

ECONOMIC AND SETTLEMENT PATTERNS IN SOUTH-EASTERN EUROPE
DURING THE NEOLITHIC

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Anthropology

ACCEPTED
FACULTY OF GRADUATE STUDIES

DATE

29th May 1981

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UNIVERSITY OF VICTORIA

June 1980

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ABSTRACT

The purpose of this study is to examine economic and settlement variation in south-eastern Europe during the Neolithic and to offer possible explanations for why this variation occurred.

By gathering as much quantified faunal data as possible and by examining the available floral data certain differences between the northern and southern Balkans became apparent. The reliance on sheep and goats and on domesticated animals was greater in all periods in the southern Balkans. In northern Balkan sites bones of cattle were usually more frequent than those of sheep and goats, except during the early Neolithic, and in all periods wild animals were of greater importance in these sites than in those of the southern Balkans.

Among the crops planted, legumes were important in the southern Balkans in all periods, but were absent from northern Balkan sites.

It is suggested that these differences are related to climate, since within the Balkan region there are two major climatic zones: the Mediterranean, with hot,

dry summers, and the Humid Continental, with maximum precipitation falling in late spring and early summer.

The relationship between fauna and climate is assessed using two by two tables and Tau as a measure of association. The results of these tests show that a relationship between fauna and climate does exist.

It is also proposed that settlement patterns were strongly affected by economy. The relationship between economy and site longevity is assessed. Again a moderate relationship was shown to exist, although environment can not be rejected as the determining factor. But a close relationship between environment and settlement pattern would be expected because of the close relationship between economy and environment.

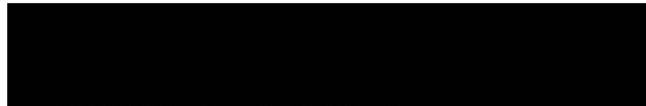
The effect of soil, topographic, and vegetational conditions on economy are also considered. The view is taken that the climatic effect on the economy is increased by these three factors, which are all ultimately related to climate itself. By further study of these factors the relationship between agriculture and herding, which remains uncertain, may become more clear.

Our understanding of Neolithic economy will be very much increased by further regional studies relating environmental factors to economics.

Examiners:



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ACKNOWLEDGEMENTS

First and foremost, I would like to thank Nicolas Rolland, my committee chairman, for his continued guidance and encouragement from the inception to the conclusion of this project. It was he, who introduced me to the topic of prehistoric economies, and suggested that the Neolithic economies of the Balkans would offer a fertile field for investigation.

I would also like to thank the other members of my committee, Donald H. Mitchell and John P. Oleson, for their advice and encouragement.

Bernardo Berdichewsky deserves special thanks. He provided from his own library much needed literature, unobtainable from other sources, and through an introduction to a colleague in Prague opened the door for me to the archaeological community of eastern Europe.

I would also like to thank Robert Carneiro for his continued encouragement and for our many discussions about the processes of simple agricultural systems, which were very influential in my approach to prehistoric subsistence economies.

Bohuslav Novotny of Bratislava also deserves special thanks for the considerable amount of literature he gave me, and for his introductions to a number of colleagues

in south-eastern Europe, among whom were Nándor Kalicz of Budapest, who opened his files at the Institute for Archaeology to me, and staff members of the Móra Ferenc Museum in Szeged, who kindly showed me the Neolithic collections of the Museum.

A very special thank you is due Betty Gibb and the staff of the Inter-library loan department of the University of Victoria Library. Without their help in finding and ordering difficult to obtain literature it would not have been possible to write this thesis.

I would also like to thank Margaret Lacy for helping in the preparation of the tables.

Finally, I would like to thank my husband, Bruce, for his help in the creation of the maps and graphs, and most of all for his patience, understanding, and support during the many months this project has been in progress.

DEDICATED
to the memory of my
MOTHER
1900-1962

I. INTRODUCTION

Until very recently, the main preoccupation of archaeologists in south-eastern Europe has been the search for cultural affinities between the Near East and Europe. Such affinities have been sought primarily through careful scrutiny of ceramic remains with the goal of establishing relative chronologies which were intended to show the direction of cultural diffusion.

Because of the early development of agriculture in this part of Europe, the Balkans have played an important role in developing concepts of diffusion in archaeology. The similarity of cultural and economic developments in Anatolia and the Aegean was interpreted early as the result of diffusion from east to west. Similarly, the development of agricultural societies throughout Europe was interpreted as being the result of diffusion from the south-east to the rest of the continent. The first radio-carbon dating lent strong support to this concept of the Neolithic development of Europe. Grahame Clark (1965) used the radio-carbon dates from a large number of sites in the Near East and Europe to demonstrate the zonal expansion of agriculture from south-eastern to north-western Europe. More recent calibrated radio-carbon dates, which have pushed the European

Neolithic back in time, continue to support this viewpoint, but tend to reduce somewhat the relative importance of diffusion as compared to local initiative in European developments.

While no archaeologist would deny that diffusion played an important role in the development of the European Neolithic, some like Colin Renfrew (1973a, 1973b) and David Clarke (1976), would question the traditional emphasis placed on diffusion as the means by which Neolithic and later developments took place in Europe.

The work of V. Gordon Childe has been of particular significance to the archaeology of the Balkans and of Europe as a whole. Although much of his work is descriptive, Childe, nevertheless, sought to explain culture change in terms of environmental change and diffusion. Further it was his opinion that the principal aspect of human organization to be affected by these factors was economy.

Childe's stress on the importance of culture change has acted in the past twenty years as a catalyst in structuring new approaches to archaeology: approaches, whose emphasis is on economic and social problems rather than on the museum oriented goals of classification.

The application of environmental approaches to the archaeology of south-eastern Europe during the past decade is of particular interest. These have attempted to establish relationships between the Neolithic populations of south-eastern Europe and their natural environments. Among these studies those of greatest interest are the territorial analyses of Bintliff (1977) and Kosse (1979), and the site catchment studies of Dennell(1978) and Barker (1975).

OBJECTIVES

Each of these studies relates to only a small portion of south-eastern Europe. In the present study the Neolithic economic strategies of all regions of the Balkans will be related to their environments and then compared to one another. The view to be presented in this study is that Neolithic economic strategies in south-eastern Europe were marked by considerable variation and that this was the result of environmental adaptation.

By studying the faunal and floral remains of several sites in different regions, and by relating these data to the topographic, soil, vegetation and especially climatic conditions of these regions, it is hoped that an important step will be taken in clarifying the amount and type of regional variation which occurred during the

Neolithic in the relative importance of the various animals and plants utilized and in the relative importance of the economic strategies of agriculture and of herding.

It is also hoped that by comparing settlement patterns with economic ones a relationship between the two can be shown in terms of site longevity and organization.

AREA OF STUDY

The area on which this study focuses is Greece, excluding Epirus and the islands of the Adriatic; Bulgaria; Jugoslavia, east of the Dinaric Alps, but including Bosnia; south-eastern Hungary in a region bounded on the west and the north by the Tisza and Körös rivers; and Roumania (Figure 1). The boundaries are drawn in such a way as to exclude sites of the Linear Pottery culture which was associated with a different environment, the less covered plains of central Europe. The region of the Adriatic coast of Jugoslavia and of the Dinaric Alps is also excluded since this area, with its impressed ware rather than painted pottery, is more closely related to the Neolithic of Italy than it is to that of what Gimbutas (1973a) calls the "Aegean-Central Balkan" region. In addition, it is cut off

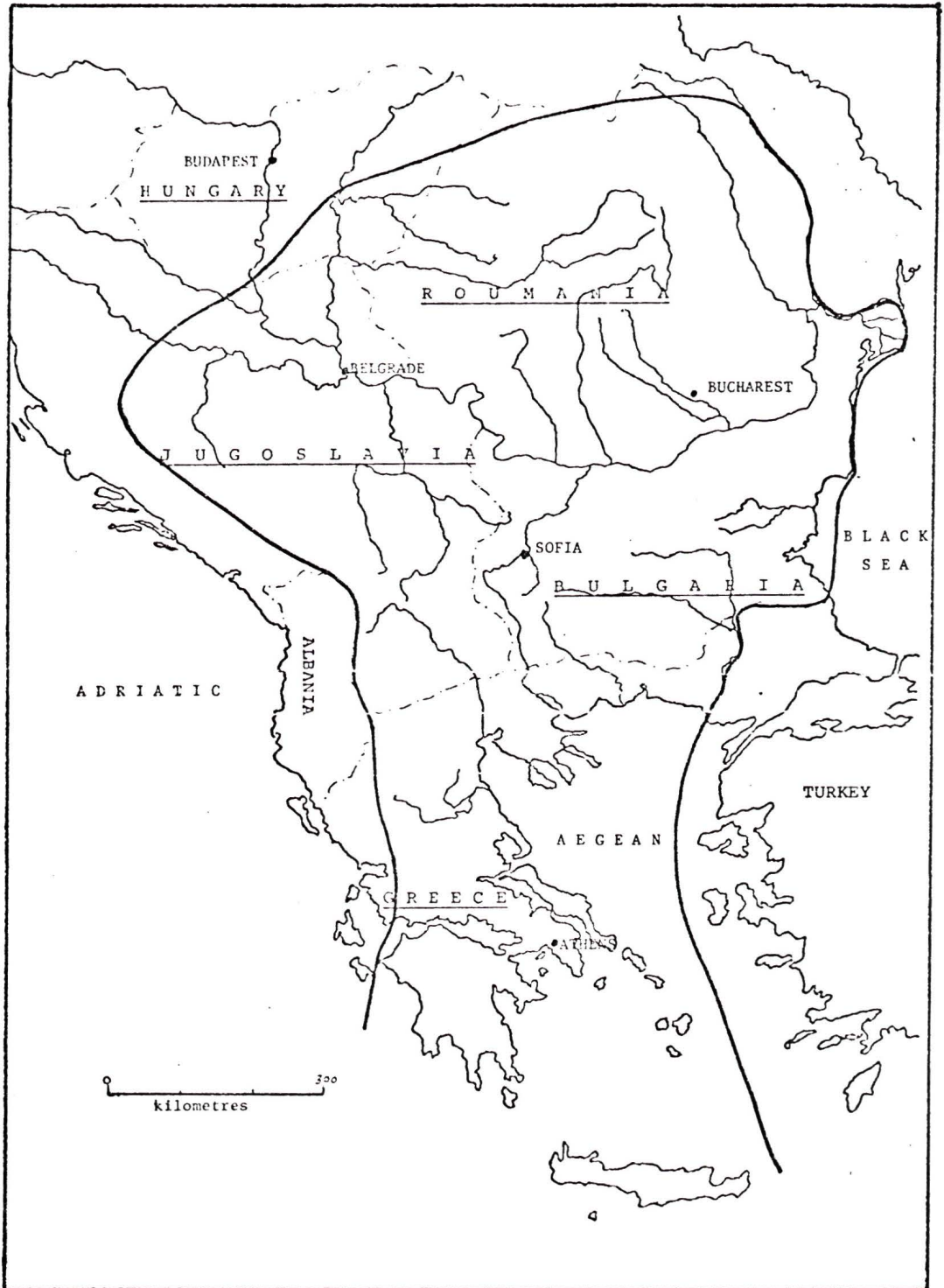


FIGURE 1 MAP OUTLINING AREA OF STUDY

from the rest of the Balkans by the natural barrier of the Dinaric Alps. The naming of these latter two cultural areas reflects the widespread use of pottery as the diagnostic criteria, but other aspects of the cultures, for example housing and economy, clearly differ considerably from those of south-eastern Europe.

TIME PERIOD AND DEFINITION OF NEOLITHIC

The time period of this study is that of the Neolithic, which, for this geographic area is generally considered to cover the period from about 7000 B.C. to about 3200 B.C., at which time the Bronze Age is usually considered to have begun (Tringham 1971; Gimbutas 1972, 1973a, 1973b, 1978; Colin Renfrew 1972; Theocharis 1973). This time span for the Neolithic is based on calibrated radio-carbon dates from a number of sites from all parts of the Balkan peninsula, and on cross-dating of the ceramic remains from these sites with those from sites for which radio-carbon dates are unknown. The available radio-carbon dates are listed in Appendix 3.

The term Neolithic is here used to denote a change in economic pattern from a hunting and gathering pattern to one of agriculture and/or herding, accompanied by changes in technology and social organization. Childe (1956, 1958) viewed the effects of the changed economic

pattern as revolutionary, but it becomes clear as more late Palaeolithic, Mesolithic, and early Neolithic sites are studied that the Neolithic should not be viewed as revolution but as evolution.

David Clarke defines the Neolithic in such a manner as to emphasize its transitional rather than revolutionary character. He says:

... husbandry moves into food production when the energy expended in the maintenance and control of food supplies first expands beyond that expended in the detection and pursuit of plant and animal food resources (1976:459).

While major changes in social organization occurred during the Neolithic, it is the changing economy which is most essential to the definition of the term. The essential elements of the Neolithic are the farming of those grains and the herding of those animals which today remain the chief sources of the world's food supply. These, of course, vary depending upon the part of the world being studied.

Thus it is not necessarily the true beginnings of farming and herding, but rather the use of a new complex of plant and animal species, which is defined as Neolithic. In the Balkans this group consists of sheep and goats, cattle, pigs, and dogs, and of wheat, barley and a variety of legumes.

The Neolithic, however, must not be viewed as a period during which hunting and gathering was no longer of importance. During this time red and roe deer, wild pigs, aurochs, and a variety of fish, birds and molluscs, and wild fruits and nuts were used in varying degrees by the inhabitants of Balkan sites. In some of these sites wild animal species were of very great importance and may make up as much as one-half of the identified animal remains.

In order that a settlement be considered Neolithic the mainstay of its economy should be agriculture, herding or both, but the use of wild plants and animals cannot be excluded as economically important sources of food and raw materials.

A look at pre-Neolithic relationships between man and the bases of his subsistence shows that an economic definition of the Neolithic cannot rely simply on the concept of domestication which is defined by Bökönyi as

... the capture and taming by man of animals of a species with particular behavioural characteristics, their removal from their natural living area and breeding community, and their maintenance under controlled breeding conditions for profit (1969:219).

The relationship between man and animal during the late Palaeolithic seems to have been more complex than was once thought. The type of domestication practised,

for instance, by present day Laplanders may be very old indeed (Zeuner 1963; Leeds 1965). Studies at Star Carr by Grahame Clark (1971) and of European reindeer economies by Sturdy (1974) seem to indicate a very close relationship between late Palaeolithic man and the animals he hunted.

A lack of plant data from Palaeolithic and Mesolithic sites means that man's use of his floral environment during this long period of time is almost completely unknown. Recently published data from Franchthi Cave (Hansen and Jane Renfrew 1978) are the only available pre-Neolithic floral data for the Balkan region. Ethnographic studies, however, indicate that it is highly likely that the earliest men were obtaining much of their nutrition from plant sources (Lee 1974; Thomas 1959). Even today in the Balkans a wide variety of wild plants are used as dietary supplements (Mary Forbes 1976a, 1976b).

David Clarke (1976:452) claims that archaeological investigation favours the appearance of agriculture during that period of time we think of as the Neolithic because very few excavations of pre-Neolithic sites have involved the use of techniques such as sieving and flotation to obtain information about prehistoric plant use.

In the Balkans a gap in the record of human populations during the period between the late Palaeolithic and the early Neolithic favours the appearance of herding as well as agriculture at this time.

In this thesis the Neolithic in the Balkans is taken to be that period of time between about 7000 B.C. when there was a change in the economy in the Balkans from a reliance on one group of animal species to a reliance on another group, and probably a shift in plant utilization as well, until about 3200 B.C. when greater complexity of social organization and the introduction of bronze mark the beginning of a transition to a new stage in European development.

The major characteristics of the Neolithic in the Balkans were the proliferation of villages of some permanence; a technology which included harvesting and grinding tools and ceramics; an increasing social complexity for which there is growing evidence particularly from late Neolithic sites; and of course the importance of sheep and goats, cattle, grains and legumes in the economy.

II. THE NEOLITHIC IN SOUTH-EASTERN EUROPE

A SURVEY OF SITES

The Neolithic in south-eastern Europe generally is divided into three major periods, early, middle and late, with the addition of an aceramic period for certain sites in Greece. But other ways of subdividing the period are frequently used. Gimbutas (1972, 1973a, 1973b, 1978) and Dennell (1978b) divide the Neolithic of the northern Balkans into only two periods, early and late. While this seems justified for that area, in Greece it may be reasonable to consider the middle and late Neolithic periods as separate. Towards the end of the middle Neolithic there was "intense regional differentiation" in Greece (Theocharis 1974:68). However, Theocharis also points out that "In Thessaly, at least, the continuity in some basic spheres is certain (1973:89)." Some archaeologists, for example Todorova (1978), add an eneolithic or chalcolithic period to the above classification, while others, among them Tringham, Gimbutas, and Dennell, assign sites or levels containing copper artefacts to the late Neolithic because the introduction of the minor use of unalloyed copper is all that distinguishes them.

The inconsistencies in classifying the Neolithic into periods undoubtedly arise from the use by different

archaeologists of different criteria. When pottery and ceramic figurines are used as the only criteria, as they have been until recently, then the number of Neolithic periods is increased, for relatively abrupt changes in the fine ceramic wares occurred from time to time. When other criteria such as settlement organization, technology and economy are used the number of periods is generally considered to be fewer since changes in these are gradual and continuous throughout the Neolithic.

The organization of the various cultural traditions of south-eastern Europe into the various Neolithic periods is complex. In different countries archaeologists have assigned different names to the same or similar cultural traditions. For example, Starčevo, Criş, and Kőrös are names which refer to basically the same early Neolithic cultural tradition, as it manifests itself in Jugoslavia, Roumania, or Hungary. The Karanovo culture of Bulgaria, whose Neolithic periods, beginning in the early Neolithic and extending to the latest Neolithic, are designated as I to VI, is known by several other names referring to different periods of time. Examples are the middle Neolithic Veselinovo and late Neolithic Marica cultures. Appendix 1 shows into which Neolithic periods I have classified the most frequently used names for the cultural traditions of the Balkans.

The Mesolithic Background

In order to understand just how important were the changes in south-eastern Europe brought about by the introduction of a Neolithic economy it is essential to have a grasp of the archaeology of the preceding Mesolithic period in the region. The two best known sites of this period are Franchthi Cave and Lepenski Vir, the former much earlier in time than the latter. Radio-carbon dates for Mesolithic levels at Franchthi Cave range from 7480 ± 160 b.c.¹ to 6758 ± 100 b.c. (Jacobsen 1974; Catling 1978), those from Lepenski Vir from 5410 ± 100 b.c. to 4610 ± 100 b.c. (Srejović 1972). These two sites are particularly important because in them early Neolithic levels succeed Mesolithic ones, providing direct comparisons between the technologies and economies of the two periods.

A number of other Mesolithic sites are known, many in Roumania or Jugoslavia in the mountainous country in and near the Iron Gate gorge of the Danube. The majority of these sites are caves. At Hoților and Ciumești, and at La Adam in the Dobrogea the bones of wild caprovines have been discovered along with Mesolithic tool kits

1. Throughout this thesis b.c. is used to signify conventional radio-carbon dates while B.C. is used to indicate the estimated true historical age as derived by tree-ring calibration.

(Tringham 1971:32). A few sites like Lepenski Vir on the Danube were riverside settlements consisting of a number of trapezoidal houses organized into what were probably permanently occupied villages (Srejović 1968a, 1968b, 1972, 1973; Milošević 1973; Tringham 1971:54-57; Nandris 1968).

1. Lepenski Vir: The houses at Lepenski Vir were constructed using basic geometrical principles with considerable precision. Short streets connected the houses with the river and to a central square. The Mesolithic village here was better constructed and more carefully organized than was the later Neolithic community that marked the end of the settlement (Srejović 1973).

Mesolithic tools at Lepenski Vir were of bone and antler, and of three types of stone. The majority of the flint implements were microliths. Sedimentary rock was used for clubs and weights (Srejović 1972:131-132). With the advent of the Neolithic there were major changes in the technology at Lepenski Vir (Table I). The most noticeable difference was the appearance in Neolithic levels of three types of pottery. At the same time obsidian from the Bükk mountains of north-eastern Hungary began to be used as a raw material for chipped stone tools. Microliths continued in use but larger forms such as knives and leaf-shaped flint borers appeared.

TABLE I COMPARISON OF MESOLITHIC AND NEOLITHIC TECHNOLOGIES AT LEPENSKI VIR AND FRANCHTHI CAVE

TOOLS	LEPENSKI VIR		FRANCHTHI CAVE	
	Mesolithic	Neolithic	Mesolithic	Neolithic
<u>Raw Materials</u>				
Flint	x	xx	xx	x
Obsidian	-	x	x	xx
Sedimentaries	x	x		
Other	x	x		
<u>Chipped Stone</u>				
Microburins			x	
Microliths	x	x	x	
Blades		x	x (backed	x
Sickle Blades			bladelets)	x
Borers		x		
Axes		x (few)		
Arrowheads				x
Scrapers			x	
<u>Polished Stone</u>				
Celts				x
<u>Ground Stone</u>				
Querns/Mortars		x (few)		x
Clubs	x			
Weights	x			
<u>Bone</u>				
Fishhooks		x		x
Gouges				x
Points			x	x
Spatulae		x		
Polishers	x	x		
Scrapers	x	x		
Borers		x	x	
Needles		x		
<u>Horn</u>				
Borers	x			
Hoes				x (LN)

x = present

xx = most frequent

- = definitely absent

The bone industry was expanded to include a number of new forms (Srejović 1972:142-151).

In the Neolithic level there were a small number of stone axes and a very few millstones and mortars. This suggests that agriculture was of little importance. The very location of the site on a small beach within a steep-sided gorge was one to discourage all but a minor interest in agriculture. Nor does herding seem to have played a major role in the Neolithic economy at Lepenski Vir since domesticated animals, primarily cattle, make up only twenty-five per cent of the bone sample (Appendix 5, Table XXXI).

It was probably the excellent and consistent source of fish in the Gospodin rapids just below the site that permitted Lepenski Vir to become a permanently occupied village (Tringham 1971:55). Fish bones made up over forty per cent of the Mesolithic faunal sample and fifteen per cent of the Neolithic.

The settlements of Padina, on the south bank and Schela Cladovei on the north bank of the Danube were also well situated to take advantage of the river's rich fish life.

