archaeologist with chronological problems. The second is becoming increasingly frequent and elaborate (see Heizer, p. 93 in Heizer and Cook, 1960). That the first may be heavily dependent on the second seems not to have been very fully appreciated in numerous instances. The special kind of thanatocoenosis (community of death) which is found where man has lived is unlikely to reflect in any full and comprehensive manner the biocoenosis of the adjacent countryside. An assumption that the hunters and collectors of the Pleistocene systematically sampled the total plant and animal communities of their neighborhoods is hardly reasonable. Selection is certainly present and by upper Pleistocene times cultural choices, as an aspect of selection, were certainly operative.

The remarkable thanatocoenosis of the Mt. Carmel caves (Tabūn, Skhūl and Wad) has been superbly described by the late Dorothea Bate (Garrod and Bate, 1937). Two animals whose remains she encountered often in the archaeologically determined levels of the Tabūn and Wad caves were Gazelle (several species) and the Fallow Deer (*Dama mesopotamica*). The former is represented by 7,428 identified specimens and the latter by 12,556 specimens. She was convinced that the two ungulates were adapted to different environments and these in turn reflected different climates. The frequencies of identified specimens of the two forms she published in the form of a diagram which relates these to the successive levels of the two caves which range from an Upper Acheulian at the base of Tabūn to the mesolithic Natufian at the top of the sequence in the Wad. For each level the percentage relations to each other are shown. Miss Bate gratefully acknowledged the help of Professor F. E. Zeuner in the construction of the diagram. Many readers are undoubtedly only familiar with it in the modified form in which Professor Zeuner has presented it in the various editions of his remarkable book, "Dating the Past," and in the most recent edition of his "The Pleistocene Period." His modifications of the original diagram do not give the frequencies.

Miss Bate had no doubt that a climatic interpretation could be made from the diagram and so states (Garrod and Bate, p. 142, 1937). The varying proportions of Gazelles and of Dama she thought reflected drier (Gazelle) and moister (Dama) climatic conditions. This evidence she believed was fully supported by other aspects of the total situation reflecting the other fifty-four genera of mammals and reptiles she had identified. Professor Zeuner has, I believe, given the impression to many of his readers that the Gazella-Dama diagram could be read as a rainfall chart of a substantial fraction of the Upper Pleistocene. Read in this way, further inferences are then made as to where the changing precipitation pattern fits what is believed to be the overall fluctuations of precipitation of the later Pleistocene. This has not been a completely successful venture, since the "rainfall curve" has been "fitted" quite variously and not even near unanimity appears to have been reached in this matter. There are the gravest objections to this method, not least of which is that the Bate-Zeuner diagram presents the original materials in ways which obscure important and contradictory relationships.

The first important assumption underlying the diagram is that the hunter's success in bringing either Gazelle, Dama, or both to the caves was a function of the frequencies and availability of the respective herds of each kind of beast. From this is follows that the frequencies reflect the changing natural proportions of the animals and the biotopes of which they are believed to be representative.

All levels from F in Tabūn to B in the Wad have one or more identified specimens of Fallow Deer. One sublevel in Tabūn lacks Gazelle, all other levels in both caves have one or more specimens. Simply stated, this means that there were Gazelle and Fallow Deer always within hunting range of the caves.

The different kinds of habitats and the different habits of gazelles and cervids suggest very powerfully that it was not a matter of indifference to the hunter which animal was killed. Ease of kill and of butchering must have been affected by the technology of hunting weapons and by individual or group lore concerning the "tricks" needed to succeed in killing different kinds of animals and at different ages. Add to this preferential combinations involving meat and sinew in some animals, meat and hides in others, meat and horns in still others, and the variables increase rapidly. Nor can one wholly ignore the probability of dietary preferences affected by the prior history of the human group. That Pleistocene hunters were so continuously on the verge of starvation that they used every food resource at hand is one of those lingering nineteenth century assumptions which appear today as highly improbable. Short term crisis situations may have been characterized by such necessities, and these may have been important in either biological or cultural change of great rapidity, but it seems doubtful if our technology and methodology of prehistory yet permit us to specify such phenomena with much if any precision.