Outside Yugoslavia and southern Roumania known Mesolithic sites are fewer. An open air site in north-eastern Bulgaria in a region of sandstone hills called

Pobiti Kamani, contained the bones of wild caprovines, a wild horse and red deer (Tringham 1971:52). The large cave of Golemata Peștera, also in Bulgaria has Mesolithic as well as Neolithic remains (Gaul 1948:40).

In Greece there are very few known Mesolithic sites. Seidi Cave in Boeotia has remains from the late Palaeolithic and Mesolithic periods and the open air site of Boebe in Thessaly contains remains from both Mesolithic and Neolithic settlements. At this site in the middle of the now-drained Lake Boebeis (Karla) the remains from both settlements are mixed, making the stratigraphy unclear (Theocharis 1973:24).

2. Franchthi Cave: The best studied of Greek Mesolithic sites is Franchthi Cave in the southern Argolid. Here a continuous record of occupation extends from late Palaeolithic times right through to the late Neolithic with faunal and floral information from all levels. Jacobsen (1976:76) says that it was likely the perennial springs near the cave which attracted people to it.

In the later Mesolithic levels at Franchthi Cave two important changes occurred, one economic, the other technological (Jacobsen (1976:81). In the faunal sample from this period large fish vertebrae, probably from

tuna appeared for the first time. At the same time the first obsidian appeared in the deposits. It has been shown that it was imported from Melos. Over the course of the Neolithic the amount of obsidian in the deposits steadily increased (Jacobsen, 1973a:79).

The Mesolithic toolkit as outlined in Table I consisted of an abundance of flint and obsidian microlithic implements and of bone tools, particularly points.

About 6000 B.C. or shortly thereafter something began to happen at Franchthi. There is no marked discontinuity in the occupational sequence, but the materials excavated from these levels differ in many respects from anything found in earlier ones (Jacobsen 1976: 82).

The fauna and flora show conspicuous differences (Appendix 5, Table XLII and Appendix 7, Table LXIII). For the first time domestic sheep, goats and pigs appear in the bone sample. Wild goats disappear and possibly wild swine as well. Cattle bones were discovered in the deposits but it is unclear if these were wild or domestic.

The wild grains and legumes found in pre-Neolithic levels at Franchthi Cave were replaced by domesticated grains, particularly emmer wheat, and hulled two-row barley and by domesticated lentils.

A changed technology accompanied the economic changes. Ground and polished celts and millstones appeared

and studies of the flint blades recovered show sickle gloss (Table I).

During the Neolithic the area of occupation at Franchthi Cave increased, spreading beyond the limits of the cave itself. The possibility of craft specialization has been suggested for the earliest Neolithic level at Franchthi Cave. Tools used to manufacture shell beads along with the finished products were found in certain deposits outside the cave (Jacobsen 1976:84).

The Aceramic Period

Probably the earliest purely Neolithic site in the Balkans is Argissa, Thessaly, for whose aceramic level a radio-carbon date of 6180 ± 100 b.c. has been calibrated, according to the Suess curve, at 7200 B.C. (Milojčić 1973:250). At Knossos there is an aceramic date of 6100 ± 180 b.c. The earliest date at Sesklo is 5805 ± 97 b.c., at Maroula 5925 ± 500 b.c., and at Franchthi Cave 5844 ± 140 b.c. (Appendix 3, Table XIV).

1. Argissa: At Argissa elliptical pit dwellings with walls and roofs of perishable materials were discovered. Some contained hearths and pebble floors (Theocharis 1974:60). The settlement on the Peneios river was built on a natural knoll above the river's floodplain. The use of low knolls for locating settlements during the Neolithic was very common (Heurtley 1939)

and suggests that seasonal flooding may have been frequent.

The stone technology at Argissa consisted of blades, scrapers, borers, and microburins made from either flint or Melian obsidian. Some blades had a silica sheen indicating their probable use in wood or bone sickles. Awls, points, graters and polishers were created from bone (Milojčić 1960:325,327). Interestingly no stone axes were found at Argissa (Murray 1970:19), (Table II).

Argissa's location was well suited to a farming and herding economy. Only two per cent of bones and twenty-seven per cent of individuals found in the aceramic level here were from wild animals (Appendix 5, Tables XLI and XLII). Of domestic species sheep and goat bones were the most common. The plant sample consisted of wheat, barley, vetch and millet (Jane Renfrew 1966:24).

A quantitative breakdown of seed remains from the aceramic levels at the sites of Sesklo and Ghediki (Appendix 7, Tables LXI and LXII) indicate that emmer wheat was possibly of greater importance than the other grains. A very high proportion of pistachio nuts, over ninety per cent, at Sesklo is particularly interesting. Jane Renfrew (1973b:28) believes these to have

TABLE II COMPARISON OF ACERAMIC, EARLY, MIDDLE AND LATE NEOLITHIC TECHNOLOGIES OF GREEK SITES

	<u>ACERAMIC</u>	<u>EARLY NEOLITHIC</u>			<u>MIDDLE NEOLITHIC</u>				<u>LATE NEOLITHIC</u>			
	Argissa	Nea Nikomedeia	Knossos	Servia	Sesklo	Tsani	Tsangli	Zerelia	Dhimini	Servia	Olynthus	Saliagos
<u>TOOLS</u>												
<u>Raw Materials</u>												
Flint	x	x	x	x	x	x	x	x(scarce)	x	x	x	x
Obsidian	x	-	x		x	x	x	x	x	x		xx
Sedimentaries		x										
Chert		x					x					
Other		x	x	x(Greenstone)						x(Quartz)	x(Quartz)	x
<u>Chipped Stone</u>												
Microliths	x		x		-							
Blades	x	x		x	x	x	x	x		x	x	x
Sickle Blades	x											
Borers	x											
Points									x			x(tanged)
Ovates												x
Flakes		x				x		x				x
Triangular Points									x	x		x
<u>Polished Stone</u>												
Club heads									x			
Axes		x	x(rare)									x(small)
Adzes		x										
Celts	-			x		x	x	x	x	x	x	
Chisels		x		x	x	x	x	x			x	
Stone Studs		x										

	Argissa	Nea Nikomedeia	Knossos	Servia	Sesklo	Tsani	Tsangli	Zerelia	Dhimini	Servia	Olynthus	Saliagos
<u>Ground Stone</u>												
Hammers	x			x		x	x	x		x		
Pounders						x	x	x	x		x	
Querns/Mortars	x			x		x	x	x	x	x	x	x
Polishing Slabs	x			x		x		x				
Wedges				x						x		
<u>Bone</u>												
Chisels												
Points			x									x
Needles			x	x				x				x
Awls				x		x		x				
Spatulae			x									x
Polishers				x								
Gouges				x								
<u>Pebble</u>												
Waisted Pebbles					x(axes)							x(weights)
<u>Horn</u>												
Sleeves				x								
Hammers						x		x				
Picks								x				
<u>Clay</u>												
Loom Weights			x		x							
Spindle Whorls	x		x	x	x	x	x	x	x	x	x	x
Sling Bullets	x				x	x	x	x	x		x	

x = present xx = most frequent - = definitely absent

been a supplement to a diet based on grains. In the Near East these tiny nuts are still considered a delicacy (Jane Renfrew 1973b:28).

Aceramic sites in Greece were distinctly Neolithic in economy. They are set apart from the early Neolithic sites which follow only by their lack of pottery, their use of perishable building materials, and a technology in which microliths played a greater role than was later to be the case and in which stone axes were still rare. In addition the settlements of the aceramic period were smaller than those which followed them.

The Early Neolithic

In contrast to sites of the aceramic period, which so far have been found only in Greece, early Neolithic sites have been found throughout the Balkans. Uncalibrated radio-carbon dates for the beginning of the early Neolithic in Greece range from 6215 ± 150 b.c. at Nea Nikomedeia to 5620 ± 150 b.c. at Knossos. In the remainder of the Balkans dates range from 5353 ± 150 b.c. at Tell Azmak to 4655 ± 100 b.c. at Deszk-Olajkút in Hungary. But the majority of dates in the Balkans outside of Greece range from a little earlier than 5300 b.c. to a little later than 5200 b.c. (Appendix 3, Table XIV). These dates are interesting in that they show that while

early Neolithic sites appeared in Greece somewhat earlier than seems to have been the case in the rest of the Balkans, the first appearance of Neolithic sites from southern Yugoslavia and Bulgaria to northern Yugoslavia and Hungary seems to have occurred almost simultaneously. When one considers that from the Greek border to southern Hungary is a distance of about six hundred fifty kilometres and that the lateral distance is almost as great, this fact argues for a strong integration of a pre-Neolithic community in the Balkans.

All of the early Neolithic sites provide evidence of an organized village life. In Greece, Bulgaria and southern Yugoslavia rectangular surface dwellings of mud brick or of wattle and daub replaced the pit dwellings of earlier levels.

1. Greece: i. Nea Nikomedeia: At Nea Nikomedeia in Greek Macedonia a settlement was created on a small knoll not far from the sea. Although today the foundations of the site are waterlogged it seems likely that during the Neolithic it was dry. At the time the site was occupied sea level was probably considerably lower than at present (Bintliff 1976:245). Bintliff (1977:10-26) claims that there has been a rise of six to nine metres

in the level of the Aegean since the Neolithic. Consequently it is likely that some prehistoric sites have been drowned by rising sea levels, while others like Nea Nikomedeia are now waterlogged. Marshy areas useless for agriculture may once have been fertile fields.

On one side Nea Nikomedeia was bordered by a lake, on the other it was protected by two concentric walls (Rodden 1965:83). The site covered an area of about twenty-four hundred square metres, and consisted of small rectangular mud huts constructed on a framework of posts. One house, larger than the other, was divided into three rooms and contained figurines of women. It is believed that it may have served some ritual purpose (Rodden 1965:84).

The tool kit consisted of polished stone axes, adzes and chisels of marble or serpentine, as well as hammerstones, querns, mortars, and polishing slabs of basalt, schist, granite, sandstone and limestone (Rodden 1962:279). The chipped stone industry of flint and chert consisted mostly of blades and utilized flakes. No obsidian was used. There were also clay sling-stones, spindle-whorls, and reed matting (Rodden 1962:286), (Table II).

The site was surrounded by rendsina soils, the preferred soil type of Neolithic farmers (Bintliff 1976: 252). The frequency of seed finds from Nea Nikomedeia

indicates that of the grains emmer wheat and naked six-row barley predominated. But lentils appear twice as frequently as either wheat or barley and thus must have played a very important dietary role (Van Zeist and Bottema 1971), (Appendix 7, Table LX).

The faunal remains from Nea Nikomedeia have not been quantified, but Higgs (1962:272-273) offers as evidence for the domestication of sheep and goats, cattle, and pigs, the large number of immature animals represented in the bone sample (Appendix 5, Table XLIV).

At Nea Nikomedeia pottery appeared in Greece for the first time. It was mostly a coarse hand made ware but there was also a white painted ware with red decoration (Rodden 1962:281-284).

ii. Lerna: In the Peloponnese the best known early Neolithic site is Lerna. This tell lies on the plain of Argos and is well supplied with spring water. The early Neolithic level is waterlogged. Houses were rectangular and constructed on stone foundations (Caskey 1969:ii).

Evidence from Lerna (Appendix 5, Table XLV) indicates that sheep and goats were the most numerous of domesticated animals. It is interesting to compare this with the very small faunal sample from early

Neolithic levels at Argissa, which shows a shift at this time towards a preference for pigs (Appendix 5, Tables XLI and XLII). The sample is so small, however, that one might question its validity, particularly as at no other early Neolithic site in Greece do pigs seem to have been so important.

iii. Knossos: At Knossos fired brick architecture replaced huts of perishable materials on the knoll above the Kairatos river, and the settlement was larger. It had become a real village instead of just a herders' camp (Theocharis 1974:82).

The technology from Knossos can be seen in Table II. The small stone axes were rare and only three bone spatulae were found in the early Neolithic levels to which they were restricted (J.D. Evans 1968:270-271).

The pottery was uniform in texture and design throughout the Neolithic, but increased in quantity as the Neolithic progressed (Sakellarakis 1973:132).

2. Bulgaria: i. Karanovo and Tell Azmak: The early Neolithic of Bulgaria and southern Yugoslavia is very similar to that of Greece. At Karanovo, probably the best known of Bulgarian sites, there are two early Neolithic levels. They form the base of a large tell near Nova Zagora in the northeast at the foot of the Sredna

Gora (Mikov 1959:89). The site was located on a diluvial fan with excellent soils and was well supplied with water. It is estimated that there were about sixty houses in the early Neolithic settlement (Piggot 1965:-7). These were constructed in parallel rows separated by a planked street (Dennell 1978b:4). Some houses contained hearths and ovens. In other cases these were outside.

The technology at Karanovo as outlined by Mikov (1959:92) can be seen in Table III. One of the more interesting finds from this site was an antler sickle with the inserted blades (Tringham 1971:39).

Near Karanovo in the Marica Valley was Tell Azmak, "circular in plan and surrounded by a wall of stamped clay 1 m wide which supported a palisade (Mellart 1975: 255)." Inside the wall the site was built of the same materials as Karanovo and organized in much the same way (Mellart 1975).

ii. Goljamo Deltschevo

Goljamo Deltschevo in the Stara Planina suggests a social organization different from that of the early Neolithic sites of the Marica valley. Here the buildings formed a semi-circle along the bank of the Luda Kamčija river near Tsonevo. The wattle and daub buildings

TABLE III COMPARISON OF EARLY, MIDDLE AND LATE NEOLITHIC TECHNOLOGIES OF THE BALKANS EXCLUDING GREECE

	EARLY NEOLITHIC			MIDDLE NEOLITHIC		LATE NEOLITHIC				EN - LN	
	Valea Răii	Chevdar	Starčevo	Vinča	Vădastra	Divostin	Gumelnita	Căscioarele	Hordistea	Karanovo	Anza
<u>TOOLS</u>											
<u>Raw Materials</u>											
Flint	x		x	x			x	x	x	x	x
Obsidian		x	x	x	x(rare)	x(rare)					-
Chert						xx					x
Other			x(slate)	x	x		x(copper)		x	x(copper)	x
<u>Chipped Stone</u>											
<u>Microliths</u>											
Points						x					
Blades		x	x	x	x	x	x	x	x	x	x
Sickle Blades	x									x	x
Axes							x	x	x		
Scrapers				x					x		
Borers				x	x		x	x			
Hammers					x		x	x			
Awls							x				x
Flakes						x					
<u>Polished Stone</u>											
Axes					x		x		x	x	x
Adzes										x	
Celts		x	x	x		x					
Chisels											x
Gouges						x					

	Valea Răii	Chevdar	Starčevo	Vinča	Vădastra	Divostin	Gumelnita	Căscioarele	Horodistea	Karanovo	Anza
<u>Ground Stone</u>											
Pounders							x				
Picks										x	
Querns/Mortars		x	x		x		x				
Polishing Slabs							x				
<u>Bone</u>											
Chisels	x				x				?		
Wedges				x							
Points					x						
Awls	x									x	x
Spatulae	x	x	x					x		x	x
Borers	x			x							
Knives									x		
<u>Horn</u>											
Harpoons				x			x	x			
Picks						x	x				
Hammers											
Sickles		x									
Plough								x			
Multipurpose								x		x	
<u>Clay</u>											
Loom Weights					x			x		x	x(LN)
Sling Bullets										x	x(LN)
Spindle Whorls		x	x					x		x(LN)	x(LN)

	Valea Răii	Chevdar	Starčevo	Vinča	Vădastre	Divostin	Gumelnita	Căscioarele	Horodistea	Karanovo	Anza
<u>Copper</u>											
Pins						x					x(LN)
Fishhooks						x					x(LN)
Axes									x(1 only)		

x = present
 xx = most frequent
 - = definitely absent

were of two types, some small and others large and trapezoidal in form with interior divisions (Todorova 1973:226-227).

There is unfortunately no early Neolithic economic data available from this site but the late Neolithic economy relied heavily on wild animals. They make up over forty per cent of the identifiable bone remains from that period (Todorova 1978:58).

A lack of quantified economic data from all but three early Neolithic sites of Bulgaria makes it difficult to relate differing settlement patterns to the economy.

iii. Kazanluk and Chevdar: These two sites provide the only faunal information for the period. Kazanluk and Chevdar are located in the Stara Planina away from the Marica valley where the majority of Bulgarian sites are located. In both cases wild animals played an important role in the economy (Appendix 4, Table XX). It is uncertain, however, whether the swine in the samples were domesticated or not. Dennell believes them to have been wild (1978b:124,246). A comparison of the number of bones and teeth of the different animal species found at Kazanluk in early, middle and late Neolithic levels is provided in Appendix 5, Table XXXIX.

The only quantified floral evidence for Bulgaria comes from Tell Azmak, where in early Neolithic levels emmer and bread wheats seem to have been of about equal importance and the grass pea was found in quantity (Appendix 7, Table LIV). However, judging from the wide variety of plant species found at Chevdar and Kazanluk a number of different plant species were used (Appendix 7, Tables LV, LVI and LVII).

3. Jugoslavia: i. Anza: In Jugoslav Macedonia early Neolithic sites are much like those of Greek Macedonia. Anza is the most fully excavated and published of the Jugoslav sites. The economy here was based almost exclusively on domesticated animal species. The site though not forming a massive tell continued in existence for about a thousand years. It was a large site covering more than four and a half hectares and possibly containing as many as two or three hundred houses during the early Neolithic. Houses were of mud brick with tamped earth floors (Gimbutas 1976:34).

The chipped stone industry consisted of end, disc, and side scrapers, awls, blades and multipurpose tools of jasper and volcanics (Elster 1976). There were backed blades with a silica sheen suggesting their use as harvesting tools, bone awls, a spatula and two fragments

of musical pipes (Smoor 1976:189), (Table III).

Anza and Rug Bair both located in the Ovčje Polje south of Skoplje had similar economies, with sheep and goat the predominant domestic animal species and very limited numbers of wild animal remains (Appendix 4, Table XX and Appendix 5, Tables XXXII and XXXIII). The floral remains from Anza indicate that emmer wheat was likely the most important of the grains, followed by club wheat and six-row barley (Appendix 7, Table LIII).

ii. Obre 1: In Bosnia, Obre 1 on the Trstionica river, a tributary of the Bosna, provides the best information about early Neolithic settlement in that area. There were rectangular houses with walls of clay daub supported by wooden posts and a large house on a stone foundation (Gimbutas 1970:290). Flint and stone tools were few in number but bone awls and polishers were frequent as well as spatulae and pins.

Pottery was mostly plain ware consisting of large storage vessels and dishes (Gimbutas 1970:290). Wild animals were important in this economy but domestic animals, especially cattle, the bones of which formed forty-eight per cent of the identified faunal sample, were of primary importance.

4. Northern Yugoslavia and Hungary: In northern Yugoslavia and southern Hungary early Neolithic

settlements were located on riverbanks or on low river terraces (Galović 1962-63:1; Tringham 1971:91; Berciu 1967). In Hungary a westward expansion of early Neolithic settlement was prevented by the infertile sand hills which lie between the Tisza and Danube rivers (Bognár-Kutzián 1966:250; Kosse 1979:94).

North of the Danube early Neolithic sites are known primarily from surface scatters (Barker 1975:100) so that very little can be said about the organization of settlements. But Banner (1942:17) describes the Körös sites of Hungary as being large and spread out. In two sites, which he does not name, the remnants of burnt beams and plaster fragments permitted a description of the probable hut type. According to Banner:

The men of this culture lived in huts which had no walls, but only a roof. The entrance was in all probability covered with animal pelts and opened towards the south. The roof rested on a shelf whose outer and inner sides were covered with clay. In the middle of the hut was a hearth (1942:17 -- my translation from the German).

This description of a Körös house is quite different from diagrams of huts from Rösske-Ludvár and Tiszajena found in Tringham (1971:85). These diagrams show rectangular wattle and daub huts.

The toolkit from imported raw materials consisted of shoelast and trapezoidal celts, grindstones, bone

knives, awls, borers, spatulae, harpoons and fishhooks and clay spindle whorls, net and loom weights. Storage jars were formed by lining holes dug in the ground with clay (Banner 1942:17-18; Draga Garasanin 1970:9-10).

i. Starčevo: The eponymous site of the early Neolithic in the northern Balkans is Starčevo on the north bank of the Danube near Pančevo. The site is located on the edge of a flat level plain into which the Danube has cut. The original settlement seems to have consisted of oval pit huts with a superstructure of wattle and daub, reminiscent of the aceramic settlements of Greece (Fewkes et al. 1933b:41-42).

The technological remains from Starčevo can be seen in Table III. Despite the likely importance of fishing at this site no harpoons, fishhooks or netweights have been found in the early Neolithic levels.

Few floral data from the north Balkan sites are available. On the other hand, thanks to the work of Bökönyi, there is a great deal of faunal information. In Table LII of Appendix 7 the only quantified floral data presently published for early Neolithic sites of the north Balkans are provided. Einkorn wheat appears with greatest frequency, but a large part of the sample is only identified as cultivated cereal.

Quantitative breakdowns of the entire faunal samples from three Hungarian and two Jugoslavian sites are provided in Tables XXVI to XXX of Appendix 5. In addition to outlining the primary faunal food sources, these tables indicate that the staples were supplemented by a large variety of casual resources.

In comparison with the more southerly sites the reliance on wild animal species is marked. Among domestic animals, however, sheep and goats predominated as they did throughout the Balkans at this time. But cattle instead of pigs took second place among domestic species in the north while the reverse was true in the south.

The Middle Neolithic

The earliest radio-carbon dates for the middle Neolithic in Greece range from 5560 \pm 50 b.c. at Achilleion to 4675 \pm 170 b.c. at Sitagroi and the latest dates are 4080 \pm 130 b.c. at Sitagroi and 3572 \pm 88 b.c. at Knossos. In Bulgaria dates range from an earliest date of 4851 \pm 100 b.c. at Karanovo to a latest date of 4130 \pm 80 b.c. at Jaso Tepe, and in Jugoslavia from 5130 \pm 60 b.c. at Anza to 4150 \pm 100 b.c. at both Medvednjak and Staro Selo. The only middle

Neolithic date from Hungary is 4100 ± 100 b.c. at Oszentivan VIII. There are no dates for the period from Roumania.

1. Greece: According to Weinberg (1965:292) a difference in pottery style was the most obviously new item to appear in the middle Neolithic of Greece. Chief among the new wares was the Neolithic Urfirnis ware, a thoroughly fired pottery decorated with simple linear patterns. In addition building methods and town planning became more complex (Theocharis 1973:60). But Theocharis stresses the "progressive" rather than radical characteristic of the Greek middle Neolithic (1973:60).

i Sesklo: In Thessaly the middle Neolithic culture takes its name from the site of Sesklo. This settlement was built on top of a low flat hill and contained between thirty and fifty dwellings in an area of twenty to twenty-five acres (Wace and Thompson 1912:58). The hill stands at the foot of wooded mountains in the Thessalian plain and projects steeply between two streams which have washed away perhaps half of the site (Theocharis 1974:68). The west side of the acropolis away from the streams was fortified (Theocharis 1974:69).

Houses of mud brick on stone foundations were constructed both inside and outside the acropolis (Theocharis 1973:66). These small huts, usually containing

only one room were frequently repaired and rebuilt. The central building of the acropolis was a megaron, larger than the other huts. A two room hut has been identified as a pottery workshop. Houses were constructed in parallel lines separated by narrow roads (Theocharis 1973:65-66).

The technology consisted of flint and obsidian blades (Table II). Microliths were absent, but according to Theocharis, "Polished axes and chisels and bone tools become standardized (1973:68)."

Theocharis (1973:68) suggests that there were between three and four thousand inhabitants at Sesklo during the middle Neolithic. If this estimate is correct then Sesklo must be considered a small town and not a mere farming village.

There are no available economic data from Sesklo, but a faunal breakdown for the Thessalian sites of Sitagroi, Otzaki and Achilleion is provided in Appendix 4, Table XXI. It must be noted, however, that the information for Sitagroi includes both middle and late Neolithic levels. A comparison of the faunal remains discovered in the four middle Neolithic levels from the site of Otzaki can be seen in Appendix 5, Table XLVII. As was the case in the early Neolithic sheep and goats were the animals found most frequently in these faunal samples, and wild animal species were rare. Unfortunately

no quantitative floral data are available from this period in Greece.

ii. Lerna: In the Peloponnese Lerna showed development similar to that of Sesklo. Houses were of mud brick on stone foundations with floors of trodden earth covered with clay and were frequently repaired and rebuilt (Weinberg 1965:293-294). The economy as in the Thessalian sites was based on sheep and goats, but molluscs were an important gathered food source (Appendix 5, Table XLV).

iii Knossos: Knossos showed similar signs of development. The area covered by the site increased. The buildings of pisé on stone foundations were larger than those of the earlier settlement and were renewed or rebuilt from time to time (J. Evans 1974:107). Floors were clay covered and there were permanent hearths (Theocharis 1974:82). The most interesting structure from this period was a complex of several joined but irregularly placed rooms, interspersed with pebbled courtyards (Theocharis 1974:82). By the late Neolithic the majority of buildings were arranged in this fashion with only a few isolated structures (Colin Renfrew 1972: 80).

During the middle Neolithic the number of sites in Greece increased greatly. In the rest of the Balkan

peninsula the number of settlements also increased. But unlike Greece for the most part the size of already established villages remained relatively unchanged.

2. Bulgaria: In Bulgaria the middle and late Neolithic were periods of "profound stability and continuity (Dennell 1978b:6)." The same words could equally be used to describe southern Yugoslavia at this time.

The middle Neolithic seems to have brought greater change to the most northerly regions of the Balkans than it did to Bulgaria or southern Yugoslavia, but continuity can be seen in these regions too.

i. Karanovo and Tell Azmak: At Karanovo the number of houses remained at about sixty indicating that the population size was relatively static within the site (Clark and Piggott 1965:234; R.K. Evans 1973). The only change in the dwellings was a modest increase in their size. In the latest phases there were some two room megaron buildings (Clark and Piggott 1965:234).

Little is known about the economy but barley appeared in the floral remains of Karanovo for the first time during the middle Neolithic (Dennell 1978:187; Gimbutas 1972:27), and among animal remains the bones of cattle were common (Mikov 1959:94).

The floral remains from early, middle, and late Neolithic levels at Tell Azmak can be compared in Appendix 7, Table LIV and in Appendix 6, Tables XLVIX to LI. There are some important differences between the tables because of the samples used. The tables of Appendix 6 combine quantified and unquantified information while Table LIV uses only quantitative data.

3. Jugoslavia: i. Anza: In Jugoslavia the middle Neolithic settlement at Anza was smaller in area than the previous settlement had been. The houses were now of clay daub on a framework of thin round posts and were slightly smaller than formerly. The economy shows no evidence of change (Appendix 7, Table LIII, Appendix 5, Tables XXXII and XXXIII). And the technology and pottery remained much like those of the previous period (Gimbutas 1976:34,37).

The middle Neolithic in the northern Balkans is generally referred to as Vinča in Jugoslavia, as Tisza in Hungary and as Vădăstra I or Dudești in Roumania. Sites occupied similar habitats to those which preceded them and in Jugoslavia were frequently continuations of earlier Starčevo sites. But in Roumania and Hungary there were seldom middle Neolithic levels above the Criș or Körös occupations.

ii. Vinča: The site of Vinča was on a ridge of loess above the Danube. A small stream beside the site provided an excellent water supply (Childe 1929:26). Above the pit dwellings of the early Neolithic were constructed rectangular houses of wattle and daub (Childe 1929:27).

The technology consisted of numerous celts, flint blades, end-scrapers, and borers, bone wedges and borers, and antler harpoons, which Childe suggests were used in fishing (1929:29-30), (Table III).

4. Roumania: i. Vădăstra: In Roumania the middle Neolithic is represented at Vădăstra, a site lying on an old terrace of the Danube, where rectangular wattle and daub surface huts have been found overlying early Neolithic oval pit huts. The chipped stone tools at Vădăstra were mostly of Chalcedony but obsidian was also used. Only ten per cent of the retrieved material was in the form of finished tools. The variety of reported tool forms is shown in Table III.

Barley and wheat, cattle, sheep and goats formed the basis of the economy. More than fifty per cent of the bone sample here is derived from cattle (Mateescu 1965:259). The bones of carp and, according to Mateescu (1965:259) of the domestic horse were also discovered. Unfortunately

the relative proportions of wild and domestic animals is not known.

5. Hungary: The middle Neolithic settlement pattern in Hungary is no better known than that of the early Neolithic. Banner (1942) says that the buildings and culture differed little from those which preceded them. Riverbanks continued to be the preferred locations for settlement. Such locations offered easy access to the rich fish resources of the rivers and were also well suited to the hunting of wild game (Banner 1942:32).

While there may be little cultural change between the early and middle Neolithic periods of this region there is an important change in the economy. During the early Neolithic sheep and goats appeared with greater frequency in the faunal samples than did cattle, which took second place among domestic animal remains at that time. But during the middle Neolithic the situation was reversed. In fact pig bones appeared more frequently in the samples from this period than did those of sheep and goats (Appendix 4, Tables XX and XXI). Wild animal species continued to be important in these northern settlements (Bökönyi 1974).

The Late Neolithic

Except in Greece the late Neolithic was a period of stability with change occurring only gradually. But in

Greece the area of settlement was expanded and in Thessaly present evidence indicates a marked change from the previous period.

The radio-carbon dates for the late Neolithic in Greece range from an earliest date of 4850 b.c. at Kitsos to a latest date of 2876 ± 56 b.c. at Kephala, in Bulgaria from 3938 ± 100 b.c. at Tell Azmak to 3055 ± 150 b.c. at Karanovo and Tell Azmak, in Roumania from 4030 ± 100 b.c. at Căscioarele to 2110 ± 160 b.c. at Baia-Hamangia and in Jugoslavia from 4365 ± 100 b.c. at Grivac to 3300 ± 100 b.c. at Divostin.

1. Greece: i. Saliagos: In Greece during the late Neolithic a number of settlements grew up in the islands of the Aegean, where previous Neolithic or Mesolithic settlements are so far unknown. Chief among these late Neolithic sites are Saliagos and Kephala. The island sites had a distinct technology. At Saliagos the technology consisted of a chipped stone industry containing tanged points, ovates, triangular points, flakes and blades, slugs, burins and discs (Table II). The raw material used was primarily obsidian. In addition there were small stone axes, bone points, chisel ended tools and spatulae, shell spoons and scoops, potsherd burnishers, clay rods, spindle whorls, discs of clay and stone, waisted weights,

mortars, querns, pestles and rubbers (J.D. Evans and Colin Renfrew 1968:46-71).

This toolkit, the large number of fish bones found among the faunal remains from Saliagos and other island sites and their maritime locations suggest that fishing was a major occupation at these so-called Saliagos culture sites.

On the basis of estimated meat weights (Appendix 5, Table XLVIII) J.D. Evans and Colin Renfrew (1968:79) indicate that tunny and other fish were important food sources at Saliagos. Of cultivated plants hulled two-row barley and wheat were certainly used there (Jane Renfrew 1968:139-140).

ii. Dhimini: In Thessaly the late Neolithic culture takes its name from the site of Dhimini.

But this culture, whose importance was over-emphasised in the past, and which was once regarded as synonymous with the Late Neolithic for Thessaly, is rather a local phenomenon confined to the east part of the region (Theocharis 1973:91).

Nevertheless, Dhimini is an interesting site and seemingly quite different from the sites which preceded it in eastern Thessaly. It was a fortified acropolis built on a natural mound in the plain near the foot of the mountains (Wace and Thompson 1912:75). The area of the settlement was almost ten thousand square metres. It was surrounded by a series of six concentric

fortification walls, inside the last of which was a central courtyard and megaron. According to Theocharis, "The settlement itself must have lain outside the acropolis (1974:79)." Inside the outer wall a potter's kiln has been discovered. This, Catling (1979) claims, is evidence of high craft-specialization rather than of a cottage industry.

The minimal technological information from Dhimini is outlined in Table II.

iii. Sesklo: At Sesklo after the destruction by fire of the middle Neolithic site and some five centuries later a settlement arose which was similar to that at Dhimini (Theocharis 1973:90). The fortifications here consisted of three concentric walls, in the centre of which was a large megaron.

The floral remains from Sesklo were quite varied. Emmer wheat, which appeared in large unmixed samples (Jane Renfrew, 1973a:162), was probably the staple grain.

A number of Thessalian sites were destroyed at the end of the middle Neolithic. At the same time middle Neolithic painted wares disappeared. For these reasons plus the appearance of new Dhimini wares, characterized by meanders, chessboard, and step patterns (Theocharis 1973:102), it was believed that the Dhimini culture was introduced to Greece from outside the Balkans.

While this point of view cannot be rejected it is perhaps wiser at present to await further excavations before looking for the source of the tradition, particularly since no comparable site destruction seems to have occurred elsewhere in the Balkans at this time.

A further interesting and unexplained development in Greece during the late Neolithic was an increasing use of caves, both on the mainland and in Crete (Theocharis 1973: 90).

While there is some evidence for a changing settlement pattern in late Neolithic Greece, the subsistence economies remained unchanged, continuing to rely on sheep and goats, grains and legumes (Appendix 4, Table XIX, Appendix 6, Table LI).

2. Bulgaria: i. Karanovo: In Bulgaria the gradual changes begun in the middle Neolithic continued. Buildings were larger than they had been and the two room megaron style of building had become common at Karanovo (Piggott 1965:49). There is some evidence for the development of craft specialization. One structure at Karanovo contained more than one hundred pots and another with several crucibles is thought to have been a metallurgy workshop (R.K. Evans 1973:78,89, 1978:118). For the

first time copper items such as pins and fishhooks appeared.

ii. Polyanitsa: A good example of the scale of organization of late Neolithic settlements in Bulgaria is provided by the site of Polyanitsa, where three parallel wooden palisades forming a rectangle enclosed the village of about thirteen hundred square metres. There were entrances in each of the four walls, with streets leading from each and meeting at right angles in the centre of the site. The wattle and daub houses contained as many as three rooms. As the settlement developed they became more crowded and the spaces between them almost disappeared (Todorova 1978:48-50).

A necropolis was associated with the mound. Such necropoli were not at all uncommon during the late Neolithic in Bulgaria and southern Roumania. The best known are those at Varna near the Black Sea and at Cernica and Cernavoda in Roumania. At Varna, Todorova (1978:77) says that the distribution of grave goods "point to a considerable social, sex and age differentiation." And R.K. Evans (1973:131) mentions an uneven distribution of grave goods at Cernica.

The amount of economic data available for Bulgaria is small so it is difficult to ascertain if there were

any major changes in the economy during the late Neolithic. Todorova (1978:60) claims that in Bulgaria cattle were the most important of domesticated animals in all investigated sites, but the evidence from Kazanluk is contradictory (Dennell 1978b:267), Appendix 5, Table XXII). Unquantified lists of the animals found in several late Neolithic sites in Bulgaria can be found in Appendix 5, Tables XXXIX and XL.

3. Jugoslavia: i. Anza: At Anza in Jugoslavia the size of the site increased greatly in the late Neolithic but the technology (Elster 1976), economy (Appendix 7, Table LIII, Appendix 5, Tables XXXII and XXXIII), and construction techniques remained much as they had always been. The major difference between this level and earlier ones was in the style of pottery (Gimbutas 1976).

ii. Divostin: At Divostin south of Belgrade a settlement consisting of rectangular houses laid out in regular rows was found. The longest house contained three hearths. This settlement was occupied in the early Neolithic but according to McPherron and Srejović (1971:9) "the mode of settlement was quite different in the two phases." The Starčevo houses "appear to have been much less massive, perhaps less permanent (McPherron and Srejović (1971:9))."

The technology consisted of a chipped stone industry of flakes, blades, and microblades, many of which showed sickle gloss. There were ground stone axes or adzes and gouge forms. The main raw material was chert but a few pieces of obsidian were found (McPherron and Srejović 1971:6). The bone and antler industry consisted of shaft-hole picks or hoes, shaft-hole sockets probably for the ground stone axes and other bluntly pointed tools (Table III). The ceramics had impressions of woven fabrics. A few beads and some small shapeless lumps of copper were also found. As in the early Neolithic level at this site the best represented animal species in the faunal sample was cattle (McPherron and Srejović 1971:12).

iii. Obre 11: In Bosnia the site of Obre 1 was abandoned and Obre 11 established. The faunal remains here showed little change from those of the earlier site (Sterud 1976:240). Wheat, barley and legumes made up the floral remains (Jane Renfrew 1976:312).

iv. Copper and Flint Mining Sites: There is evidence in both Bulgaria at Aibunar and Nedoklan and in Yugoslavia at Rudna Glava and Čakmaklāk for settlements which were not simply communities of subsistence farmers (Jovanović 1971, 1973, 1976, 1979, 1980; Jovanović and Ottaway 1976; R.K. Evans 1973; Černych 1978).

At Aibunar and Rudna Glava copper ores were mined. Neither of these sites is located in a place suitable for agriculture. Ore from Aibunar has been analyzed and the copper ores found in some Bulgarian settlements have been shown to originate in this mine (Černych 1978: 203). Čakmaklák near Novi Pazar and Nedoklan near Razgrad were flint mining sites (R.K. Evans 1973:103).

4. Roumania: In Roumania little is known about earlier settlement but a number of late Neolithic sites have been described. These show considerable variation.

In Moldavia are found sites of the Cucuteni cultural tradition which extends into the Ukraine. These are large sites usually built on promontories, with their limits on the landward side marked by ditches (Gimbutas 1978:230; Tringham 1971:167). Houses were frequently arranged in concentric circles (Gimbutas 1978:230). The typical Cucuteni house was large. At Dimbul Morii the largest contained seven fireplaces with large hearths constructed on platforms of river pebbles and was likely divided into several rooms (Petrescu-Dîmbovita 1965:247). The settlement itself covered an area of more than eighteen hundred square metres.

i. Habașești: Another Cucuteni site which has been well described is Habașești. The houses of wattle and daub with reed and thatch roofs were constructed on

a foundation of clay covered tree trunks. Most buildings were four or five metres by eight or nine metres but in the centre of the settlement were two larger buildings (Daicoviciu and Condurachi 1972:56). The houses were all arranged in circles (Berciu 1967:62) and the whole was defended by a ditch (Condurachi 1964:56).

At Cetatuia, a riverside site, among the faunal remains were fish bones (Murray 1970:330-331). The relative quantities of bone remains is unknown but Tringham (1971:168) mentions that fishing and shell collecting were important at such sites. However at upland sites there is no evidence for fishing.

Quantified faunal information is available from three Cucuteni sites, Traian, Troyanov, and Techirghiol. In all three cattle were the most important of domestic animals. Wild and domestic animals were, according to Tringham (1971:169), of about equal importance in Cucuteni sites, but the information from Tangîru and Techirghiol does not support this claim (Appendix 4, Table XXII). Virtually nothing is known about the plants used in north-east Roumania. The only floral information for Cucuteni sites comes from Habaşesti, where club and bread wheats were discovered as well as vetch (Murray 1970:334).

ii. Gumelnița: In southern Roumania the late Neolithic culture takes its name from the large site of Gumelnița (Dumitrescu 1966:163). This site covering about two hectares was built on an old terrace of the Danube. The economic information from the site indicates that among domesticated animals cattle predominated (R.K. Evans 1973:125). Copper fishhooks attest the importance of fishing. In two houses vases filled with carbonized wheat were found (Dumitrescu 1925).

The stone technology from Gumelnița is known from more than nineteen hundred pieces (Table III).

Settlements of the Gumelnița culture were typically located in low lying areas with watercourses on more than one side (Berciu 1967:60), and were fortified by either a ditch alone or by a ditch and rampart (Berciu 1967:56).

iii. Căscioarele: At Căscioarele, on a small island less than one hundred metres square in Lake Cașalui, sixteen rectangular huts of wattle and daub supported by large posts were found. There seems to have been no particular village plan but the north-west part of the island had not been built upon. R.K. Evans (1978: 121) claims that evidence for craft specialization was found in a hut containing the raw materials, finished artefacts, and tools needed to manufacture chipped stone

implements, and in another containing a large number of clay loom and fish net weights. Among the tools discovered were flint axes, hammerstones, blades, scrapers, triangular arrowheads, a plough of horn (Dumitrescu and Bănăţeanu 1965:38), and a barbed antler spearhead (Table III). All dwellings contained stone querns.

More than eighty per cent of the animal species represented in the bone sample at Căscioarele were wild. Most important of these were deer. Among the few domesticated animals cattle and dogs occurred most frequently. A large number of horse bones were discovered too, but these have been tentatively classed by Dumitrescu (1965:40) as wild.

Although Dumitrescu mentioned that no plant remains were preserved, Murray (1970:333) claims wheat was found in this site.

Hungarian late Neolithic sites have not been included in the study since the Linear Pottery cultural tradition which varied considerably from the cultural traditions of south-eastern Europe, covered the whole of the Pannonian plain at this time as well as spreading throughout central Europe.

Summary

The foregoing survey of sites in south-eastern Europe illustrates that over the thirty-five hundred

years or so of the Neolithic there was a gradual transition towards greater complexity in settlement pattern and social organization. At the beginning of the period there is little evidence of social differentiation but by the end of the Neolithic ample evidence for a minor degree of stratification is provided by indications of craft specialization (R.K. Evans 1973,1978), by the increasingly complex organization of some sites such as Dhimini and Sesklo, and by the variability in the amount and kind of grave goods found at the necropoli of Varna and Cernica (Todorova 1978; Gimbutas 1977; R.K. Evans 1978; Colin Renfrew 1978).

The number of sites increased throughout the Neolithic, particularly at the end of the period. From a sample of eight hundred sixty-four Neolithic sites in Greece, Bulgaria, Jugoslavia and Roumania there were only two hundred two in existence during the early Neolithic but by the late Neolithic the number had increased by two hundred sixty-five per cent to seven hundred thirty-seven. Table IV which follows shows how these sites were distributed.

The figures may not reflect very well the actual increase in sites over this period of time since, for lack of information, a very large number of sites could

TABLE IV DISTRIBUTION BY COUNTRY OF EARLY AND LATE NEOLITHIC SITES

COUNTRY	No. of EN Sites	No. of LN Sites	% Increase in Sites	Total No. of Sites
Greece	35	92	162	108
Bulgaria	50	217	334	245
Jugoslavia	76	82	8	140
Roumania	41	346	744	371
TOTAL	202	737	265	864

not be included in the above sample, and the Yugoslav sample includes only those sites which have been most thoroughly studied and therefore probably represent a disproportion of sites containing remains from all periods.

Besides a general increase in the size and number of sites over the Neolithic and an evidently increasing social complexity, Tringham (1971:146) and Theocharis (1973: 91) suggest that regional diversity increased. Such diversity in town planning, in technology, and in economies, as well as in ceramic wares is evident in the few sites described in this chapter.

There has, however, been little study concentrating on regional variation except for ceramic differences. Instead with, until recently, a primary concern of

establishing chronologies and on tracing Neolithic diffusion it has been broad similarities rather than regional adaptations which have been sought.

DIFFUSION OR REGIONAL DEVELOPMENT

The history of archaeology in south-eastern Europe revolves around discussions of the inter-relationship of Neolithic and later developments in this region with those taking place in the Near East. The majority of archaeologists subscribe to the view that the Neolithic of south-eastern Europe was derived from that of the Near East. Before the use of radio-carbon many believed that the Neolithic economy was brought intact to Europe by colonists. This is a view which is no longer prevalent but can still be found expressed in general works such as Jacquetta Hawkes' Atlas of Ancient Archaeology (1974) and David and Ruth Whitehouse's Archaeological Atlas of the World (1975).

Diffusionist theories developed out of the concept of the three age system, coupled with Morgan's (1907) economic classification of the evolution of human society. The three age system was the result of Thomsen's and later Worsaae's attempts in the late nineteenth century to organize the artefact collections of the Danish National Museum (Daniel 1950:40-45). Together the

technological and economic classification systems were used to interpret prehistoric remains in terms of economic evolution with accompanying social changes.

It was Childe, who, in 1925 with the publication of the first edition of The Dawn of European Civilization, first set out a clear statement of the development of the European Neolithic based on this materialist concept. In Childe's view the Neolithic, which he defined primarily in economic terms, was a revolutionary development arising in the Near East in response to a drying climate (1956:77-80, 1957:16). This new economy practised by a growing population led to the beginning of settled village life (Childe 1957:15). From the Near East the Neolithic economy spread to Europe by means of a migration or series of migrations of swidden farmers (Childe 1957:16). It is clear that Childe believed the initial development of the Neolithic in Europe was the result of colonists for he writes:

To find food for rising generations, the simplest step was to bring fresh land under cultivation and annex new pastures. That meant a continuous expansion of colonization and the progressive multiplication of farming villages (1957:16).