A number of interesting features become apparent if we treat the sample of identified specimens of Gazelles and of Fallow Deer, and the subsamples which compose it, in ways additional to that presented in Volume 1 of

"The Stone Age of Mount Carmel." Figure 1 shows the percentages for each level of Dama and Gazelles treated separately. In an approximate way, the histograms reflect the varying "abundance" of each form against time. Level F of the Wad has been omitted, not because of the modest frequencies of each form (47 Gazelles, 40 Dama) but because the peculiarities of this level are such that it is doubtful if it was a midden deposit in the way the other levels were. It may well represent the washed and naturally sorted remnants of such a level. Layer G of the Wad is here shown separately to show its relationship to the successor layers in that cave, but in artifacts and faunal remains it is not separable from layer B of the Tabūn. Miss Bate did not record separately the frequencies for Chimney I and II and layer B of Tabūn, and consequently any possible time changes within this thick deposit are not demonstrable in the way they are for the artifact-based subdivisions of Tabūn E.

The histogram for Gazelles (see also Table 1) shows first that 85 per cent of all specimens were found in the M. el Wad, and Wad B, C, and E alone account for 75 per cent of all specimens in both caves. If we read the histogram from right to left the schematic picture for the Gazelles shows some fluctuation, but the overall trend is an increase from earliest to latest. The fluctuations to lesser numbers are in Tabūn D and Wad D, following periods of greater abundance of the form, and it is interesting that Dama also declines at the same times after a previous period of greater numbers.

The Dama histogram is most peculiar. Wad G, Tabūn C and D have frequencies of less than one per cent and Wad B, F, and Tabūn F less than half of one per cent. Tabūn B-Wad G together account for 66 per cent of all Fallow Deer, with most of the remainder appearing in Wad C, D, and E. The layers of M. el Wad contained about 29 per cent of all Dama specimens, not quite twice the frequency of Gazelles in all the Tabūn layers. If frequencies of each layer represent differing natural abundance of the forms, then Dama was rare in Tabūn F, modestly present in Tabūn E, rare in D and C, and fantastically abundant in Tabūn B-Wad G times. During the time of Wad E, D, and C it was more abundant than during any time preceding Tabūn B, but becomes quite rare in Natufian times (Wad B).

Now let us turn to figure 2 and Table 1. This also relates abundance to time. The numerical values along the vertical axis of the diagram represent the number of identified specimens for each 10 cubic meters. The number of cubic meters excavated from each level was approximated as closely as the plans and sections would permit. No estimate was attempted for Wad F for reasons stated above, but all other levels, including the subdivisions of Tabūn E, were used as the denominators of a fraction whose numerator was the number of specimens. The values obtained were expressed as decimals and further multiplied by 10 to reduce the number of instances with values less than one.

The two caves differed not only in archaeological content but in amount of deposit. Et-Tabūn contained a much greater amount of fill and approximately eight times as much was removed from it than from the Wad. If animal remains occurred with equal frequency in the levels of both caves,

then there should be eight times as many from Tabūn as from the Wad. Such is not the case with the Gazelles and the Fallow Deer, although the number of identified animal species in Tabūn was greater than in the Wad.

Figure 2 shows that the concentration of Gazelles and Dama in Tabūn F, the earliest level with any mammals, is excessively scant. They run 8 Gazelles and 3 Dama per 1000 cubic meters. Tabūn E was a thick and massive level. Dama is more frequent than Gazelle, but both were concentrated in the upper third, Ea, Eb. Level D has the same concentration of Gazelles and Dama, with both being quite scant. The next layer, C, is slightly less in amount of deposit, about the same concentration of Dama as in D but Gazelles are a little better represented.

Tabūn B-Wad G as expected show abundant Dama, but for the first time in the history of this cave Gazelles become frequent.

Layer E of the M. el Wad was, with the exception of Layer F of the same cave, the thinnest of all the levels. In concentration per unit of deposit, Gazelles and Dama reach their peak, with Gazelles about a third more common than Dama.

Wad D was twice the amount of E, with substantially lesser relative values of both forms. Dama is, however, more abundant than Gazelles. Layer C shows Gazelles in excess of Dama and so does B, but relatively Gazelles are declining and Fallow Deer are very scant.

The foregoing raises some real questions as to the representativeness of the samples from the several levels. During the time preceding the Upper Levalloiso-Mousterian of Wad G-Tabūn B, both Gazelles and Dama were present but in concentrations that leave me in doubt as to their value as good indicators of shifting biotopes and the climates that are assumed to be correlated with them.