Although Childe considered the initial development of the Neolithic in Europe to be the result of migrations (1969:36) he recognized that later developments were distinctly European in nature. In Prehistoric Migrations

in Europe Childe wrote:

The spread of neolithic cultures in our continent depended... not merely on colonisation by immigrant farmers but also on the multiplication of established populations that had adopted the new productive economy (1969: 36).

Childe combined the notions of diffusion and social evolution to show that an economy, accompanied by a technology and social organization appropriate to it, could be transferred entire from one region to another and then gradually adapted to better suit local conditions.

Since Childe was writing before radio-carbon as a dating device had been discovered he had to rely on the development of cultural elements to show that his evolutionary and diffusionist ideas were plausible. In particular he relied on similarities in ceramic wares as evidence of the spread of farming populations, but as he pointed out in the preface to the 1957 edition of The Dawn of European Civilization this practice had to be re-evaluated. His stated reason was that "not all farmers were potters (xiii)."

The study of the ceramic wares of the Balkan Neolithic has developed into and continues to be the primary means of relating the local cultural traditions to one another and is used almost exclusively to relate these traditions to those of the Near East. It is quite

legitimate and useful to use ceramic wares as evidence of the direction of influence, a point which Childe recognized. He referred to the similarities between the ceramic wares of the Balkan peninsula and those of Dhimini (1957:64) and mentioned the possibility of a colonization of people from the Balkans into Greece. Nonetheless he preferred the proposal put forward by Milošević that both areas were influenced by people from the Near East (1957:66) since this explanation better fit his colonial theory.

The first radio-carbon dates appeared in 1949 (Colin Renfrew 1973a:48). Until then there was really no way to successfully test the theory of Neolithic diffusion. So when it was introduced the technique of radio-carbon dating became an invaluable tool.

The earliest radio-carbon dates supported Childe's colonization theory. But since 1966 with the introduction of tree-ring calibration (Colin Renfrew 1973a:69) the Neolithic of south-eastern Europe has been shown to be much older than was originally thought. It is now clear that certain traits which were considered to have been imported to the Balkan peninsula from the Near East must now be viewed as indigenous.

The appearance of the bones of domestic cattle at aceramic Argissa is at present the earliest known

occurrence of domestic cattle anywhere (Fagan 1974:213-214; Bökönyi 1974:19). The development of a copper metallurgy in the late Neolithic of the Balkans is certainly an indigenous rather than imported technological development (Jovanović and Ottaway 1976). So, too, is the appearance of marked tablets common in a large number of late Neolithic sites in the Balkans (Winn 1973). These were once thought to have been derived from what we now know are much later sites in the Near East (Winn 1973:243).

The realization that these were indigenous developments is the direct result of the use of tree-ring calibration. In Appendix 3, Tables XIII to XV the effect of tree-ring calibration on radio-carbon dating can be seen. It will be noted that for dates earlier than 2000 b.c. the correction is as much as one thousand years, while for dates of about 2000 b.c. the correction is considerably less, only about four hundred years (Table XV). Unfortunately the calibration curve for correcting radio-carbon dates at present only reaches back to just before 6000 b.c. (Colin Renfrew 1973a:74).

Uncalibrated radio-carbon dating relies on a number of assumptions. It is assumed that radioactive carbon will decay at a known rate unaffected by physical

or chemical conditions, and that the amount of radio-carbon in living things is a constant and does not vary from place to place. It is also assumed that the amount of radioactive carbon found in the earth's atmosphere never changes. Finally it is assumed that samples taken for dating will not have been contaminated after their death (Colin Renfrew 1973a:52). On the basis of these assumptions and within its limits of accuracy radio-carbon dating was considered to produce absolute dates for the period with which we are concerned.

The use of tree-ring calibration, however, has shown that the amount of radioactive carbon in the atmosphere does vary from time to time (Colin Renfrew 1973a:70) and consequently the amount of radio-carbon found in living things is not constant. As a result radio-carbon dates can no longer be considered absolute.

Until recently tree-ring calibration has been relying on the use of the California bristlecone pine. In order to test the validity of using this tree as a means of calibration outside of the United States and therefore the validity of the assumption that physical location will not affect the rate of radio-active decay, dates are now being calibrated with different trees from other parts of the world. The results

obtained are being compared with those obtained from the use of the bristlecone pine. A recent study using the Irish oak (Pearson et al. 1978) achieved results which compare favourably, though not exactly, with those from the bristlecone pine. The possibility of precise dating must await further research into the characteristics of radioactive carbon.

As a consequence of the use of both calibrated and uncalibrated dating, the lack of dates from many sites, and the continuing strong influence of museum archaeologists the chronology of south-eastern European archaeology, though much discussed, is fuzzy except in its broad outlines.

* One of the most influential of archaeologists studying Neolithic development in south-eastern Europe is Ruth Tringham. Like Childe, she emphasized the importance of economic development, and considered some sort of diffusion as the most likely means by which the Neolithic was introduced to Europe (1971:68,70). She points out, however, that one of the mainstays of this theoretical position is a lack of knowledge about human populations in the region in the period just prior to the Neolithic.

As has already been mentioned there are only two well-documented sites from this period, Franchthi Cave

in the Peloponnese (Jacobsen 1969, 1973a, 1973b, 1974, 1976) and Lepenski Vir in the Iron Gate Gorge of the Danube (Srejović 1968a, 1968b, 1972, 1973) and the evidence from these two sites can neither be used to wholeheartedly support nor reject a diffusionist point of view, though migration as a means of diffusion would certainly seem to be unlikely on the basis of the information from these sites.

While little evidence for a Mesolithic population is cited as an important reason for believing that a migration of swidden agriculturalists occurred, according to Tringham, "The major factor in interpreting the early neolithic cultures of eastern Europe in terms of an intrusive population is the economy itself (1971:71)."

Using the Neolithic economy based on grains and sheep, goats, pigs and cattle as the basis for propounding a diffusionist position is not without pitfalls of its own. The belief in the spread of agriculture and herding from the Near East to south-eastern Europe relies on the assumption that the domesticated species are derived from species which today are found wild in a region stretching from northern Iran to the eastern Mediterranean littoral (Murray 1970: Figures 1 and 2). The actual distribution of these wild species in prehistoric

times is unknown, and the actual wild species from which the later domesticated ones were derived is still a matter for discussion (Bökönyi 1974; Payne 1968; Zeuner 1963; Jarman 1969).

Theocharis (1973) in his synthesis of the archaeology of Greece also stresses the importance the lack of information about sites transitional between Palaeolithic and Neolithic has had on the formulation of theories about the spread of agriculture and makes it clear that in his opinion simple migration even in the earliest Neolithic stage is no longer a tenable position so far as Greece is concerned. He writes:

Even if domestication and cultivation were introduced from the East, as is thought to be the case (both as ideas and concepts, in practical terms involving domestic animals and the seeds of cultivated crops), it would be very difficult to explain the diffusion solely in terms of small bands of "immigrants" (a hypothesis for which there is no supporting evidence) and to ignore the role of an already existing population which was culturally at the end of the hunting and gathering stage and ready to receive the new practice in the organisation of its way of life (1973:24).

Theocharis (1973:34) points out that climatically and geographically Greece is a part of the Near East and that "many of the most important crops and animals of the new economy are found in their wild condition... in Greece and the Balkans." If Greece is to be viewed as a part of

the Near East then any concept of diffusion in this region takes on a different aspect.

Since calibrated radio-carbon dates and a limited amount of evidence for an indigenous transitional population make the simple concept of groups of colonists crossing from the Near East to south-eastern Europe inadmissible as explanation for sweeping economic and social changes, other more complex concepts which combine diffusion and local initiative must be put forward as explanation for Neolithic development in south-eastern Europe.

At present there is no-one who would reject diffusion as a part of the explanation for the introduction of the Neolithic economy into Europe, but views as to the extent of its role and the means by which diffusion occurred vary considerably.

Colin Renfrew believes trade to have been a vital mechanism in the spread of cultural and economic traditions (1973c). Evidence for some kind of exchange system exists throughout the Balkan region. Obsidian artefacts in Greece have been examined and show that the ore found in most Greek Neolithic sites originated on the island of Melos where two ore sources with evidence of Neolithic mining have been found (Colin Renfrew 1973c).

Spondylus shell is found in sites throughout the Balkans, though the nearest source is the Aegean (Colin Renfrew 1973c). According to Gimbutas during the late Neolithic:

Varna appears to have been a harbor where exotic materials, such as Spondylus and dentalium shells and perhaps marble arrived by the sea from the south, obsidian and flint from the north and were exchanged for gold and copper.... There is no doubt that lively trade activities existed between the Black Sea coast, central Europe, Moldavia, the western Ukraine, and the Cyclades (1977:44).

The possible trade networks involved have not up to this time been studied but Varna's importance may well lie in its position as an exchange centre. Childe suggested that Vinča, Turdaş, and Csöka were important because they were situated on a major avenue of exchange between the northern Balkans and the Aegean (1929:32). The suggestion that trade was an important mechanism for diffusion opens up a whole new area for Neolithic research.

David Clarke has questioned the validity of considering diffusion as the prime mover of the European Neolithic. He begins a recent article by cautioning the archaeologist not to become too complacent about conventional interpretations. He claims that:

Widely accepted interpretations then become the conventional framework for further discussion and research, and the conventional interpretation becomes traditional (1976:499).

He then goes on to say that:

... the analysis and interpretations of any data are constrained and distorted by missing information, inherent biases, sampling aberrations and persistent stereotypes (traditional misinterpretations) and by the fundamental difficulty that the results of any analysis will usually fit a very large number of different interpretive models (1976:499).

In trying to understand the development of the Neolithic in south-eastern Europe a very strong "traditional" interpretation has been created. Behind virtually all writing about Neolithic archaeology in south-eastern Europe is the assumption, often not stated, that the Neolithic traditions of the Balkan peninsula were reflections of similar traditions in the Near East. What was an important new and vital interpretation of the available data when Childe introduced his desiccation and diffusion theories for the development of agriculture and herding has now become an interpretation into which new data must be molded.

Thus it is refreshing to be confronted with a new and well thoughtout interpretation, though one not without problems of its own, of the development of agriculture in Europe, an interpretation in which diffusion plays a small if still important role.

Clarke believes the Mesolithic of Europe contained all the pre-requisite elements for the development of

agriculture and herding. Like Childe he relies on climatic change as the triggering mechanism. Along with rising sea levels, climate is viewed as the essential element in changing a late Mesolithic economy based on hunting and gathering into a simple agricultural and herding economy relying on plants and animals native to Europe, which had been exploited for some time (Clarke 1976:466). Animals such as the dog, pig, rabbit, ibex, and ovicaprids, along with grasses, legumes, bulbs, fruits and trees, he believes were not only hunted and gathered by late Mesolithic populations but were being "manipulated" as well (Clarke 1976:477). Manipulation would, according to Clarke, undoubtedly have increased as the climate and flora changed. Just what sort of manipulation Clarke envisages is not discussed.

Permanence of settlement Clarke considers a Mesolithic development related to the utilization of a coastal or marshland environment (1976:469). In such an environment, he claims, all the subsistence requirements could be obtained with a minimum of seasonal movements. The impetus, then for the beginning of the Neolithic in Europe occurred within Europe itself. The relationship with the Neolithic of the Near East was a later development beginning only after the indigenous establishment of a simple agricultural economy. Some

confirmation of this view is provided by the very early radio-carbon dates now being published for sites in the western Mediterranean as well as in the Balkans (Guilaine 1979:23-24).

The introduction of Asiatic crops and animals to Europe, according to Clarke was most probably the direct result of "the appearance of the first reliable sea-going canoes c. 6500-6000 B.C. (Clarke 1976:478)." These dates unfortunately do not fit very well with those which others have suggested represent the beginning of the Neolithic in Europe, nor do they fit well with the much earlier evidence for sea travel from Franchthi Cave.

Until we have more information about the period immediately before the Neolithic in the Balkans and until the actual subsistence, settlement and exchange patterns of south-eastern Europe can be clearly delineated, the relative importance of diffusion and local initiative will remain matters for argument.

MUSEUM OR ANTHROPOLOGICAL ARCHAEOLOGY

In the past few years the study of the Neolithic period in south-eastern Europe has shifted from complete concentration on a museum oriented archaeology devoted to the collection of artefacts for study and display and

the development of a Neolithic chronology to a more anthropologically oriented archaeology. This does not mean, of course, that museum collecting is today being neglected nor that the understanding of chronology is no longer of importance. In fact, the museum remains the primary focus of archaeology in the Balkans.

The majority of archaeologists in the area are trained by and work for museums (R.K. Evans 1973:4). It is accordingly not surprising to find that current research in the Balkans can for the most part still be called art history.

It has recently become obvious, however, that such an approach can provide only limited information about such topics as economic and social organization.

Undoubtedly the many works of V.G. Childe published between 1925 and 1957 have been influential in encouraging an anthropological approach to the archaeology of Europe. In 1925 Childe was restricted to using the tools of the art historian to outline the economic and social prehistory of Europe but the problems he wanted to solve were those of anthropology.

Since that time better excavation techniques and the use of scientific specialists have permitted a better rate of recovery of the perishable material necessary for

the study of prehistoric economy. The improvement in archaeological technique is, however, more the result of changed interests than it is of technological advances.

As a result of a shift in interest there is now a real effort being made to come to grips not only with the problem of chronology but also with the problems of social and economic organization during Neolithic times.

Included among the topics which archaeologists in the Balkans are now discussing are the importance of craft specialization (R.K. Evans 1973,1978; Colin Renfrew 1973c), the exploitation and distribution of raw materials such as flint, obsidian and copper (Colin Renfrew 1969, 1973b, 1973c; Jovanović 1971, 1973, 1976, 1979, 1980; Nandris 1975,1976; Černych 1978), the choice of settlement location and the organization of settlements (Tringham 1971; Todorova 1978), and the type of subsistence economy and its development (Murray 1970; Necrasov and Haimovici 1959,1966; Ghetie and Mateesco 1971,1972,1973a, 1973b, 1974, 1977; Jane Renfrew 1973b; Bökönyi 1974; Dennell 1978b).

Recent regional surveys such as Todorova's review of Eneolithic Bulgaria (1978) and Theocharis' review of the Greek Neolithic (1973) reflect the change in emphasis in south-eastern European archaeology and at

the same time point out the need to make greater efforts towards solving the many economic and social questions still unanswered.

III. THEORETICAL BACKGROUND

The primary concern of archaeologists studying prehistoric subsistence patterns is understanding the relationship which exists between man and his environment. The environment is seen to influence the economy and through the economy to influence settlement patterns and social organization.

The effect of environment on people and their institutions has been a subject of interest since the days of classical Greece. In the nineteenth century, consideration of the relationship between environment and man led to the culture area model, which attempted to sort out the importance of environmental and diffusionist factors in the development of human culture. The idea of the culture area was introduced by Adolf Bastian (Honigmann 1976:168). Bastian stressed the importance of the environmental influence on human culture, but when the idea was picked up by Friedrich Ratzel in 1891 environment and invention were viewed as playing secondary roles to diffusion as the prime mover in the development of human culture (Honigman 1976:168; Marvin Harris 1968:382-383).

In North America the culture area idea was adopted by Mason (1894), Wissler (1926), and Kroeber (1939) and

adapted to the North American scene. Each of these men divided the North American continent into a number of different natural areas which could be seen to correspond with variations in culture areas. The role of environment in this relationship was, however, seen as permissive rather than as decisive. According to Wissler, "The influence of the environment thus appears as a passive limiting agency rather than as a causal factor in tribal life(1929:339)."

The culture area model as it was perceived by Kroeber used diffusion and environment to explain the concentration of certain cultural traits in the centre of a culture area and their gradual diminishment and disappearance at its outer edge. Environment was viewed as a necessary condition for defining culture areas and for explaining varying degrees of cultural intensity. Nevertheless, in Kroeber's opinion culture was best understood in cultural terms.

... on the one hand culture can be understood primarily only in terms of cultural factors, but... on the other hand no culture is wholly intelligible without reference to the noncultural or so-called environmental factors with which it is in relation and which condition it (Kroeber 1939:205).

A view of the part played by environment similar to those held by Mason, Wissler and Kroeber, was expressed

by the British anthropologist C. Daryll Forde, who stressed the importance of environment to the development of human culture, but who, nevertheless, viewed environment as no more than a permissive factor (Forde 1934:3, 464). In the introduction to Habitat, Economy, and Society he wrote, "Despite the intimate relation between human activities and the conditions and resources of the physical world, there are clear limits to this explanation (Forde 1934:3). In the conclusion of the same book he again stressed the permissive quality of the environment.

Physical conditions enter intimately into every cultural development and pattern, not excluding the most abstract and nonmaterial: they enter not as determinants, however, but as one category of the raw material of cultural elaboration (Forde 1934:464).

While he claimed that the environment affects all aspects of human life, as Forde (and Wissler too) perceived it, the closest environmental-human relationship lay in the realm of technology and economy.

CULTURAL ECOLOGY

Julian Steward, to whom we owe the concept of cultural ecology, concentrated on this economic-environmental relationship. He believed that anthropologists like Forde, Mason, Wissler, and Kroeber were wrong to assign

only a permissive role to the environment (Steward 1955). Further, he believed they were wrong to think that culture could only be understood in cultural terms. For Steward culture could be understood best as an adaptation to environment, which he defined as the "total web of life wherein all plant and animal species interact with one another and with physical features in a particular unit of territory (1955:30)."

It was Steward's view that the social and ideological fabrics of human culture were influenced or determined by a group's economic adaptation to its environment. But he recognized that adaptations to quite different environments produced societies with the same level of socio-political organization. Thus environment alone could not be considered the controlling factor in socio-political development. Another crucial factor was the economy.

Basic to Steward's concept of cultural ecology was the idea of the "cultural core". This he defined as, "the constellation of features which are most closely related to subsistence activities and economic arrangements (1955:37)."

Steward's method of cultural ecology involved three steps: first, the analysis of the inter-relationship of environment with the exploitative or productive

technology; second, the analysis of the behaviour patterns involved in that exploitation using the given technology; and third, the assessment of the effect of these behaviour patterns on other aspects of the culture (Steward 1955:40-41).

THE ECONOMIC APPROACH

The Ecosystem Approach

In Britain a view analogous to that held by Steward with regard to the relationship between environment and culture was espoused by the archaeologist Grahame Clark. He called this the "economic approach". In the introduction to Prehistoric Europe: The Economic Basis (1952) Clark states that "the economic life of early man can most fruitfully be considered in relation to the wider economy of nature (6)."

In Clark's view the interaction between human culture, all living organisms and the habitat is directed to maintaining a state of equilibrium. This ecosystem model is central to Clark's studies of prehistoric economy, which, he says is at any given time "necessarily the product of an adjustment between culture and environing nature (1952:7)." The ecosystem model stresses static relationships and according to Clark, "economic and cultural stability... was no doubt the normal condition

of primitive society (1952:8)." He goes on to say, however, that:

... it is equally certain that during pre-historic times there must have been phases of disequilibrium when the pattern of life changed, at times drastically and often quite rapidly (1952:8).

It is these periods of disequilibrium, brought about by natural environmental changes, by changes in environment resulting from human exploitation, and by changing relationships between human groups, which are of greatest interest to the student of economic prehistory (Clark 1952:8).

It is clear that Clark thought of the relationship between economy and environment as primarily a dynamic one, particularly after the introduction of agriculture, for the processes of agriculture involved a transformation of the original environment (1953:224). In fact Clark makes the point that a major difference between the Palaeolithic and Neolithic periods lies in the fact that the " change was one from a relatively passive to an active, dynamic attitude towards nature (1953:224)."

The greatest difference between Clark's economic approach and the approach of archaeologists who preceded him was that for Clark the "most decisive criteria" for determining evolutionary development (particularly

the origins and spread of agriculture) was "biological" rather than cultural. Harriss (1971:40) suggests that Clark's approach belongs to the tradition of field archaeology while the cultural approach can be traced to the museum tradition.

Probably Clark's most explicit and one of his more recent statements of the goal of economic archaeology is as follows:

... it is essential to consider the biological data from archaeological sites in relation to the territories exploited by their inhabitants. It is only when excavated material is considered in relation to the resources of the territory utilized, the nature of the technology and the size of the community, that a meaningful picture is likely to emerge of the manner in which economic needs were met... (1972:viii).

This statement appears in the forward to Papers in Economic Prehistory, one of two important publications of the British Academy Major Research Project in the Early History of Agriculture. The other major publication to result from this project was Palaeoeconomy (1975).

Clark (1971) applied this technique with some success in excavating the site of Star Carr, and later in his study of stone age settlement in Scandinavia (1975). To understand the economy of Star Carr and its effect upon the social organization of its inhabitants, it was necessary to study the habits of red deer, the animal

most important to the economy. The annual hunting territory of the population of Star Carr, Clark concluded, must include the annual migration territory of the deer. Thus Clark surmised that Star Carr was the winter home of a small hunting band which journeyed to the uplands in summer following the deer (Clark 1971).

Bioarchaeology

According to Harriss (1971:49), a student of Higgs, Higgs' approach to economy is considerably different from that of Clark in that Clark views man as a carrier of culture while Higgs, like Zeuner (1963:36) before him, stresses his animality.

Despite his stress on the use of biological criteria Clark wrote that:

... bioarchaeology is not, in the final analysis, biological; it is archaeological because it is concerned with communities whose behavioural patterns were conditioned and mediated by and through culture -- communities, moreover, whose members subscribed to socially transmitted and consciously held values (1971:15).

Harriss rejects Clark's approach because it is not concerned with explanation but with "the essentially practical problems of field work and the taxonomic needs arising from it(1971:42)." In other words archaeology has been descriptive. In order to make it explanatory, Harriss (1971) believes that the approach of

Higgs and his co-workers in trying to understand man's relationship to his environment through his economy is a step in the right direction.