Layer B of Tabūn provides us with the first absolutely and relatively large number of specimens of either form and with about two-thirds of the Fallow Deer from both caves and all levels. If a substantial part of the specimens came from the chimney part of this level, as is probably the case, then a further mystery is added. Professor Garrod's lucid and comprehensive description of Tabūn and its probable history provides a reasonable but not wholly satisfactory explanation of the chimney with a deposit whose top was about 5.50 meters above the level of the same deposit in the main cave.

Wad G was accumulating during the time of the Chimney-Layer B filling in Tabūn. In the former, Dama is about twice as frequent as Gazelles, but both absolutely and relatively to amount of deposit the numbers are low. In Tabūn at this time Dama is thirteen times more frequent than Gazelles, but the latter is not absolutely scarce.

Gazelles and Fallow Deer were absolutely and relatively quite abundant in level E of M. el Wad. Levels D, C, and B have already been described. Neither kind of animal was in short supply until Dama nearly disappears in Natufian times. Also the time span covered by the accumulating layers from

F through B in the Wad was certainly much shorter than the time during which Tabūn with its chimney was filling. I find it hard to see in the ideas presented here on the Gazelles and Fallow Deer the slowly changing climatic pulsations which they are believed to exemplify. Something special and peculiar happened in the time Tabūn chimney and layer B were accumulating, but that it only concerns changes in temperature and precipitation is not fully evident.

If the absolute and relative amounts of Gazelles and Dama reflect even partially the number of animals killed and butchered, then from the time of the Upper Levalloiso-Mousterian of Tabūn B until the close of the Natufian meat was abundant. The changes in amounts and ratios of the two kinds of game seem just as plausibly interpreted as resulting from increasing overall skill in hunting and from changing preferences in diet. During the time they lived in the Wad, the Aurignacians of Layer E were far and away the most skilful hunters, followed by the people of Layer C. Both layers are of moderate thickness and amount. The Bate-Zeuner diagram presents them as nearly the same in percentages of Dama and Gazelles to each other. Were the habits of Dama such that they were easier to kill for some Palaeolithic hunters than were the Gazelles?

Table 1 presents the data used to construct the histograms of figures 1 and 2. The final two columns show the totals of recorded implements for each prehistoric archaeological layer and the average implement frequency per cubic meter. The latter, like the similar frequencies per 10 cubic meters for the Gazelles and Dama, are minimal values. Excavation, sorting, and collecting techniques for both kinds of material, stone and bone, were rigorous to the point where fluctuating sampling errors seem unlikely to affect the calculated values for the several levels. If these ratios reflect in some considerable degree, within a single major tool tradition, intensity of occupation, then it is interesting to note the gradually increasing values in the Acheulean in Tabūn F upward through the phases of E. The Levalloiso-Mousterian has quite different and smaller values in Tabūn D, C, and B, but the earliest occupation in the Wad of this culture shows a fourfold increase. The Skhūl deposit and its industry, which has been equated with all or part of level C of Tabūn, shows a ratio of nineteen artifacts per cubic meter (c. 540 m^3 of deposit). If unworked flakes saved are reduced by about a third, it brings the value down close to that for Wad G, and here the collecting practices did certainly differ from those employed in the Tabūn excavations. Neither Skhūl nor Wad show evidences for an Acheulean occupation. Were the Tabūn inhabitants beginning to live part of the time, first at the Skhūl and mainly later in the Wad? The Upper Palaeolithic peoples made quite casual and fleeting use of both Skhūl and Tabūn. The people of Wad E, D, and C left many more implements per cubic meter. The Natufian (Wad B) has its own tool tradition and characteristic value for it.

The case for climatic change was not based only on the Dama-Gazella graph. The appearance and disappearance of some other genera and species were interpreted as supporting this, especially part of the microfauna represented by bats, rats, mice, cricetines, and others. The time relations involving their presence and continuity is shown in the master table

(Garrod and S.A.M.C., Bate, pp. 156-157, 1937) which lists fifty-two kinds of mammals and two kinds of reptiles. Small mammals are very widely regarded as fairly sensitive indicators of environmental change if they show differences through time, as reflected in their changing character in an archaeological deposit. The often sharply graded microclimates which exist under, on, and in the first few inches above the ground justify this proposition. But the relation of shrews, mice, and rats to the thanatocoenoses of humanly inhabited caves is less clear. Firstly, caves and their immediate environs themselves represent microenvironments. Secondly, are the small mammals commensals of man, introduced by him or by some other animal or bird? Most typically, owls, hawks, and similar birds are regarded as the chief agents of the accumulation and transport of the mammalian and reptilian microfauna, and the pellets left by these birds leave no doubt that they are responsible in some instances. It seems a doubtful proposition that the human occupation of the cave was a matter of indifference to such birds, with a consequent reflection in differing amounts as well as of kinds of small animals they "left" in or about the cave or shelter.

Then, thirdly, the variety of life-ways to which modern insectivores and rodents are adapted, sometimes with and sometimes without cranial, dental, and skeletal differences, poses problems as to the degree of probability with which the principle of uniformitarianism can be applied in particular cases. If, as seems to be widely believed, small mammals can and often do evolve rapidly, can we then infer with much accuracy what their presumed physiology and behavior reflects as to the biotope of which they were a part?

The tables which follow group the genera and/or species in several ways in an attempt to show continuity through the archaeological levels and the lack of it. Table 2 shows those animals with records covering all or nearly all of the time of the combined cultural sequence. Seven of the eleven are ungulates and each was a food animal. Internal evidence (the nature of the broken bones) in the several levels and external evidence, that the same animals were similarly used by both earlier and later prehistoric peoples, confirm this. The gazelles, the equids, the goats suggest fairly open, grassy meadows or plains with not too much brush or timber. Fallow deer, roedeer, the bovids suggest a distinctly more brushy and forested environment. The rodent mole (Spalax) is shown as persisting throughout but there is a break not shown in the diagram in Tabūn D and C. It is counted as a "dry" form. The vole (Microtus cf. guentheri) has a somewhat uncertain record from Tabūn B to Wad D, but otherwise seems always to have been present. The foregoing were among the animals which suggested to Miss Bate that every level showed a "mixed" fauna, indicating somewhat contrasted environments not too far from the caves. She refers to this frequently.

The second grouping is presented in Table 3a and 3b. This shows forms with moderately long histories but confined fairly strictly to either the Tabūn sequence or to that of the Wad. In the Tabūn, hippo and crocodiles suggest one environment, rhino and hartebeest a different one. Also it appears odd that jerboas, mice and dormice are Tabūn animals but not recovered or reported from the Wad. Even more peculiar is the absence of bats from the later cave with its narrow, high-ceilinged interior extension. Do the

Wad records of martens, wildcat, hare, and tree squirrel reflect an interest in their pelts by the Upper Palaeolithic hunters?

The foregoing conditions and inferences suggest to me that a substantial number of variables, more than were allowed for originally, must be considered in interpreting the animal remains from the Carmel caves. Marshes and lagoons may well have flanked the Carmel hills to the west during the time of higher and then retreating sea levels of the Achelean and Levalloiso-Mousterian occupation of the caves. But a day's journey on foot eastward across the hills takes one to the edge of the Plain of Esdraeolon. While one cannot now specify the floristic conditions during the Upper Pleistocene, the essential physiography of the Mount Carmel caves is varied and comprises distances such that a human on foot can move from one biotic zone to one of several others within a day's time or less. Hunting on the coastal plain with, for a time, its marshes and lagoons, in the wadis and on the ridges of the Carmel hills and across into the Plain of Esdraeolon would provide the varied larger fauna of the caves, a "mixed" one. Since social and cultural factors determine methods and skills in hunting, in dietary preferences, and in differential utilization of bone, sinew, hides and other parts, these factors cannot be assumed to have been without effect on the residues that were recovered. Differing activities in and about the caves may well have affected the lives of the small mammals with consequences for the archaeologist and for the biologist who identifies and interprets the remains. That both the human and the animal communities were subjected to changes in temperature and precipitation patterns is unquestionable. Some radical sets of events took place between the time of Tabūn C and Wad E. The faunal evidence as reviewed above, however, suggests to me that we are not yet clearly able in this example to reach an unambiguous set of conclusions about climate that are so specifiable as to support the chronological inferences that in their turn have been derived from them.