In the introduction to Palaeoeconomy Higgs and M.R. Jarman stress the point that economy is, "a basic aspect of human behaviour which can be shown to conform to predictable laws over long time periods (1975:4)." According to them, "Animal (including human) behaviour is conditioned by the way the animals get their living (1975:4)." They go on to say that it is important to study and understand the behaviour of animals, in particular that of wild carnivores if:

... we hope to ascertain which behaviour patterns may be considered specifically and characteristically human. At present precisely similar patterns of behaviour tend to be considered very differently depending on whether they are undertaken by man or other animals (1975:4).

Higgs and Jarman reject, however, the ecosystem model as part of their approach because they claim that, "the ecosystem... is inherently beyond empirical study in itself," and that, "it focuses attention on subsidiary aspects of the main objective (1975:3-4)."

The major difference between the economic approach of Higgs and Jarman and that of Clark in practical terms lies in the relative emphasis placed on the study of

artefactual and biological and locational data. In both Prehistoric Europe: the Economic Basis (1952) and in The Early Stone Age Settlement of Scandinavia (1975) Clark places a strong emphasis on the study of technology and cultural remains along with faunal and floral analysis. Higgs, on the other hand, stresses territorial studies and the symbiotic relationship between man and the plants and animals he uses. Technology and cultural remains are of only secondary importance.

Crucial to Higgs' approach are the biological concept of territoriality (or more properly "home range" Foley 1977:182; Hardisty 1977:185), and the technique of locational analysis, borrowed from geography.

Higgs was influenced by Wynne-Edwards' discussion of social behaviour and territoriality. Wynne-Edwards was in turn influenced by the work of Carr-Saunders, who, in The Population Problem (1922), illustrated that territoriality was common to all human populations and the populations within a given territory were maintained at an optimum size.

Carr-Saunders borrowed the concept of the optimum population size from the industrial economists of his day and applied it to the study of less complex societies (Wynne-Edwards 1962:493). As a result of his study of

simple hunting and agricultural societies in which he stressed the importance of the common practices of birth control, infanticide and post partum taboos in maintaining stable population levels Carr-Saunders wrote:

There is... a density of population which if attained, will enable the greatest possible income per head to be earned; if the density is greater or if it is less than this desirable density the average income will be less than it might have been. Obviously it must be a very great advantage for any group to approximate to this desirable density (1922:213).

In Animal Dispersion in Relation to Social Behaviour

(1962) Wynne-Edwards took up this theme. He wrote that, "Minimum territory size is inversely related to the productivity of the habitat (12)." But he stressed that the relationship is indirect. Competition among animals is for space not food.

The substitution of a parcel of ground as the object of competition in place of the actual food it contains, so that each individual or family unit has a separate holding of the resource to exploit, is the simplest and most direct kind of limiting convention it is possible to have. It is the commonest form of tenure in human agriculture. It provides an effective proximate buffer to limit the population-density at a safe level... and it results in spreading the population evenly over the habitat...(1962:12).

Site Catchment Analysis

Using the territorial model of Carr-Saunders and Wynne-Edwards as a basis for research, Higgs felt it

should be possible to identify the utilized territories of prehistoric settlement sites. To do this he borrowed from geography the technique of locational analysis as it was defined and illustrated by Chisholm (1962).

Locational analysis as it is used in geography is the study of the location and distribution of settlements and industrial centres, and of the means by which they are connected with one another and integrated with their environments for the purposes of resource exploitation (Haggett 1965). The concept is based on the principal that man strives for the greatest return for the least effort. A large number of different models are used in locational analysis (Haggett 1965). One of the first to be developed was "central place theory".

It is this model based on the concept of the isolated state (der isolierte Staat) developed by von Thünen which Chisholm used (Chisholm 1962:26). It assumes that all the land surrounding a settlement, in particular a rural agricultural settlement, is of equal value for agricultural purposes and that there are no trade relations with other settlements (Chisholm 1962:26). Given this, how then will the community make use of its land? If one takes the settlement as the pivot and draws concentric circles around this centre, one would

expect that the nearer the land is to the settlement the greater its economic importance will be and that the further the land is from the settlement the lesser will be its economic importance.

Locational analysis as it was adapted for archaeology by Higgs and Vita-Finzi was given the name site catchment analysis (Higgs and Vita-Finzi 1970). On the basis of Lee's (1969) well-known study of !Kung Bushmen, in which he illustrated that, despite scarce water resources and the need to congregate around these, the Bushmen do not travel any further than necessary to obtain food, although the distance varies according to the season and according to the length of time the site has been occupied, as a result of a gradual depletion of resources; and keeping in mind Chisholm's analysis of modern rural communities, which shows the decreasing economic importance of outlying lands of agricultural settlements, Higgs and Vita-Finzi (1970) suggested optimum circular site territories with a radius of five to ten kilometres or of one to two hours walking time depending upon the type of economy practised. The goal of the archaeologist, then, is to assess the availability of food resources, water sources, and raw materials for tool, clothing, and shelter manufacture within the chosen

radius. In addition it is necessary to assess soil quality and climatic conditions. Given a certain level of technology all of these things affect the type of economy practised and in turn the social organization of the population.

The technique of site catchment analysis has been used in a variety of ways by several British archaeologists. Dennell and Webley (1975), Dennell (1978b), Barker (1975), and H. Jarman and Bay-Petersen (1976) have used the technique in the Balkans to study the suitability of lands surrounding Neolithic sites for agriculture and herding.

Higgs and Vita-Finzi view the technique as a useful tool for relating sites with one another where a population practised a "mobile" or "mobile cum sedentary" economy (1970, 1972), that is for relating to one another the various sites of nomadic or semi-nomadic populations. Higgs (1976) suggests that the routes of possible prehistoric pastoral transhumance in the Balkans, Spain and Italy might be determined by comparing modern herders' routes with prehistoric site locations and by estimating using site catchment analysis the value of these locations to a herding economy.

Dennell (1978b) and Dennell and Webley (1975) note that the sites in Bulgaria which they studied were

located in places admirably suited to a combined agricultural and herding economy. The sites gave easy access to upland pastures probably used for summer grazing, and were surrounded by fertile agricultural soils and rich pasture lands suitable for winter grazing.

According to Hardisty (1977:246) there are two questions to which we expect ecological approaches to provide answers. The first of these is simply: "what human populations existed and what plants, animals, climates and so forth were associated with them." This is the least important of the two questions but unfortunately usually the only one for which answers are attempted. The second question which ecological approaches pose has to do with man-environment relationships (Hardisty 1977:246).

Site catchment analysis is intended to answer this second question, but its success has been limited.

The most crucial criticism that can be made is that despite its technical sounding terminology it is not really an analysis of the value of an area for human use, any more than some of the earlier descriptions. All that occurs is a qualitative description of arbitrary habitat 'types' that are available around the site. These habitats are then correlated with particular economic forms. This is by no means the same as measuring the 'extractive value' of the habitats, even less so the extractive value in relation to the site or a particular technological system (Foley 1977:164).

Factors which have been ignored in site catchment studies include such things as the annual variability of a territory's productivity, the relationships which obtain between the various animal and plant species found within the territory, and in the economy, and the relative importance of various aspects of a site's subsistence economy.

Foley suggests that instead of site catchment analysis, "habitat analysis should... be carried out independently of the site locations (1977:196)." The habitat he envisions is not simply a matter of circular territories surrounding a site, but rather a less precisely defined area which follows natural boundaries (Foley 1977:169). The focus of habitat study is not the site at all, but the environment.

Flannery (1976) says that the basis of analysis should be the region and not the site itself. To illustrate this point he shows that it is not possible to say that a site was non-agricultural even though its catchment area contained only a low percentage of arable land. For example, a population of about fifty families could support itself on one hundred hectares of arable if emmer wheat were the staple crop, that is they could support themselves on only 1.3 per cent of their catchment

area of seven thousand nine hundred hectares (Flannery 1976:92). Further, Flannery points out that while the site of Nahal Oren in Israel, studied by Higgs and Vita-Finzi (1970) contained within its catchment area less than eight per cent of arable land, it contained within this same area almost one hundred per cent of the total available arable land within a considerable region (Flannery 1976:93). Obviously the catchment area should not be studied in isolation.

Foley points out that a major problem of site catchment analysis is, "that the technique imposed is the direct product of a hypothesis about resource utilization, rather than a tool to test it (1977:182)." In his opinion territorial analysis must make use of the "concept of energy balance (Foley 1977:164)." He stresses the importance of assessing the territory in terms of primary (plant), secondary (herbivore), and tertiary (carnivore) resource availability (Foley 1977:176). Only once the total energy system of the habitat area has been assessed should one relate this habitat to possible economic strategies.

As a result of not viewing the territory as an ecosystem one of the weaknesses of site catchment analysis as it has been applied, so far, to the study of

agricultural and herding communities has been its inability to cope with the dynamic relationship between a population and its environment.

The static approach of site catchment analysis has tended to ignore the roles of population growth and technology in changing man's relationship with his environment over time, as well as the role of the structural evolution of the landscape itself (Vita-Finzi(1978:10).

Boserup (1965) has suggested, and Smith and Young (1972) would agree with her, that increasing population played the major role in man's changing use of his environment. In Boserup's view population growth was followed by the technological development needed to allow a change in the method of subsistence, adequate to provide sufficient sustenance for the growing population. It is probably more useful, however, to consider population growth and technological development as occurring together to provide a catalyst for economic change.

It is also important to consider man's reciprocal relationship with his environment for there is every reason to suppose that environmental degradation plays a role in producing a need for change in the method of subsistence. Such degradation may not be dependent on population growth but may arise simply as a result of

the subsistence economy itself.

While site catchment analysis studies may not have been able to cope with dynamic man-environment relationships, what they have achieved is a thorough description of the lands surrounding prehistoric sites at a given point in time, in terms of their usefulness to a given economy. Site locations are thus not viewed as random but rather as intimately related to the environments in which they are found. In addition sites and their immediate environments have been viewed as integrated units.

The essentially descriptive technique of site catchment analysis should be viewed not as an end in itself but rather as an important methodological step in the technique of territorial analysis, the aim of which is to establish hypotheses about economic strategies. Dennell defined the difference between site catchment and territorial analyses as follows:

... whereas the former is empirical, the latter results in hypotheses on the most plausible subsistence strategy of an extinct community.... the former is simply a product of the archaeological record and represents the location of contemporaneous sites in an area, the latter is a behavioural reconstruction of the social and economic relationships between settlements and other activity areas (1978b:52-53).

The goal of territorial analysis is:

... to indicate the probable annual subsistence strategy of a community by integrating on-site data on the size and type of settlements, their technology and resources with off-site data from site catchment analysis and other palaeoenvironmental investigations (Dennell 1978:52).

SPATIAL ANALYSIS

The model of spatial analysis is another useful approach for studying the relationship between economy and settlement. Like site catchment analysis it has connections with the locational studies, developed by geographers, and with behavioural studies (Clarke 1977: 1-2).

As David Clarke (1977:9) defines it spatial analysis stresses artefactual and architectural remains rather than environmental and biological ones. Together with territorial analysis it provides a means of studying the dynamic relationship between economy and environment, since changes in man's relationship with his environment should be reflected not only in economy but in technology and in settlement and social organization as well. In fact, as the relationship between a population and its environment changes the subsistence base may remain the same; while the organization of society and settlement and/or of technology change to cope with the

new ecological situation.

Clarke defines spatial analysis as:

... the retrieval of information from archaeological spatial relationships and the study of the spatial consequences of former hominid activity patterns within and between features and structures and their articulation within sites, site systems and their environments: the study of the flow and integration of activities within and between structures, sites and resource spaces from the micro to the semi-micro and macro scales of aggregation (1977:9).

He goes on to say that:

Spatial archaeology deals... with human activities at every scale, the traces and artefacts left by them, the physical infrastructure which accommodated them, the environments that they impinged upon and the interaction between all these aspects (1977:9).

Clarke is careful to point out that spatial and settlement archaeology are not the same thing since spatial archaeology attempts to relate all types of sites, not only settlement sites.

While he stresses cultural remains as opposed to biological ones, economy as it is represented in these remains is a crucial concern of spatial analysis. Site catchment analysis can in fact be included under the rubric of spatial analysis but it is important to recognize the essentially ecological approach of this technique. Spatial analysis on the other hand is essentially a cultural approach.

Using spatial analysis, settlement can be studied on three levels, the micro level, which is concerned with individual structures within a site, the semi-micro level which is concerned with the arrangement of structures and artefacts within sites, and the macro level which is concerned with relationships between sites (Clarke 1977: 11-13; Chang 1968:7).

The relationship between settlement and economy is strongest, according to Clarke, at the macro level and least at the micro level (1977:11-13). At the micro level settlement-economic relationships can be looked for in the form of the technological component. At the semi-micro level we must look for relationships in the types of structures, their methods of construction and in the locations relative to one another, of structures within the site. At the macro level the settlement-economic relationship is much stronger. Clarke writes:

Because of the scale involved and the friction effect of time and distance on energy expenditure, economic 'best-return-for-least-effort' factors largely dominate most social and cultural factors at this level (1977:13).

It is at this level that the location of sites as they relate to the economic factors of trade, natural resources, and transportation is considered.

While relationships between settlement and economics may be discovered at each "level of aggregation" and while the relationship may become stronger at the macro level it is important to recognize that at no level is economics the sole factor involved in choosing a location and laying out a settlement.

In the present study the methods of economic archaeology, making use of published site catchment and territorial analyses, and of spatial analysis will be used in an attempt to show how and why economic and settlement patterns varied from region to region. In order to show how these techniques can be applied to this study it is necessary first to define the terms economy and settlement.

DEFINITIONS OF ECONOMY AND SETTLEMENT

Economy

The major issue of economic anthropology centres around the development of a definition of economy which reflects the economic organization of simple societies. The two sides of this issue have been labelled formal and substantive economics. Until the middle of this century, when Karl Polanyi pointed out that the economies of non-industrialized societies did not fit the mold of market economy, the formalist view held sway. This concept of economy holds that all members of a society

are in competition for scarce resources. Economy can thus be defined as the judicious use of scarce resources to attain production, distribution, exchange and consumption goals (Samuelson and Scott 1966:5).

Since it has been demonstrated that in even the simplest of hunting and gathering societies scarcity is much less of a problem than was once believed (Lee 1969, 1974; Sahlins 1972), and that in such societies solutions to the problem of periodic scarcity lie in food sharing and in moving to new locations, the formalist conception of economy is viewed by many as not applying to primitive societies.

According to Sahlins the concept of production for profit is not applicable to non-industrial societies, where the guiding principle is production for need (1972: 83).

Thus, as is pointed out by Polanyi (1968:140):

The two root meanings of economic, the substantive and the formal have nothing in common. The latter derives from logic, the former from fact. The formal meaning implies a set of rules referring to choice between the alternative uses of insufficient means. The substantive meaning implies neither choice nor insufficiency of means; man's livelihood may or may not involve the necessity of choice, and, if choice there be, it need not be induced by the limiting effect of a "scarcity" of the means;...

Sahlins points out that economy is a function rather than a structure of primitive societies. "Rather than a distinct and specialized organization, 'economy' is something that generalized social groups and relations, notably kinship groups and relations, do (1972:76)."

In such an economy the various forms of reciprocal exchange and redistribution act as important means of social and political integration, both within and between communities (1972:76).

While Sahlins takes a substantivist view of the economies of primitive societies, both he and Lee (1969:76) point out that economic evolution has proceeded in the direction of creating institutionalized scarcity. The first step in this process was taken when people began to store surplus food rather than share it. In Neolithic societies relying as they do on the production from specific plots of land and from specific herds of animals food storage became an important hedge against natural disaster. The Neolithic can thus be viewed as one of a number of stages in economic development related to the social organizations of bands, tribes, and civilization (Schneider 1974:7). Such a view is reminiscent of Morgan's outline of the development of economies (1907).

The debate in anthropology about the way in which the economies of primitive societies are organized offers

little help to one who would study the subsistence activities and organization of prehistoric societies. Since it is obvious from the ethnographic literature that the economic systems of present day societies are not yet clearly understood, it is manifest that at the present time any attempt to define prehistoric economic systems is doomed to failure. It is probably for this reason that neither Clark, when he called his approach to the study of prehistoric subsistence patterns the "economic approach" nor Higgs, in his studies of prehistoric economies ever defined what they meant by the word economic. It is clear, however, that it was subsistence and the extraction of natural resources which was of primary concern to both Clark and Higgs.

Hole and Heizer (1973:322) define prehistoric economy in the following manner:

Prehistoric economy consisted of the way in which man hunted, fished, and collected food; the way he farmed, harvested, and prepared food; the way he used or distributed these products; the shelters in which he lived and the tools he used; the trade he carried on for raw materials; and the manner in which he traveled. In short, prehistoric man's economy was multifaceted, reaching into the technological, environmental, and social spheres of his life.

In this study the only aspect of economy which will be considered is the subsistence pattern of prehistoric

communities. Stress is placed on the method of making a living rather than on the relationships which pertain between individuals, groups and communities involved in the subsistence pursuits.

A conception of subsistence economy particularly useful in an archaeological context because it distinguishes between the food getting and food sharing aspects of economy is that of Lee (1967). Two types of relationships are involved: one is the relationship between man and the other species within an ecosystem; the other is the relationship between individuals and groups of people.

Only that aspect of economy which is concerned with the relationship between human communities and the plants and animals utilized will be dealt with here. Exchange relationships between individuals and groups within or between communities while considered essential to a full understanding of economy have for practical reasons been excluded from the study.

Settlement

Settlement can be defined as the space occupied and utilized by a community. Chang defines an archaeological settlement as, "the physical locale or cluster of locales where the members of a community lived, ensured their

subsistence, and pursued their social functions in a delineable time period (1968:3)." Community as Hole and Heizer define it is: "all the people who comprise the sustaining area for one village. That is, all the people who are related through marriage, trade, or political ties to form a viable social system (1973:435)."

The situation in Swat, Pakistan, described by Barth (1956) is of interest in relation to this definition to community. Three ethnic groups, one of which is a transhumant pastoral group, another a sedentary agricultural group and a third which practises both agriculture and herding, all dwell in the same region. Members of the first two groups live together for part of the year in the same villages and can thus be considered to form single communities. Such a concept is valid for Balkan ethnography where Vlach transhumant pastoralists are similarly related to sedentary agriculturalists throughout the region (Carrier 1932; Wace and Thompson 1914; Kindersley 1978).

Settlement and site are not identical entities, yet it is clear that all sites are related in some way to settlement since non-settlement sites serve settlements in one way or another. Clark defines an archaeological site as:

... a geographical locus which contained an articulated set of human activities or their

consequences and often an associated set of structures; sites may be domestic settlements ceremonial centres, cemeteries, industrial complexes or temporary camp locations (1977:11).

Non-settlement sites can be viewed as serving limited purposes while settlements must be the centres of a wide variety of activities essential to the maintenance of a community's well-being.

Non-settlement sites may be the locales for activities which involve the members of more than one community. A large ceremonial centre or a campsite for obtaining raw materials for toolmaking, for example, might bring together for a short period of time members of several different communities.

A settlement is here defined as a geographical location at which a community, bound together by common interests, makes its home for part or all of the year. Such a location must be able to supply the community with its basic needs of food, water, shelter and protection. On the other hand the location of settlements may be such that they are unable to supply a variety of the raw materials useful in toolmaking or for decoration. In fact the value of decorative items may be enhanced by the very fact of their inaccessibility.

During the Balkan Neolithic the types of sites which have been described include settlements, cemeteries and

sites for the mining of flint and copper. Other types of sites may well be present but have not yet been identified.

APPLYING TERRITORIAL ANALYSIS TO THE SOUTH-EASTERN
EUROPEAN NEOLITHIC

Since the physical space being studied is vast and the time element equally so, and since the data are limited to published sources it is possible to study the relationship between environment, economy and settlement only in the broadest terms.

The terrain of south-eastern Europe is highly dissected with numerous mountain ranges separated by fertile valleys. Such terrain typically produces a great number of micro-environmental conditions within a larger environmental region. Much as it would be desirable, it is completely impossible to study these micro-environments in a thesis which seeks to find environmental factors operating over a large geographical area.

It is possible, however, to consider some environmental factors in a more general way. In particular it is possible, using as a basis for research the general worldwide climatic pattern distributions as defined by Köppen and modified by Trewartha (1954), to show that a relationship exists between climate and economy.

In south-eastern Europe there are two major climatic types which prevail, the Mediterranean and the Humid Continental (Trewartha 1954: Plate 1). Each is expected, all other things being equal, to give rise to different economic strategies. Other environmental factors which are expected to affect economy are topography, soils, and vegetation.

In mountainous regions the distribution of soils tends to be in small pockets of varying depths and fertility, brought about by their formation out of different mineral components and organic humus. Agricultural communities would be expected to take advantage of suitable locations near soil pockets of considerable depth and high fertility.

In general one would expect, in a terrain such as is found in south-eastern Europe, to find agricultural settlements located in the alluvial plains of major river valleys or in large basins such as commonly occur throughout the Balkans. Upland sites are more likely to be associated with herding or with the exploitation of mineral resources.

The relationship between settlement and environment must be considered for the most part to be indirect, that is dependent on the economy. One would not expect to

find hunting and gathering societies choosing locations or organizing settlements in a manner identical to those of farmers and herders. Different combinations of economic strategies might well be expected to lead to the choice of a different set of criteria as the basis for establishing settlements. That farming and herding involve very different organizational strategies has been pointed out by many anthropologists, and geographers, among them Lees and Bates (1974), D. Harris (1971), Barth (1950,1956), and Semple (1932). Farming is basically a sedentary occupation tied to specific areas of land, while herding is a nomadic occupation involving following herds in search of pastures. Where both are practised by the same community using a simple technology it is generally necessary to divide the population in a way which permits some to stay and tend the fields while others travel with the herds for a part of the year. However, in some instances all members of the community travel from site to site according to the season. An example of this is found in Luristan in Iran (Edelberg 1967).

David Clarke's model of spatial analysis has been used to establish expected relationships between economy and settlement pattern. Unfortunately, for south-eastern

Europe the availability of settlement pattern information is poor. There is little information to relate economy and settlement organization at the semi-micro level since few settlements have been adequately described. A certain amount of information about technology is available, however, which can be used to relate economy and settlement at the micro level of spatial organization.

As has been pointed out the economy-settlement pattern relationship can be most clearly discovered at the macro level of spatial organization, and it is at this level that settlement pattern is related through the economy to the environment. At this level one can ask questions about settlement location and longevity.