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TABLE 1

Frequencies, Percentages and Abundances of Dama, Gazella and Recovered Artifacts

	Gazelle Frequency by level	Gazelle percent by level	Gazelle abundance per 10 m^3	Dama Frequency by level	Dama percent by level	Dama abundance per 10 m^3	Estimated cubic meters per level	Frequency recorded artifacts per level	Concentration of artifacts per cubic meter
Wad B	1,950	26.3	56	56	0.4	1.6	350	12,444	36
C	1,798	24.2	500	1,304	10.4	362	36	4,522	127
D	619	8.3	121	859	6.8	168	51	4,096	80
E	1,826	24.6	913	1,255	10.0	628	20	2,035	102
F	47	0.6	-	40	0.3	-	-	-	-
G	58	0.8	7.7	104	0.8	13.8	75	1,081	14
Wad G & Tabūn B	688	9.3	9.4	8,310	66.2	113	735	3,123	4.2
Tabūn B	630	8.4	9.5	8,206	65.4	124	660	2,042	3.0
C	228	3.0	4.1	66	0.5	1.2	550	1,097	2.0
D	104	1.4	1.6	101	0.8	1.6	650	2,133	3.0
Ea	103	1.4	4.1	194	1.5	7.8	250	6,668	27
Eb	61	0.8	1.2	284	2.3	5.5	520	14,164	27
Ec	0	0	0	34	0.3	1.8	190	5,019	26
Ed	1	0.01	0.006	52	0.4	0.3	1,600	18,783	12
(comb.)E	165	2.2	0.6	564	4.5	2.2	2,560	44,634	17
F	3	0.04	0.08	1	0.01	0.03	375	4,370	12

TABLE 2

Animals with Long Records

Dama mesopotamica fallow deer	TF - WB	Bos spp. bovids	TE - WB
Gazella spp.	TF - WB	Equus caballus	TE - WB
Spalax spp. rodent mole		Equus hemionus kiang	TE - WB
Microtus cf. guentheri vole		Procavia coney	TE - WB
Caprolus roe deer	TE - WB	Panthera pardus leopard	TE - WB
Capra spp. goats	TE - WB		

TABLE 3

Animals with Moderately Long Records

3a. Tabūn only, prior to level B.

Crocidura samaritana shrew	TF - TD	Rhinoceros hemit.	TE - TC
Philistomys dormouse	TF - TD	Alcelaphus hartebeest	TE - TC
Murines	TE - TC	Sus gadarensis pig	TE - TC
Cricetines	TF - TC	Hyaena prisca	TE - TC
Gerbils	TF - TC	Canis lupaster jackal	TE - TC
Microtus machintoni "snow" vole	TE - TC	Vulpes vinetorum fox	TE - TC
Ellobius mole vole	TE - TC	Crocodilus	TE - TC
Hippopotamus amph.	TE - TC	Myotis cf. baranensis bat	TE - TD

3b. Wad only, levels E through B

Erinaceus carmelitus hedgehog		Lepus spp. hare	
Meles sp. marten		Sciurus cf. anomalus tree squirrel	
Meles cf. martes marten		Sus scrofa pig	(begins in D)
Felis sylvestris wild cat	(begins in F)	Alcelaphus hartebeest	(see 3a)