The technique of site catchment analysis is important to this work primarily because it has formed the methodological basis of some of the more important sources of information used in the study (for example, Dennell 1978b; Barker 1975; and Bintliff 1977), and the results of these analyses are used frequently to support the conclusions drawn.

The basic approach taken is that of territorial analysis which relies on environmental studies and archaeological techniques to establish possible relationships between environment, economy and settlement.

IV. EXPECTED RELATIONSHIP BETWEEN ECONOMY AND SETTLEMENT PATTERN

Both economic and settlement patterns can be considered on a number of levels. As a result relating economy to settlement is overwhelming in its complexity and scope. It can only be achieved if a limited number of economic and settlement factors are chosen for study.

The relationships occurring between all aspects of economy, and all three levels of settlement organization as they are outlined by David Clarke (1977) are important. Nevertheless this study will be restricted to a consideration of the subsistence aspects of the Neolithic economies of south-eastern Europe and their relationship to settlement longevity and location.

Although the subsistence economy was based on agriculture and herding, hunting and gathering formed a part of the economy as well, and its relative importance appears to have varied considerably from site to site. The reason why this should be so and the effect it may have had on settlement patterns are problems worth consideration.

The particular problems concerning the relationship between economy and settlement in south-eastern Europe considered here arose as a result of reading Ruth

Tringham's book Hunters, Fishers and Farmers of Eastern Europe: 6000 - 3000 B.C. (1971). Tringham believes that there was a relationship between an almost total reliance on the use of domesticated plants and animals and the development during the early Neolithic of tell sites in Greece and southern Bulgaria. She considers that these tells were the result of long-term permanent settlement (1971:89-90,156,180).²

At this same time in Jugoslavia, Roumania, southern Hungary and south-western Russia no tells were formed (Tringham 1971:91; Garašanin 1958:6; Kosse 1979:130; Todorova 1978:11; Whitehouse 1975:156; Gimbutas 1976:19), and there was a much greater reliance on wild animals (Bökönyi 1974; Murray 1970; Tringham 1971:02). Sometimes more than fifty per cent of the bones from early Neolithic sites in these areas come from wild animal species.³

Tringham offers no explanation for the suggested correlation of site longevity with a dependence on

2. Vajsova (1966:10) views tells as non-permanent settlements. "... the extensive character of the Neolithic agriculture had forced the inhabitants periodically to leave the Tells and settle in the neighbouring territory." (My translation from the German)
3. It is debatable whether or not these sites should be called early Neolithic.

domesticated plants and animals. She may be thinking in terms of an opposition between permanent and shifting forms of agriculture or of a greater reliability of economies based on domesticates, but the text of her work is not clear on this point.

Carneiro (1977) has suggested that shifting agriculture is not the primary cause of shifting settlement; rather, a reliance on hunting and gathering to supplement agricultural products and/or the frequent occurrence of warfare are important mechanisms in making swidden agriculturalists shift their villages. Intensive agriculturalists are expected to have permanent settlements.

According to Carneiro:

... a heavy reliance on hunting is incompatible with sedentary village life. Even communities as small as 15,... [can] severely deplete the game in their vicinity in a year or two. After that, a village may need to be moved several miles away if the supply of meat is to continue to be met without an inordinate amount of walking time required (1974:159).

Interestingly, where fishing is the major source of animal protein no such need for relocation of settlements occurs. In such cases settlements can remain relatively permanent. A number of examples, both archaeological and anthropological, have been described (Carneiro 1974:159;

Drucker 1965; G. Clark and Piggott 1965:124; Spencer and Jennings et al. 1977:120; Bibby 1956:112; Srejović 1972; Tringham 1971:95).

To illustrate his point that hunting and gathering forces frequent settlement shifting, Carneiro used two communities of swidden agriculturalists in the Amazon basin. The first, a Kuikuru village, was primarily agricultural with some fishing. It has remained in its same location for the past eighty to ninety years (Carneiro 1974:159). On the other hand the Amahuaca community studied relied on hunting for fifty per cent of its subsistence and moved very frequently (Carneiro 1974:158). Unfortunately no reasons have been suggested for the choice of different economic strategies by the two groups.

Among tropical agriculturalists there is seldom a need to shift the settlement; only fields need be moved frequently (Carneiro 1977). Numerous studies have shown that populations of swidden agriculturalists are generally well below the carrying capacities of the areas they occupy (Brown and Brookfield 1963; Rappaport 1967; Carneiro 1974, 1977; Allan 1949; Sahlins 1972:44-45).

Of course since the south-eastern European climate is not tropical, hunting and gathering may not have

affected settlement patterns in the same way that it affects modern tropical agricultural settlements.

But Carneiro's idea that it is hunting and gathering which forces swidden agriculturalists to make frequent moves coincides very nicely with Tringham's suggestion that those Neolithic sites of south-eastern Europe at which hunting was important were relatively impermanent, while those at which hunting was of little importance were permanent.

Tringham's study unfortunately was not systematic. No attempt was made to test the suggested relationships. That these existed at all was indicated simply as a result of descriptions of the economies and settlement patterns of a number of Balkan sites over a period of three thousand years. The set of sites used to describe varying economies was not, however, the same as that used to describe settlement patterns. On this basis the supposed relationships could be simply spurious. In order to establish that this was not the case some form of verification using the same sample for both variables is necessary.

The explanation given by Tringham for the apparent economic differences she describes relied on environmental factors. Bökönyi in his History of Domestic Mammals in Central and Eastern Europe (1974) also linked

differing economies with geographic factors. The greatest proportion of Bökönyi's work has been done in Hungary. Writing about the early Neolithic sites of south-eastern Hungary, he claimed that the environment "left a strong mark on the fauna of the settlements (1974:21)." He pointed out that the domesticated animals imported from the Near East, particularly sheep and goats, were not necessarily well suited to "the geographic and faunal condition of... Hungary (1974:26)."

The data provided in Bökönyi's text and those found in Murray's The First European Agriculture (1970), which covered a wider area of the Near East and Europe, lend support to Tringham's and also Bökönyi's contention that wild animals were more important in the economies of north Balkan sites than they were in the south and to Bökönyi's contention (1974) that the importance of the various domestic animal species in the economies of Greek sites was quite different from that in the economies of sites in other parts of the Balkans.

The relative importance of the various species of animals in the economies of the different sites making up the analytical sample has been determined on the basis of reported bone finds. While the use of data reporting the minimum number of individuals would have been

preferable, the sample size would have been necessarily greatly reduced.

Two major problems arise from using available data. First, it is difficult to know how truly the reported faunal remains represent the actual economies of the various sites in the sample. Vagaries in preservation or sampling errors may have skewed the data. Second, the reliability and comparability of the faunal analyses included in the sample are uncertain. The faunal analyses are the result of the work of a number of different archaeozoologists. None of my sources of data have provided adequate information about the criteria they used in classifying the faunal samples, nor about how the samples were taken.

Despite the numerous problems involved in the use of already published data, such data provide the only possibility of testing relationships between economy and other aspects of human organization for large geographic areas or long time spans.

Insufficient floral data have forced me to restrict myself to testing relationships between the animals kept or hunted and the environment and between the fauna and site longevity.

Possible relationships between the floral and faunal aspects of the economy and their combined effect on

settlement will have to be revealed indirectly through discussions of settlement location and organization and of variations in the technologies discovered at particular sites.

The environmental factor which it was felt could be most easily related to economy over such a wide area was climate.

In fact, among the several elements (climate, terrain, economic minerals, soils, native vegetation, etc.) which in combination comprise the total natural equipment of any region for human use, climate probably is the single most important one causing variations in use potentialities between extensive regions of subcontinental size. This arises from the fact that not only is climate a highly important individual element of the total natural equipment of earth regions but also because it, more than any other element, influences the character of native vegetation, soil, drainage, and to a less degree the nature of the terrain or surface features as well (Trewartha 1954:3).

General climatic zones for the region can be relatively easily established using the modern climatic types and boundaries of Köppen as modified by Trewartha (1954), (Figure 4). There is some justification for using the modern climatic pattern to establish relationships between Neolithic economies, environment, and settlement patterns, since differences in climate between Neolithic times and the present are thought to have been relatively minor (Kosse 1979; Bintliff 1977:51;

Tringham 1971; Pécsi and Sárfalvi 1964; Rodden 1964; Nandris 1976; Butzer 1964; Weide 1976a).

Unfortunately, the Neolithic climatic patterns of the Balkans are not particularly well understood. Pollen diagrams for the region are few and climatic conditions have had to be interpolated from those obtained in northern and central Europe.

Weide (1976a:284), using information from Frenzel (1966), claims that in the period between 6500 B.C. and 3500 B.C. there were six well defined climatic shifts in Europe. In Hungary, according to Kosse (1979:34), as many as fourteen or fifteen minor climatic oscillations for the Atlantic period between 8000 B.C. and 0 B.C. have been distinguished by Borsy (1961) and Vozary (1957).

Table V provides a summary of the variation of Balkan climatic conditions as Weide interprets them.

Although there is evidence to suggest variation in the warmth and moisture in the overall climate of Europe during the Neolithic, nowhere have I found any evidence to indicate that the two major climatic zones now occurring in the Balkan region were not already in existence during the Neolithic. In fact, all the evidence I have been able to obtain points to their

TABLE V NEOLITHIC CLIMATIC CONDITIONS

<u>Period</u>	<u>Dates from</u> ^a	<u>to</u>	<u>Climatic Condition</u>
Boreal	6500+	6400	Warm and/or Dry
	6400	6200	Cooling and/or Wetter
	-----	6200	Cool and/or Moist
	6000	5900	Warming and/or Drying
Atlantic	5900	5800	Warm and/or Dry
	5800	5600	Cooling and/or Wetter
	5600	5300	Cool and/or Moist
	5300	5100	Warming and/or Drying
	5100	4850	Warm and/or Dry

(after Weide 1974a)

Note. Weide based this table on the work of Frenzel (1966).

^a Dates are estimated "True Age" B.C.

existence at that time. Bintliff (1977:5) suggests that climatic conditions in Greece during the Neolithic were much the same as at the present time. According to Bintliff: " a Mediterranean climate as today predominated over the entire Holocene in Greece until late antiquity. (1977:5)."

Pécsi and Sarfálvi (1964:63) suggest that in Hungary climatic conditions were a little wetter and warmer than at present. Finds by Bökönyi of Asiatic buffalo from a Neolithic site in northern Jugoslavia support this contention (Kosse (1979:33).

The question of where the boundary between the climatic zones lay during the Neolithic is another matter.

Then as now its positioning would have been affected by topographical conditions which have remained constant. But the pattern of atmospheric circulation which also affects the world's climatic pattern may have been somewhat different. The Balkans lie within the belt of westerly winds where alternation between cyclonic and anti-cyclonic air movements is an important weather producing factor (Trewartha 1954:75,83). Kosse suggests that winds from the south-west may have been more prevalent in Hungary during the Neolithic (1979:33). These would have carried more moisture than do the presently prevailing north-west winds (Pécsi and Sárfalvi 1964:33-34). Despite increased moisture, summers in Hungary may have been drier as a result of increased anti-cyclonic activity (Kosse 1979:33).

Since most sites in the sample used are well within either the modern Mediterranean or Humid Continental Climate zones the problem of locating the Neolithic boundary is perhaps of less significance than it might otherwise be.

Only two climatic zones have been used as the basis for examining the relationship between economy and environment, despite the fact that a third transitional climatic zone can be identified. This was done

because the climatic factor which is taken to be most important is the period of the year in which precipitation is greatest (Turrill 1929:131; Semple 1932:85). This criterion permitted a division of sites into only two climatic regions instead of three, since the major difference between the transitional climatic zone and either of the other two is in the amount of, rather than in the period of precipitation. The period of the year during which the greatest amount of precipitation occurs is viewed as being more important than the actual annual amount of precipitation because of the effect the period of greatest precipitation is expected to have on the timetable of crop growing, on the maintenance of suitable pastures and on the availability of wild foods throughout the year.

Where high temperatures coincide with low precipitation as they do in the Mediterranean climatic zone, then the evaporation of moisture from the soil during summer will be high, making crop growing and the maintenance of animals difficult at that period of the year.

On the other hand in a Humid Continental climate, where the period of greatest precipitation occurs in late spring and early summer and where winters are cooler, the growing season would be expected to begin

later in the spring and to extend later into the summer. Over-wintering of animals would be expected to be more of a problem than would be providing adequate summer pasturage.

Rather than use the tell as the criterion of longevity, as Tringham did, I have simply relied on classifying sites according to the Neolithic period or periods in which they existed. This was advisable for a number of reasons: first, data describing both economy and the type of archaeological formations resulting from settlement debris were seldom available for any given site; second, site description in general was very poor; and third, tell formation may or may not be a reflection of site longevity. Although Tringham associated the development of mound or tell formations with site longevity it is possible that climate and building materials had more to do with their development than did long term settlement (Tringham 1971:89).

Since the time span of each Neolithic period is very long, classifying sites into two classes, those which were inhabited only during the early, middle, or late Neolithic, and those which were inhabited during two or more of these time periods, is really a very crude measure of site longevity. For example, the early Neolithic period lasted for about one thousand

years. The result of any attempt to relate subsistence economy to site longevity with such a crude measure can only be expected to show that at some sites permanence of settlement was really well established, while at others, occupied only during one Neolithic period, settlement may or may not have been of great permanence. For example, Kosse suggests that Körös sites remained in existence on average for about seventy-five years (1979:129). This must be considered as very short term settlement, however, when compared with sites whose remains span the period from the early Neolithic to the end of the Neolithic period and longer.

On the basis of a systematic study of quantified faunal data, location of sites within particular climatic zones and site longevity, using an availability sample (all sites from which appropriate data were available) I proposed to examine the following possible relationships:

1. In the Mediterranean climatic zone of south-eastern Europe, given the Neolithic technology and a subsistence strategy which included both agriculture and herding, there was very little reliance on wild animal species to supplement the diet.
2. In the Humid Continental climatic zone of south-eastern Europe, given the Neolithic technology and a subsistence strategy which included both agriculture and herding, wild animal species were an important means of supplementing the diet.

3. In the Mediterranean climatic zone, given the Neolithic technology and a subsistence strategy which relied on agriculture and herding, sheep and goats were the dominant domestic animal species.
4. In the Humid Continental climatic zone, given the Neolithic technology and a subsistence strategy which relied on agriculture and herding, cattle were the dominant domestic animal species.
5. Villages of the Balkan Neolithic which relied in large part on hunting to supplement the diet provided by agriculture and herding were less permanent than those which relied almost entirely on agriculture and herding.

The results obtained by testing these proposed relationships in themselves provided useful information, but the true meaning of such relationships could only be revealed by a study of further factors which might be expected to affect economic and settlement patterns. Factors of particular interest were environmental ones, other than climate, and the needs of the various plants and animals used.

Those environmental factors which were viewed as having a particularly marked effect on subsistence economies, especially those based on agriculture and herding, and therefore indirectly on settlement patterns as well, are soils, water courses, natural vegetation and topography. The importance of each of these factors lies in how it restricts or encourages the growth of the various nutritional sources used.

Logically, one would assume that the most important plants and animals in the economy of a particular settlement would be those which, given the local environmental conditions and the level of technology, would be the most productive. Traditional preference, however, may emphasize plants and animals which are more difficult to raise rather than those best suited to local conditions. Unless there is extremely strong evidence to the contrary we must assume reliance on those utilized species which are most productive. But if it can be shown that the preferred species in the economy are not those best suited to the local habitat, one might expect that economy to be one recently transferred from one type of habitat to another, and that the preferred food elements reflect the conditions of the original rather than the new habitat.

In addition to relating environmental conditions to the differing requirements of the various plants and animals known to have been used in the Balkans during the Neolithic one must consider the productivity of the various species in terms of the area required to produce equivalent nutritional and caloric values. At present there seems to be no successful way to determine the relative meat weights of various animals (Casteel 1978),

but it is obvious that this is a factor which it is important to consider in determining the relative importance to the economy of various species.

In order to understand the relative importance of each individual species to the economy, it is necessary to discover as much as possible about the ways in which the whole cluster of utilized plants and animals relate to one another. The relationships between plants and animals in general and between particular species of each will be important factors in organizing the yearly round of labour and in determining settlement location and site longevity.

It is obvious that the group of domesticated plants and animals utilized in the Balkans during the Neolithic is a particularly compatible cluster of species and that none is greatly restricted in the type of geographical regions suitable for its growth and development. Each species is found at sites in all areas of the Balkans from the beginning to the end of the Neolithic period and this pattern continues into the present day. In fact all the domesticated species with which we are concerned can be and are adapted with man's help to a wide range of geographic and climatic settings, and

indeed their adaptability may have been one of the prime characteristics of all these species which encouraged man to domesticate them.

V. ENVIRONMENTAL FACTORS

Certain environmental factors have a greater impact on man than others. For farmers and herders, topography, native vegetation, and soil quality are all factors which affect economic and settlement patterns. All are in turn intimately related to climate. A mountainous topography changes general climatic patterns as it redirects air currents. Soils and vegetation are direct results of the climatic regime and geomorphological structure.

In the following discussion of environmental factors, for practical reasons, modern political boundaries will be used to organize the information. Prehistoric settlements were in fact related to natural regions rather than to these modern boundaries, although the present day borders in most cases follow natural barriers.

TOPOGRAPHY

The land forms of the area being studied (Figure 2) fall into two quite distinct categories. In the north there is the low-lying flatland of the Pannonian plain. South and east of the Sava and lower Danube rivers (Figure 3) all of the territory is characterized by an alternation of high rugged mountains, lower, gentler hills, and fertile river valleys, depressions and coastal plains.



FIGURE 2 REGIONAL MAP OF SOUTH-EASTERN EUROPE

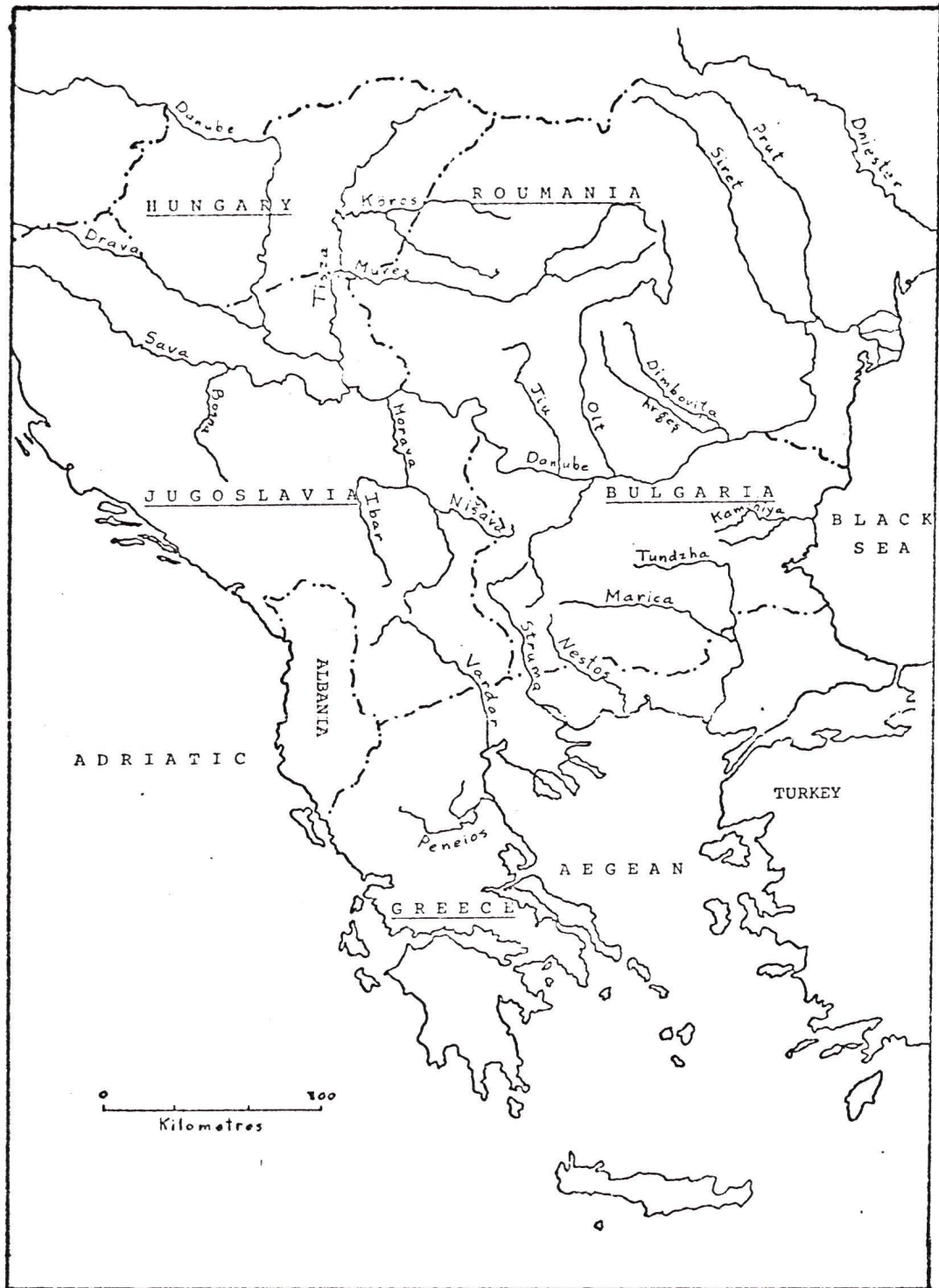


FIGURE 3 MAP OF MAJOR RIVERS IN SOUTH-EASTERN EUROPE

The Pannonian Plain Of Hungary And Northern Jugoslavia

The only part of the entire area under consideration that is flat and open is the territory along the Tisza and Körös rivers of Hungary and Jugoslavia, and the regions of Jugoslavia known as Vojvodina and Slavonia. The latter are drained by the Danube and its major Jugoslav tributaries, the Sava and Drava. Both areas are part of the Pannonian plain which is the major geographic feature of Hungary.

The plain consists of three levels, all of which are low in elevation. First, there are the present flood-plains of the rivers; second, the terraces or levees of alluvium, which are just above the flood-plains; and third, one hundred to one hundred and fifty metres above sea level there are loess plateaus (Great Britain Naval Intelligence 1944:36-37).

The southern limits of the plain are marked by the flood-plain of the Sava river. Here the foothills of the Dinaric alps begin. A number of rivers flowing north from the valleys of this alpine region feed the Sava, which flows east to enter the Danube at Belgrade. The Sava plain is divided by a belt of low hills from the similar plain of the Drava to the north. The Drava, like

the Sava, flows in an easterly direction, but enters the Danube further upstream. The major river of the plain, other than the Danube itself, is the Tisza, which flows south to join the Danube just north of Belgrade.

Apart from these major rivers, few streams drain the Pannonian plain (Pécsi and Sárfalvi 1964:42).

Prior to the nineteenth century much of the plain was a marsh, subject to yearly inundations. According to Pécsi and Sárfalvi:

Up to the middle of the last century, there were some one million hectares of swamps along the Danube and well over two million along the Tisza, practically useless for agriculture (1964:50).

The Tisza and its tributaries, including the Körös, are slow-moving streams which meander across the Pannonian plain frequently changing their courses, and leaving ox-bow lakes where the rivers flowed in former times (Pécsi and Sárfalvi 1964:47).

Flooding on both the Danube and Tisza-Körös river systems occurs twice annually, in early spring and in early summer, the latter inundation being the more extensive (Pécsi and Sárfalvi:46-49). On the Drava there is a third flood season in early autumn (Kosse 1979:69).

Early Neolithic occupation in Hungary and northern Yugoslavia was restricted to lands along the banks of the Tisza and Körös rivers. Settlement further west between the Danube and Tisza watercourses was restricted because of the dry, infertile sand hills which separate the two river systems (Pécsi and Sárfalvi 1964:10; Bognár-Kutzián 1966:250; Kosse 1979:94).

Along the banks of the Tisza and Körös rivers natural levees have been formed as a result of the silt left by the annual floods. These offered some protection from the yearly inundations and were the favoured locations of Hungarian Körös sites (Kosse 1979:125). There is general agreement that all early Neolithic sites in Hungary, northern Yugoslavia, and northern Roumania were located beside rivers (Galović 1962-23:1; Tringham 1971:91; Berciu 1967:39; Sulimirski 1970:58; Daicoviciu and Condurachi 1972:29).

The Balkan Zone

All of the area south of the Pannonian plain lies within the Balkan zone. Over the majority of the Balkans the underlying structure is of cretaceous limestone, the result of recent mountain building. The Dinaric alps and the Carpathians were formed during the Tertiary (Tringham 1971:26-28; Great Britain Naval Intelligence 1944:4). The Pindhos mountains and other fold mountains

of Greece were formed in phases from the late Mesozoic to the middle Tertiary (Bintliff 1977:6-7).

The Rhodopes of south-western Bulgaria, south-eastern Yugoslavia, and north-eastern Greece were formed earlier, at the end of the Carboniferous period, and consist mainly of granites and gneisses. They are much more eroded than are the Dinaric, Carpathian or Pindhos mountain systems (Tringham 1971:26-28).

1. Jugoslavia: i. The Dinaric Alps: The backbone of the whole of the Balkan province is formed by the Dinaric alps, running from the north-west to the south-east for almost the entire length of Yugoslavia, from the Sava plain in the north to approximately the Albanian border. In this region they meet the Pindhos mountain chain. Mountains of the Dinaric system reach elevations of as much as twenty-seven hundred metres above sea level.

The underlying structure of the Dinaric alps is almost entirely limestone. This creates a barren landscape known as karst. The most important feature of the karst from an agricultural point of view is the polje (Herak and Stringfield 1972:35). Polja (singular polje), an important geological feature throughout the Balkans, are elongated valleys which vary in length from

as little as one kilometre to as much as sixty kilometres or longer. Their name, which means cultivated fields, is indicative of their great importance to the agriculture of the region, both in the present day and during Neolithic times (Barker 1975; Great Britain Naval Intelligence 1944:12). Polja floors were once lake bottoms which have left fertile alluvial soils. In winter the bottom lands of many polja are flooded (Great Britain Naval Intelligence 1944:12). Polja are associated not only with limestone regions, but are also found in the Rhodopes. However, in the karst regions where barren limestone scarps rise all around them, the polja usually provide the only cultivable soils (Great Britain Naval Intelligence 1944:12; Turrill 1929:138).

The Dinaric alps along with the Pindhos and Peloponnesian ranges of Greece have had a profound effect on the climatic regimes of the Balkan peninsula, in that the prevailing westerlies drop their moisture on mountain slopes facing the Adriatic, leaving the interior in a rain shadow. In addition the direction of water flow has been very much controlled by the mountain systems. Few rivers flow west from the Dinaric alps and only one, the Neretva is of any consequence. The hydrographic apex of the Balkans, from which waters flow in

three directions into the Adriatic, Aegean and Black Seas is located in the Šar Planina near the Albanian border, where the Dinaric and Pindhos mountain systems meet (Great Britain Naval Intelligence 1944:14).

ii. The Central Mountain Systems: In the south-east the Rhodope massif extends into Yugoslavia. Between this massif and the Dinaric alps are a series of mountain systems. This is a region of more varied rocks than are found in the Dinaric zone, including sedimentaries, crystalline rocks and volcanics (Great Britain Naval Intelligence 1944:4).

North of the Rhodopes between the Morava and Timok river valleys, both tributaries of the Danube, is a small section of the Carpathian mountain chain. It stretches from the Iron Gate on the Danube to the Bulgarian border. The Stara Planina of Bulgaria is simply a more rugged extension of this part of the Carpathian chain.

The series of mountain chains and depressions which are the characteristic landscape of Yugoslavia run in a north-south direction. As a consequence the vast majority of rivers run either north to enter the Danube system or south directly to the Aegean.

iii. The Morava-Vardar Corridor: Among the major rivers of Yugoslavia are the Vardar (Axios), which flows south into the Aegean and the Morava, which, with its major tributary the Ibar, flows north to the Danube. These rivers form what is known as the Morava-Vardar corridor. Today the major north-south highway follows the valleys of these two rivers. Gimbutas (1974:26) believes that in prehistoric times, at least a portion of this route provided a communication link between the Aegean and Serbia. South of Titov Veles the Vardar passes through narrow gorges, difficult of passage. The Roman road apparently avoided these, and followed instead tributaries of the Haliakmon to the west, as far as Prilep, and from thence east to the Vardar near Titov Veles (Gimbutas 1974:26). From here the road followed the Bregalnica, a tributary of the Vardar, which offered an easy route to the Morava and thence to the Danube. The Morava also provided an access route to Thrace via a tributary, the Nišava, to the Sofia Basin in Bulgaria, and along the Iskur to the Marica valley.

While access from north to south is relatively easy through the major river valleys, travel from east to west is anything but easy. The Dinaric alps form a formidable barrier to communication between the interior

and the Adriatic coast. "Width, height and lack of passes make the Dinaric system maintain in a pre-eminent degree the barrier nature of mountains (Semple 1932:217)." Only a very few passes provide access, and these are approached by long routes across the highlands (Semple 1932:217). Even today few roads lead from the coast to the interior and to build these has required tremendous feats of engineering. It is, therefore, not surprising that the Neolithic cultural traditions west of the Dinaric alps were more similar to those of Italy than to those of the central Balkans.

iv. The Danube Drainage System: Except for the Vardar and the westward flowing Neretva, almost all the rivers of Jugoslavia form a part of the great Danube drainage system. Chief among these is the previously mentioned Sava, which drains both the Julian and Dinaric alps. Into it from the south flow the Una, Vrbas, Bosna and Drina river systems.

East of Belgrade, and not long before the Danube enters the narrow and turbulent Iron Gate gorge, the Morava adds its waters to the river and east of the Carpathians, the Timok flows into the river where the borders of Jugoslavia, Roumania and Bulgaria meet.

In the Balkan zone of Yugoslavia the rugged terrain has confined settlement to the alluvially floored polya and to low-lying lands in the valley bottoms. The majority of early Neolithic sites are found in the Morava-Vardar corridor and in the Bitola polje of south-western Macedonia (Barker 1975:86-87).

2. Greece: i. The Mountain Systems: Mountains cover almost the entire Greek territory. Therefore, the few fertile valleys and narrow coastal plains were particularly important for the maintenance of pre-historic agricultural communities, and they remain so today. If, as Bintliff claims, sea levels were several metres below present levels during Neolithic times these plains may have been somewhat more extensive at that time.

The backbone of mainland Greece is formed by the Pindhos mountain range, which separates Adriatic from Aegean Greece.

A break between these mountains and the Peloponnesian peninsula is formed by the Gulf of Corinth. The Peloponnese contains two important mountain ranges, the Parnon on the west and the Taygetos on the east (Bintliff 1977:373).

In the north-east the Rhodopes extend into Greek Thrace and Macedonia. North of Thessaly and separating this province from Macedonia is the Olympus range crowned by Greece's highest peak, Mt. Olympus, more than 3150 metres above sea level.

The numerous islands of the Aegean are also mountainous.

Many of the islands are remnants of a land bridge that once connected Greece and Asia Minor. The islands are actually mountaintops that remained above water when the land bridge subsided millions of years ago. Some of the islands are of volcanic origin... (Keefe et al. 1977:58).

The largest valleys and plains are found in Thessaly and Macedonia, where the majority of known Neolithic sites are located (Appendix 2).

ii. Macedonia and Thrace: These are the northernmost provinces of Greece. They contain a considerable amount of low-lying land, much of which was marshy until recent reclamation projects were undertaken (Bintliff 1976:244). Four major rivers drain Macedonia and Thrace beginning in the east with the Marica, followed by the Nestos (Mesta), which forms the border between Macedonia and Thrace, the Struma and finally in the west the Vardar (Axios). Only short stretches of these major Balkan rivers flow through Greek

territory. All are subject to flooding during the winter season and where they cross the plains their channels are apt to change after every heavy storm (Semple 1932:108).

Such is the pattern of all major rivers and streams throughout the Mediterranean (Semple 1932:108). This pattern is unlike that of the great continental river systems, with their regular spring season floods brought on by the gradual melting of the mountain snow pack and later by spring rains. The waters of the continental rivers rise slowly and steadily throughout the flood period; those of the Mediterranean rise rapidly, virtually overnight, as a result of the extremely heavy though irregular rainfalls of the winter months.

iii. Thessaly and the Plains of Southern Greece:

Thessaly, to the south-west of Macedonia, contains the largest single plain. It is drained by the Peneios river which rises in the Pindhos mountains. Near the coast is the large lake, Boebeis (Karla), the marshy area around which has been greatly reduced by reclamation projects in this century (Keefe et al. 1977:50).

South of Thessaly only relatively small areas of land suitable for agriculture are available. Crops are

grown in the Sperchios valley of Boeotia, on the coastal plains of Attica, and on the island of Euboea. In Boeotia the marshes of Lake Kopais have been drained to increase the amount of agricultural land.

In the Peloponnese the principal agricultural areas are found in the Argolid, in Laconia and in Messenia. These are either coastal plains or valleys formed by small rivers which dry up during the summer months.

iv. The Aegean Islands: For the most part the Aegean islands are not well suited to agriculture. But the larger islands have limited amounts of arable land.

The largest and best known of the Greek islands is Crete. It consists of four separate mountain groups, each separated from the next by upland basins (Keefe et al. 1977:56; Turrill 1929:10), which range in elevation from nine hundred to fifteen hundred metres above sea level. These basins afford plenty of summer pasturage (Turrill 1929:10).

Only three-eighths of the land area of Crete is given over to the growing of crops (Durrell 1978:93). Little of this arable land is suitable for grain growing. Grains are planted only on the small alluvial plains created by the short streams, dry in summer,

which flow north and south from the mountains. The Messara plain of south-central Crete is the largest single arable area.

v. Extent of Arable Land in Greece: Since about eighty per cent of the land surface of Greece is mountainous, the total area available for agriculture is small. About thirty per cent of the land is arable (Keefe et al. 1977:42), and much less is suitable for grain growing. The rest consists of rocky mountain slopes which, however, provide summer pastures for flocks of sheep and goats. In winter the highest slopes are snow covered. Vlach herders maintain permanent homes in the mountains of northern Greece but descend to the Thessalian plains for the winter (Wace and Thompson 1914).

3. Bulgaria: The situation in Bulgaria is similar to that of Greece, but the country is somewhat less mountainous. Still almost two-thirds of the land mass consists of mountains (Mihailov and Marinov, n.d.:32). All the topographical features of the country run in a generally east-west direction.

i. The Rhodopes: The Greek-Bulgarian border runs through the Rhodope mountains. These extend from the Sofia basin in the north-west to the Greek-Turkish

border in the south. In central Bulgaria the Marica valley marks the limits of this zone of granite mountains. The Rhodope massif is the highest mountain range of the Balkans with several peaks reaching heights of over three thousand metres. On the north facing slopes of the highest peaks snow may be found year round (Mellor 1975:20).

Four of Bulgaria's major rivers have their headwaters in the Rhodopes. The Struma, Mesta (Nestos) and Marica rivers flow south to the Aegean, while the Iskur flows north into the Danube and thence to the Black Sea. Nevertheless, access to the Rhodope massif is in general very difficult.

ii. Thrace: North of the Rhodopes the Thracian plain extends from an area south-east of the Sofia basin to the Black Sea. Included in this plain is the Marica valley, which contained the majority of prehistoric settlements in Bulgaria (Appendix 2).

The valleys formed by the Marica river and its major tributary, the Tundzha, also form the modern economic core of Bulgaria (Mellor 1975:20). These valleys together with a coastal plain along the Black Sea are called the Thracian plain. More than twenty thousand square kilometres of the plain are drained by

the Marica river system. Extensive areas of marsh are found in the Marica basin (Turrill 1929:127).

The coastal plain is separated from the alluvial plains by the Strandzha hills through which runs the border with Turkey.

iii. The Danube Plateau: Another area in which a large number of Neolithic sites have been discovered is the Danube plateau, which forms the northern frontier of Bulgaria. This loess plateau (Wheeler et al. 1955: 205). extends from the Yugoslav border in the west to the Black Sea and rises from heights of between one hundred and three hundred metres above sea level along the south bank of the Danube to heights of between four and five hundred metres above sea level where it merges in the south with the Stara Planina mountains. Today this dry but fertile area is the primary grain growing region of the country (Mihailov and Marinov, n.d.:9). Settlement location is largely determined by the location of springs (Mellor 1975:32).

iv. The Stara Planina and Sredna Gora: Between the Danube plateau and the Thracian plain are two mountain ranges, separated by the Valley of the Roses, which is drained by the Tundzha river. The more northerly and more elevated of these mountain ranges is the

Stara Planina with its highest peak reaching an elevation of 2379 metres above sea level.

The Stara Planina, the most southerly extension of the great chain of the Carpathians, is a complex of mountains and upland basins or polja (Mellor 1975:19) which stretches six hundred kilometres from the Yugoslav border to the Black Sea. The northern slopes of the Stara Planina are fairly gentle but on the south above the Valley of the Roses they are steep and rugged (Dennell 1978b:113).

A number of rivers flow north from the Stara Planina through the Danube plateau. Deep valleys have been cut by these rivers as they pass through the plateau on their way to the Danube which flows here between Bulgaria and Roumania sixty to one hundred metres below the level of the plateau (Keefe et al. 1974:38).

To the south of the Stara Planina the Sredna Gora rises to heights of seventeen hundred metres above sea level. Its warm south facing slopes are cultivated. Where the Sredna Gora meets the Thracian plain soils are deep and fertile (Mellor 1975:20), and it is just here where some of the largest of Bulgaria's Neolithic tells are located.

v. The Sofia Basin: In the west between the northern limits of the Rhodopes and the western limits

of the Stara Planina is the Sofia basin enclosed on all sides by mountains. This basin, a typical large polje has a length of about one hundred kilometres and a width of approximately twenty. The floor of the basin is not flat but broken up by occasional hills (Mellor 1975:20). Such hills or hums are a common feature of the karstic polja (Herak and Stringfield 1972).

A number of other smaller polja are found throughout the Stara Planina and Sredna Gora and in the valleys of the larger rivers (Keefe et al. 1974:41).

vi. Black Sea Coast: In the east the boundary of Bulgaria is formed by the Black Sea with its alternating rocky cliffs and sandy beaches. The Black Sea coast is divided into three zones: the Thracian plain in the south; the Kamchiya river system, draining the Stara Planina in the middle; and the steppes of the Dobroudja in the north. The Dobroudja is the most easterly section of the Danube plateau. It differs from the rest of the plateau, however, in that few rivers drain this section, leaving it flatter, drier, and less dissected (Mellor 1975:22). Most of the streams that do flow through the Dobroudja are intermittent (Times Newspapers 1975:Plate 82).

4. Roumania: i. Wallachian Lowlands: During the Neolithic the most populated area of Roumania was the Wallachian lowlands on the north bank of the Danube (Appendix 2). These fertile lowlands extend from the Iron Gate gorge in the west to the Danube Delta in the east, a distance of some three hundred kilometres. The width of the plain varies from about one hundred to a hundred and fifty kilometres. The lands of Wallachia slope towards the south and east, varying in elevation from two hundred metres to fifteen metres above sea level (Moraru et al. 1966:37).

The flat lands along the Danube are subject to annual flooding with the peak occurring in June (Keefe et al. 1974:41; Turrill 1929:128; Turnock 1974:67). There are extensive areas of marshland in a band of up to thirty-five kilometres wide for the entire length of the Danube (Keefe et al. 1972:34; Espenshade and Morrison 1974:165; Moraru et al. 1966:38).

The Wallachian plains are well watered by a number of rivers flowing south out of the Carpathians. Chief among them are the Jiu in the west, and moving east, the Olt, the Vedea, the Argeş, and Dimboviţa, the Ialomiţa and in the east the Siret.

Smaller plains occur along the Hungarian-Roumanian border, where the Tisza river plain extends to the edge

of the western Carpathians and in Dobrogea, between the Black Sea and the Danube.

Where the Danube enters the Black Sea a major delta has been formed. Only thirteen per cent of this Delta region is dry land. The remainder consists of marshes (sixty-two per cent) or backwaters (Moraru et al. 1966; Klein 1980). In spring and winter the marshes are flooded but in summer they dry up and are "covered with a lush vegetation (Turrill 1929:129)." Today these marsh and flood lands serve as summer pastures (Turnock 1974:67).

ii. The Carpathians: A very large part of Roumania is mountainous. The backbone of the country is formed by the arc of the Carpathians. In the east, running in a generally north-south direction are the eastern or Moldavian Carpathians. This region consists of a chain of volcanic mountains to the west, and the Carpathians proper in the east with a series of depressions between. Two of the major rivers of Roumania, the Mureş, a tributary of the Tisza, and the Olt, which flows directly into the Danube, pass through these depressions from their headwaters in the Moldavian Carpathians. The elevation of the depressions

ranges from about five hundred to about eight hundred metres above sea level. Settlement in the eastern Carpathians is restricted to these basins (Mellor 1975: 16). The highest peaks of the Moldavian Carpathians rise to about twenty-three hundred metres above sea level (Moraru et al. 1966:14-18)..

East of the Moldavian Carpathians are the sub-carpathian hills, whose average elevation of four hundred metres above sea level is well below the heights reached in the mountains. The hills run north and south in long ridges which are separated from one another by a number of depressions (Moraru et al. 1966: 29). This region of alternating ridges and depressions reaches to the Prut river which forms the boundary between Roumania and the Soviet Union.

The southern Carpathians or Transylvanian alps separate the Wallachian plain from the tablelands of Transylvania. The mountain slopes facing Wallachia are more gentle than are the steep-sided northern flanks of the range (Mellor 1975:16). Roumania's highest peaks are found in this range. Most peaks in the range, rise to levels of between twelve hundred and two thousand metres above sea level (Moraru et al. 1966:19). In the west the Transylvanian alps are separated from the

southern extension of the Carpathians in Jugoslavia and Bulgaria by the Iron Gate gorge of the Danube.

One other major mountain range exists in Roumania. This is the Bihor massif or western Carpathians. It encloses the western side of the Transylvanian depression. These mountains, lower than the other Carpathian ranges, are separated from the Transylvanian alps by the Mureş river. They were never glaciated and are therefore more rounded than the other mountain ranges (Mellor 1975:16-17)..

iii. Transylvanian Basin: The Transylvanian basin is a large tableland about a hundred and fifty kilometres wide by two hundred kilometres long and enclosed on all sides by ranges of the Carpathians. It lies at an elevation of about six hundred metres above sea level. For the most part it is a gently rolling hill country but in some places the basin is quite flat. Most of the rivers draining it flow into the Pannonian plain but the Olt flows south through a gap in the Transylvanian alps to the Danube (Mellor 1975:17).

SOILS

Soils appear to have played a very important role in determining Neolithic site locations in south-eastern Europe. Studies dealing with the relationship between

soil type and settlement pattern have been carried out by Bintliff (1977), Dennell (1978b), and Kosse (1979). The regions dealt with in these studies are southern Greece, southern Bulgaria and Hungary.

As with the topography of south-eastern Europe soil classification can be divided into two zones. North of the Sava-Drava basin the characteristic soils are wind-blown loess. South of this basin the majority of soils are the result of erosion of the underlying limestone structure.

The Pannonian Plain

North of the Sava-Drava basin with its brown forest soils, the loess soils of the Pannonian plain include the chernozems, typical of a semi-humid sylvan steppe (Kosse 1979:97; Somogyi 1964:36), and sziksoils, the characteristic soils of the true steppe (Somogyi 1964:37). The chernozems are very fertile, but because of a lack of moisture their productivity is reduced (Kosse 1979:97). However, meadow chernozems, which form where the water table is high, are well-watered. These are the most fertile soils of Hungary (Kosse 1979:97). In addition to the fertile loess soils there are also large areas of infertile windblown sand (Mellor 1975:30; Pécsi and Sárfalvi 1964:90-91; Kosse 1979:94).

Along the rivers where drainage is poor, meadow soils are extensive (Kosse 1979:97). In areas where annual flooding occurred in the past, alkali sziksoils known as solonetz have developed. These contain a high concentration of sodium (Kosse 1979:29; Somogyi 1964:43-44), in contrast to the high calcium content of chernozems (Somogyi 1964:37). The fertility of solonetz soils varies depending upon the depth of the A horizon. Deep solonetzes are the most fertile (Kosse 1979:29).