TABLE 4

Animals with Short Records

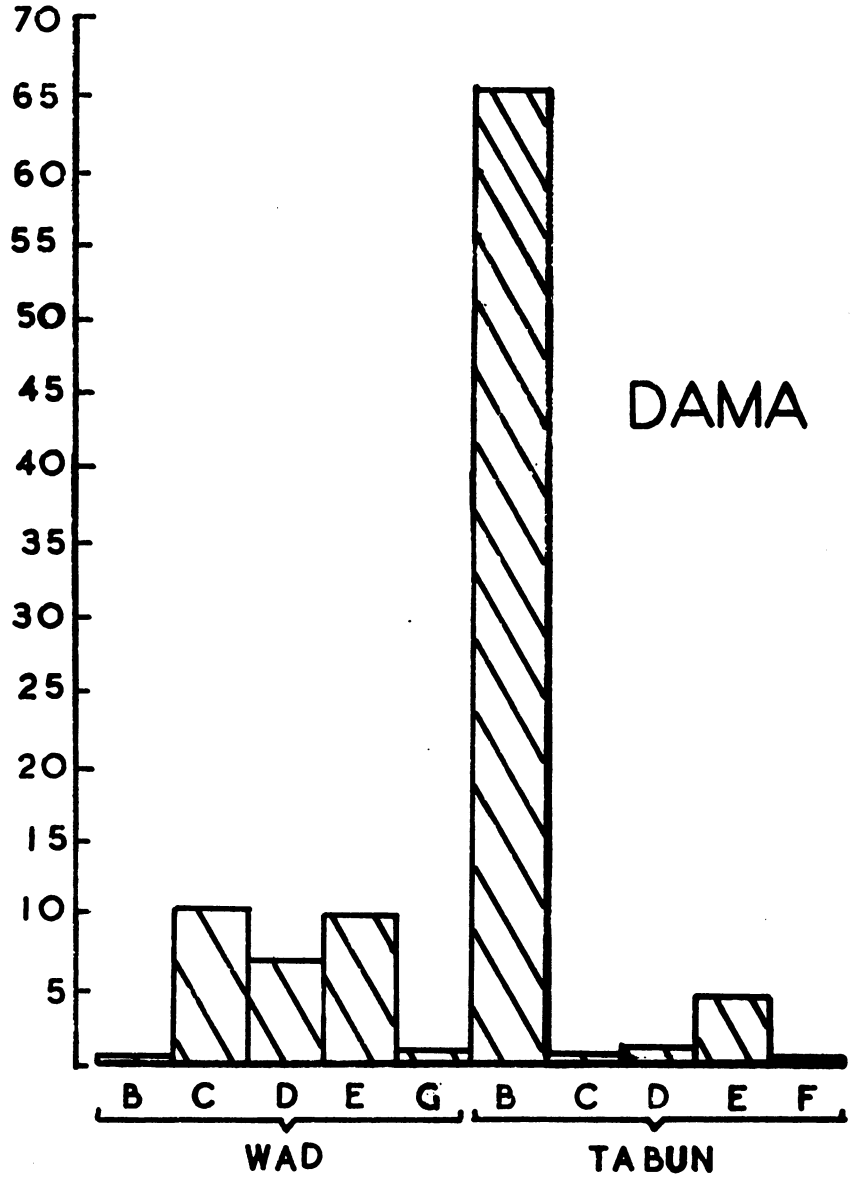
4a. Tabūn only, prior to level B

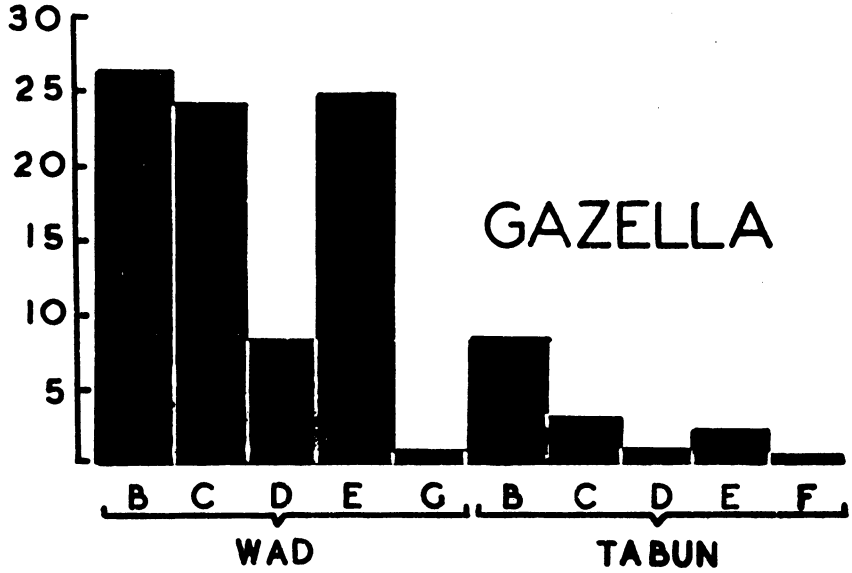
Megaderma watwat false vampire bat	F	Microtus mcCowni shrew	E
Rhinolophus bat	E	Phacochoerus garrodae wart hog	(Skhūl only)
Crocidura katinka shrew	D and E	Elephas sp.	E
Erinaceus sharonis hedgehog	D	Trionyx soft shelled turtle	E and C
Talpa mole	F		

4b. Wad only, level E and later

Erinaceus auritus hedgehog

FIG 1. Percentages by layer





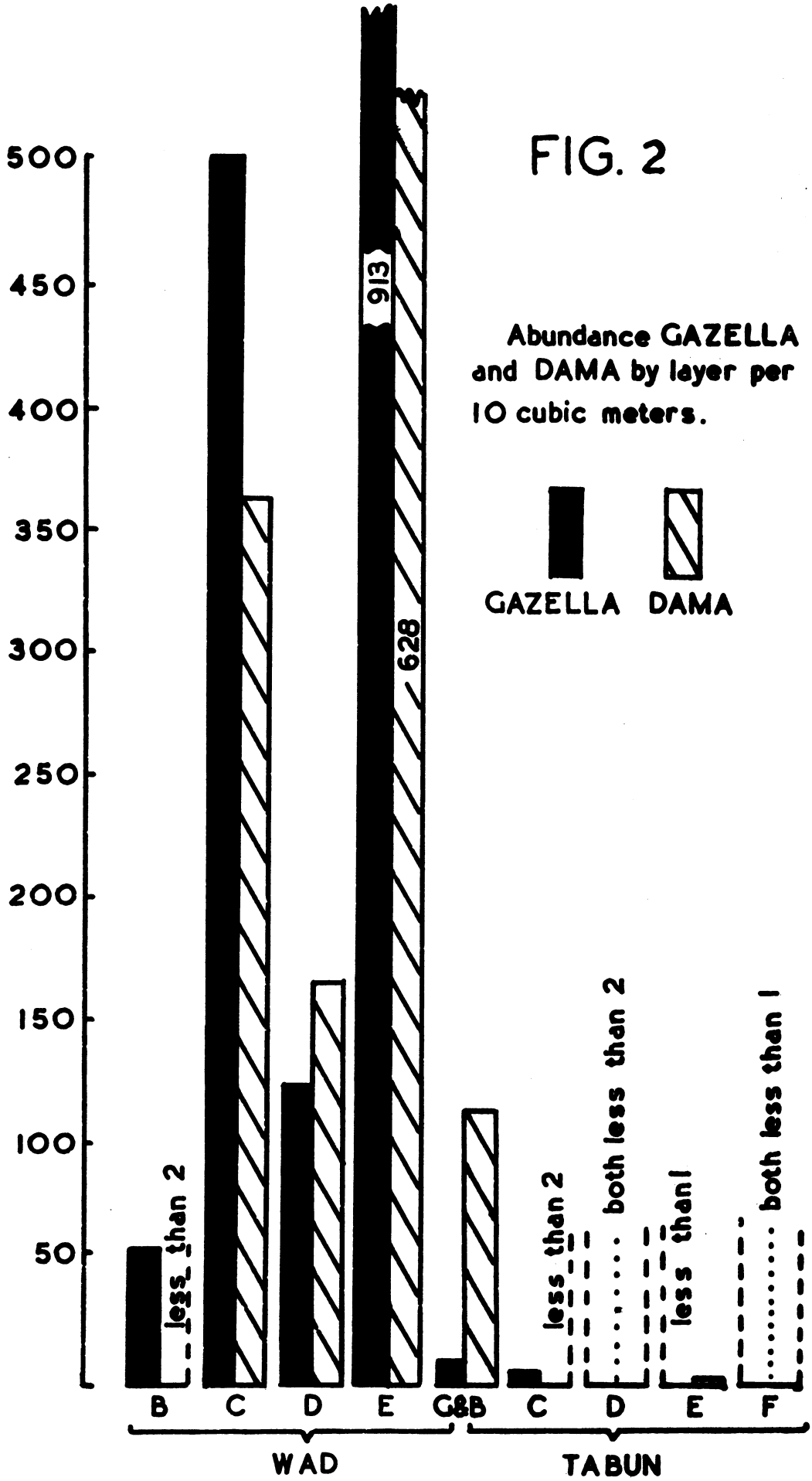


FIG. 2
Abundance GAZELLA and DAMA by layer per 10 cubic meters.
GAZELLA
DAMA
500
450
400
350
300
250
200
150
100
50
913
628
less than 2
less than 2
both less than 2
less than 1
both less than 1
B
C
D
E
G&B
C
D
E
F
WAD
TABUN