Kosse, in her study of Körös site locations, found that three soil types were preferred. Fifty-five per cent of sites are located on meadow soils, fifteen per cent on meadow chernozems, and ten per cent on meadow chernozems whose deeper layers are salty (Kosse 1979:102-103).

The Balkan Region

South of the Sava-Drava basin the soil regime is quite different. Soils throughout the Balkan zone are divided into two classes, calcareous or non-calcareous. Calcareous soils are those formed from limestone, while non-calcareous soils are those formed from all other types of rock (Great Britain Naval Intelligence 1944:257; Bintliff 1977:91-100).

1. Jugoslavia: Mellor (1975:31) describes Jugoslavia as "the pedological museum of Europe" because of the great variety of soil types found within its borders.

i. Karst Zone: In the zone of karst, that is, in the zone on the western margin of the area being studied, soils are especially poor and thin. Bare rock is exposed over much of this zone. Only in the polja are soils suitable for agriculture to be found. These soils are variable and include black earths or chernozems, grey or brown forest soils and terra rossa (Mellor 1975:32). The latter, named for its red colour, is found only in regions of hard limestone or karst.

The terra rossa is a soil formed only in Mediterranean climates, and is derived from dissolving limestone. It consists of the residue, including iron compounds, which remain after the calcium carbonate has been dissolved. Terra rossa is a rather granular soil, but when mixed with organic debris it becomes a fertile and easily worked agricultural soil (Great Britain Naval Intelligence 1944:296).

Brown forest soils and podzols cover the northern slopes of the Dinaric alps. On the eastern slopes of the range are large areas of skeletal mountain soils, mostly

calcareous, including rendzinas. Skeletal podzols are found in a wide belt east of the Dinaric alps in the central part of the country (Mellor 1975:31). These are acid soils of low fertility and little humus, which are typically found at higher altitudes in areas of moist and cold climates (Bengtson and Van Royen 1956:110).

ii. Morava-Vardar Corridor: East of this belt in the Morava-Vardar corridor, the main soil types are brown earth and smolnitzas. These are soils typical of wetter districts. Brown earth contains more humus than do the podzols, but their content is, nevertheless, not especially high (Great Britain Naval Intelligence 1944: Figure 97).

The smolnitzas are heavy soils found on high lacustrine terraces and formed on lacustrine clays. These are rich soils, with high humus content but they require deep ploughing (Barker 1975:88). During the Neolithic it is, according to Barker, unlikely that such soils were used for growing crops.

In the Morava-Vardar corridor the soils which are more likely to have served as crop-land during the Neolithic are the diluvial soils, formed where mountain streams enter the flat valley bottoms, and the riverine soils, which form on recent alluvial deposits (Barker 1975).

East of the corridor of brown soils, skeletal mountain soils again predominate (Great Britain Naval Intelligence 1944: Figure 97).

2. Greece: i. Non-Calcareous Soils: In Greece calcareous soils are most common, although non-calcareous soils are important in many of the Aegean islands. On Melos, for example, volcanic tuffs predominate. These only become useful for agriculture where there is sufficient moisture to allow chemical weathering to dissolve the glassy matrix. On Melos only where there are depressions has it been possible for such weathering to occur (Bintliff 1977:93,97).

Other non-calcic soils are the chestnut, grey and brown forest soils, relatively rich in clay, humus and nutrients, which are found in northern Greece. In the south-east and on the Aegean islands a Mediterranean dry forest soil is found, which is low in clay, humus, and nitrogen.

ii. Rendzinas: Most of the Greek soils are formed from limestone. These are of two types, the terra rossa which results from the chemical weathering of hard limestone, and the rendzinas which are the result of the weathering of soft limestone (Bintliff 1977:92,99). The

latter soils are particularly important for Greek agriculture.

The silt texture and the Calcium act to give the soil a characteristic property of moistness and notable Nitrogen retention; as a result the Rendzinas are also known as 'Humus-Carbonate Soils'. Reaction is basic and leaching low, but the light texture of the soil can lead not only to easy tillage but easy loss of the A horizon, so that frequently farmers are cultivating the embryonic soil of the underlying horizon (Bintliff 1977:92-93).

It is important that tilling of rendzina soils be not too deep. According to Bintliff:

... Rendzina soil occupies pride of place (after the recent alluvial soil) in the Aegean belt.... It is... the ideal soil for retaining water particles through the dry summer, for converting humus and other organic debris into stored nitrogen, and for forming a good soil tilth for easy working (1977:99).

Almost all known prehistoric settlements in Crete, including Knossos, and in the Peloponnese have been discovered on rendzina soils (Bintliff 1977:99).

iii. Alluvial Soil Development: There have been two major periods of alluvial soil development in the Mediterranean. Vita-Finzi (1969:92-102) calls the alluvial soils of these two periods the "older fill" and the "younger fill". As the alluviation of the "younger fill" did not take place until classical times

or later⁴, our only concern is with the soils of the "older fill" which were formed prior to the Neolithic period (Bintliff 1977:42).

iv. The "Older Fill": The soils of the "older fill" are red in colour and similar to the terra rossa soils. It is in fact, derived mainly from hard limestones, as is the terra rossa, but it also includes soil produced from other types of rocks (Bintliff 1977:92).

It is very important when studying prehistoric agriculture to make the distinction between the "older" and "younger fill". Otherwise one can easily gain an erroneous view of the soils available to Neolithic farmers.

A... result of the Historical Alluviation is to landlock numerous prehistoric and historic coastal sites, creating the false impression that they formerly dominated alluvial plains as at the present day (Bintliff 1977:48).

The "older fill" is relatively fertile but the "younger fill" is much more so. Thus this more recently deposited alluvial soil must have had a considerable effect on the development of later Greek agriculture.

4 Bintliff believes that this alluviation occurred in late Roman and Mediaeval times (1977:42).

Nevertheless, the "older fill" is considered by Anastassiades to be the most widespread soil in Greece (Bintliff 1977:100). Despite this, Bintliff (1977:100) claims that few prehistoric sites are located on this fill, and those which are, are usually found on the prehistoric coastline and include rendzina soils within their farming territory. But Dakaris et al. (1964:200) state that, "It became evident that a certain type of bright-red weathered limestone was likely to contain Neolithic and on its surface Bronze Age artifacts...".

3. Bulgaria: In Bulgaria a number of different soil types occur. The poorly drained smolnitzas, forest and riverine swampy soils, which today are important for agriculture, would have been unsuitable for farming in Neolithic times. They were probably important grazing areas (Dennell 1978b:68,70).

During the Neolithic it is more likely that diluvial sandy soils, sandy riverine soils and eroded types of forest soils were preferred, although these are not as fertile as the smolnitzas (Dennell 1978b:68,70).

Dennell suggests that:

... soil ecotones, formed where different soils grade into each other, may have been of especial significance. Fertile soils too heavy to till become more amenable mechanically where there is an admixture of less

fertile sandy soils; conversely, sandy soils are made more water-retentive and more productive by the inclusion of a heavier component (1978b:68-69).

In a series of site catchment studies Dennell has shown that Bulgarian Neolithic sites are located in areas which provide access to alluvial and diluvial meadow soils. Other soils within the site catchments vary depending upon the region. In addition to providing arable lands, site catchments provide access to permanent or seasonal grazing lands (Dennell 1978b).

According to Dennell, there is a correlation between the height of tells in the Nova Zagora region of north-eastern Thrace and the amount of available arable land. Those, such as Karanovo, established where arable land is plentiful are much higher than those whose catchment areas consist mainly of grazing lands (1978b:137).

4, Roumania: More than fifty-six per cent of the soils in Roumania are forest soils. Steppe and sylvo-steppe soils, that is chernozems and grey forest soils, make up about thirty-one per cent of soils. A little less than nine per cent are flood-plain soils, and swamp and salt marsh soils make up the remaining four per cent (Moraru et al. 1966:53).

In the Wallachian plains large areas of reddish brown forest soils are found. Similar soils are found in

the Transylvanian basin, in Banat, and in Moldavia, but in these latter regions are also found "large areas of podzolised soils on the Bîrlad Plateau and along the Carpathian foothills and footslope (Mellor 1975:53).

In Dobrogea and Moldavia, black earths or chernozems of several types are found (Mellor 1975:31; Moraru et al. 1966:53). These are fertile soils but require irrigating for successful agriculture (Bengtson and Van Royen 1956:110).

NATIVE VEGETATION

Because of the mountainous terrain which produces a myriad of micro-climates and a variety of soil conditions vegetation communities vary considerably in the Balkans. Plant communities are much more varied in the Balkan zone, than in the Pannonian plain where there is little topographic variety and where climate is more or less the same throughout, and most varied within the region of Mediterranean climate.

Slavík divides the Balkans, including the Pannonian plain into four phytogeographic zones. The Pontic zone includes all of lowland Roumania, the Danube plateau, and the Pannonian plain. All of Greece, except for the highest mountain areas, is within the Mediterranean zone. All other regions, except for the higher mountain

ranges of the alpine zone, are included in the Sub-Mediterranean zone (Slavík 1973:35).

Apart from maritime and marsh plant communities, all other plant communities are strongly affected by climate (Turrill 1929:131-132). Mediterranean forests are considerably different from the forests of central Europe, in that they are more open, with a greater number of non-arboreal species growing on the forest floor, though not necessarily a greater number of individuals (Turrill 1929:132). In addition, Mediterranean species tend to be xeromorphic, that is adapted to summer drought, while continental species are mesophytic, having a winter rest period (Turrill 1929:475-476).

Mediterranean Plant Communities

1. Forests: True Mediterranean forests are evergreen with Aleppo pines (*Pinus halepensis* Mill.) or the evergreen Holm and Kermes oaks (*Quercus ilex* L. and *Q. coccifera* L.) predominating. In the present day they form a narrow band all along the Mediterranean littoral. Such forests cover almost the whole of the Peloponnese and of Crete and the other Aegean islands. Evergreen forests may reach to an altitude of over five hundred metres above sea level (Polunin and Huxley 1965:9).

Above the evergreen forest there is a zone of deciduous forest with deciduous oaks, ash (Fraxinus sp.), hornbeam (Carpinus betulus L.), sweet chestnut (Castanea sativa Mill.), and beech (Fagus sp.). This forest type ranges in altitude from eight hundred to eighteen hundred metres above sea level (Polunin and Huxley 1965:9). It is generally open and is used for the grazing of animals (Turrill 1929:133). Above this a coniferous forest of silver fir (Abies cephalonica Loud.) and pines takes over (Polunin and Huxley 1965:9).

2. Maquis and Phrygana: Maquis is a very common brushwood community of the Mediterranean zone. Polunin and Huxley write that:

It is not possible to know whether the maquis is the highest expression of vegetative development, or climax, under certain conditions in the Mediterranean. In some cases it probably is, in which case it is known as 'primary maquis', but in most cases it is undoubtedly the result of man's activity on the 'primaeval' evergreen forest, and is consequently called 'secondary maquis' (1965: 9-10).

Turrill (1929:181) agrees in general with this interpretation. He says that only in high mountain zones and near the coast is maquis a climax vegetation.

Bintliff suggests that in south-eastern Greece, where the climate is hotter and drier than elsewhere,

a paucity of land suitable for the development of forests is the natural situation. He cites an unnamed botanist as saying that establishing young trees in the Aegean belt (south-eastern and insular Greece) is extremely difficult. It is only possible when seedlings are irrigated (1977:72).

Given the very limited expanses of landscape in the Aegean Belt where a soil has developed with high moisture retention capacity, it would seem likely that much of that landscape would be naturally inhospitable to tree growth. In other words, the present picture, with steep, soilless, barren limestone ridges is the natural one for the southeast of Greece. But on the moister zones, the areas with a deep soil, higher vegetation would in the natural state find greater scope for flourishing e.g. into a savanna woodland on the dry but deep soiled Older Fill of the plain, a dense woodland on the moist and deep soiled Neogen and Flysch sediments of the hilland (Bintliff 1977:72).

On the whole Bintliff seems to feel that the maquis and garigue types of plant communities are climax communities adapted to hot, dry regions with thin soils, low in nutrients (1977:59-86). In his opinion the roles of forest clearance and of goat herding in the creation of these vegetation types has been overstressed.

A similar view is held by Hutchinson, who says that in Epirus in western Greece "the vegetative cover is not ... closely related to the grazing pressure and it

appears that geological and soil factors largely determine the type or the density of the plant population (1969:88)."

Polunin and Huxley (1965:10-11) describe four types of maquis. The "high maquis" has small trees four to five metres high as well as large shrubs. Typical trees of the plant association are the Strawberry tree (Arbutus unedo L.) and A. andrachne L., Holm and Kermes oaks (Q. ilex L. and Q. coccifera L.), the Phoenician juniper (Juniperus phoenicea L.), the Judas tree (Cercis siliquastrum L.), the olive (Olea europaea L.), and the Aleppo pine (Pinus halepensis Mill.). Many of these trees have fruits suitable for animal fodder or even human food. The major shrubs of the "high maquis" are the myrtle (Myrtus communis L.), tree heather (Erica arborea L.), Phillyrea media L., and Spanish broom (Spartium junceum L.).

Low maquis is no more than one and a half to two metres high and contains no trees. Among its more common species are the mastic (Pistacia lentiscus L.), whose resin has been used since classical times as a chewing gum, rosemary (Rosmarinus officinalis L.), Jerusalem sage (Phlomis fruticosa L.), Erica species, and several species of the Cistus or rock rose family. Today various herbs and bulbs, common to this maquis

are gathered by Greek housewives (M. Forbes 1976b:15, 1976a).

In the hottest and driest areas a "cistus maquis" is widespread. "It can stand heavy grazing and often develops on abandoned cultivated areas (Polunin and Huxley 1965:11)."

The fourth maquis type is the Mastic-Carob (Ceratonia siliqua L.) - Myrtle maquis which is found in hot, dry areas at lower elevations. The unripe pods of the carob are used as cattle fodder and are also eaten by the poor (Polunin and Huxley 1965:91).

Another important scrub cover of the Mediterranean is garigue, called phrygana in Greece and Jugoslavia. It is found in very hot, dry areas below five hundred metres above sea level where there is little soil and much bare rock. The shrubs of the phrygana are often spiny with small leathery leaves. "The species inhabiting this rock 'heath' are very numerous; there are woody and herbaceous perennials, biennials in abundance, e.g. the Greek phrygana has over 200 different species (Polunin and Huxley 1965:11)."

Little information about the Neolithic vegetation of Greece is available, but Rodden (1962:275) reports that the vegetation around Nea Nikomedeia in Macedonia

was probably maquis with a high proportion of evergreen oaks. Bintliff (1976:261), on the other hand, believes that swamp forests of willow (Salix), poplar (Populus), plane (Platanus) and elm (Ulmus) likely grew on wetter soils, with deciduous forest, especially ash (Fraxinus), on drier parts of the Macedonian plain.

At Osmanaga Lagoon in western Greece pollen cores indicate the presence during the Neolithic of pine, and Erica species, a shrub found in pine woods, oak, wild olive and pistachio (Wright, Jr. 1972:193-196).

Plant Communities of the Humid Continental and Transitional Zones

1. Bulgaria: In Bulgaria it is thought that in Neolithic times steppe vegetation predominated at elevations below five hundred metres above sea level. Above this, to one thousand metres above sea level, there was an open deciduous Quercus-Carpinus forest with a rich undergrowth. Between one thousand and two thousand metres above sea level the dominant trees were Pinus and Betula (birch), and above this plants of the alpine plant community grew (Dennell 1978b:69; Turrill 1929:140-143). The latter is either a scrub brush community of dwarf juniper (Juniperus sp.) or mountain pine (Pinus montana Mill.) or of very low shrubs such as whortleberry

(Vaccinium sp.) and bearberry (Arctostaphylos sp.) accompanied by an herbaceous flora (Great Britain Naval Intelligence 1944:265-266). In the Rhodopes mixed coniferous woods of Picea, Abies, and Pinus nigra Arn. cover the mountain slopes.

Hopf (1975) reports the presence of oak and of a species of Malus or Pirus at Chevdar in the Stara Zagora near Sofia. From Tell Azmak near Nova Zagora she reports oak, ash, viburnum, elm and hornbeam and from Goljama Deltschevo on the Luda Kamchiya river she reports the presence of oak, sweet chestnut (Castanea sat.), viburnum, Cornus cf. sanguinea and elm.

i. Shibylak: A brushwood community similar to maquis and garigue, but consisting of deciduous shrubs rather than evergreens is commonly found in Bulgaria. It is called shibylak. Dennell (1978b:71-73) claims that in places shibylak is a natural sub-climax vegetation, but extensive land clearance and the grazing of sheep and goats, particularly in this century, have greatly extended the area of shibylak in Bulgaria.

Shibylak is not simply a scrub form of the climax forest of oak and hornbeam. It is a quite different complex of shrubs and smaller plants which require the

large amounts of sunlight which the open community can provide. If trees of the climax forest were permitted to grow back the shibylak would be destroyed (Dennell 1978b:72).

2. Balkan Jugoslavia: The vegetational communities of Jugoslavia are similar to those of Bulgaria and are equally varied. Deciduous oak and mixed forests are the most prevalent vegetational covering of Jugoslavia (Great Britain Naval Intelligence 1944:260). Branches from these oaks are gathered for animal fodder and the acorns are used to feed pigs. A number of Quercus species are found in these forests, including Q. frainetto Ten., Q. cerris L., and Q. petraea Mattuschka (Great Britain Naval Intelligence 1944:260).

On mountain slopes beech (Fagus sylvatica L.) woods are found at elevations between eight hundred and sixteen hundred metres above sea level. The branches of these trees are commonly used as fodder for cattle and sheep.

Above the beech forest is the zone of coniferous forests, which occurs at lower elevations in northern Jugoslavia than in the warmer south.

Brushwood communities include shibylak, karst woods, and high mountain brushwood. Karst woods are found in areas with a transitional climate. The trees typical of

this community are ash (Fraxinus), hornbeam (Carpinus), Turkey oak (Q. cerris L.), wild pear (Pyrus amygdaliformis Vill.), and a large number of small shrubs. High mountain brushwood is found only above the tree line (Great Britain Naval Intelligence 1944:260-266).

In a pollen sample taken at Divostin, a site on high ground beside a tributary of the Morava, Beug and Gröger have identified Quercus, Ulmus and Tilia (linden) (Mcpherron and Srejšović 1971:10).

Gröger has identified Pinus, Quercus, Betula, Tilia, Corylus, Abies, and Juniperus in a pollen sample taken at Anza. Among herbaceous species Compositae dominate, but grasses and Chenopodiaceae also occur frequently in the samples (1976:294).

Srejšović describes in detail the modern forest around Lepenski Vir, which he believes resembles closely the probable natural vegetation of the Iron Gate region when the site was occupied. Oak forests predominate. These contain Q. pubescens, Tilia grandifolia and Tilia parvifolia, Q. cerris, and Carpinus orientalis. In addition a wide variety of bushes and herbaceous species are found in the oak woods. There are also beech and walnut woods on the damper, shaded slopes, and just above the Danube bank hackberry and walnut are found (1972:177-178).

3. Roumania: The flora of Roumania in general follows the pattern of Jugoslavia and Bulgaria. Lower elevations are dominated by oak forests of Q. sessiliflora, Q. robur, and Q. cerris. These are open forests containing a rich undergrowth. Above this at elevations of four hundred to fourteen hundred metres above sea level is the beech zone and at still higher elevations the coniferous zone. The lower alpine zone supports a brushwood community and the very highest levels of vegetation consist of dwarf shrubs and hardy herbaceous species. The latter zone reaches to elevations of over twenty-five metres above sea level (Moraru et al. 1966: 55-58).

There are also areas of forest-steppe vegetation in south-eastern and western Roumania where precipitation is the least (Moraru et al. 1966:55-58).

Although today much of Roumania is steppe or sylvo-steppe Berciu believes that in Neolithic times forests covered the entire country except at the highest elevations (1967:34). Contrary to this opinion is that of Protopopescu-Pake, Mateesco et al. (1969:148), who believe that the vegetation of the Neolithic site of Vădastra in south-western Wallachia was that typical of the sylvo-steppe. Charcoal fragments identified here

include Quercus, Ulmus, Tilia, Populus, Salix, Acer pseudoplatanus, Acer campestre, Fraxinus, and Prunus avium. Tree pollens include Alnus (alder), Tilia, Betula, Quercus, Corylus (Hazel), Ulmus, and Buxus (box), while among the herbaceous species are found Cruciferae, Dipsacaceae, Plantago lanceolata, Rumex (dock) and others (Protopopescu-Pake, Mateesco et al. 1969:160).

4. The Pannonian Plain - Hungary and Jugoslavia: In the Pannonian plain the vegetational community is the forest steppe. Depending upon soils and the amount of moisture the actual plant communities within the forest steppe vary somewhat.

In low alkali pastures common species are fescue (Festuca pseudovina), sagebrush (Artemisia maritima), and salt-meadow grass (Puccinellia limosa). A tartar maple-oak forest (Galatello-Quercetum roboris) is found at higher elevations (Kosse 1979:48).

Two types of forest communities are associated with the low-lying flood-plains. Immediately along the river banks and subject to annual flooding are willow and poplar groves (Saliceto-Populetum), while elm, oak, and ash (Ulmus campestris, Quercus robur and Fraxinus oxycarpa) all grow at slightly higher elevations where annual inundations are less likely to occur (Kosse 1979:47).

Marsh Communities

The only plant communities which are relatively similar throughout the Balkans are those associated with the large areas of marsh.

In high mountain areas there are Sphagnum bogs, supporting a wide variety of low vegetation (Turrill 1929: 130). Along river flood-plains are communities of willows (Salix sp.), osiers (Salix viminalis L.), alders (Alnus sp.), and poplars (Populus sp.). Moors and swamps support various reeds, bulrushes (Scirpus) and sedges (Cyperaceae).

Unique aquatic communities are found in the Aegean and in the Danube Delta. The coastal fringe of the Aegean supports a rich community of Algae while the fringes of the Black Sea contain little plant life.

In the Danube delta islets of floating rhizomes support the growth of a number of aquatic species including bulrushes (Scirpus), water hemlock (Cicuta maculata), and brook mint (Moraru et al. 1966:58-59; Klein 1980:30).

CLIMATE

The existence in the Balkans of two major climatic zones with a transitional zone between, has already been mentioned. Concentrating on just these zones gives

a slightly false picture of the climatic regimes of the Balkans. The mountainous topography creates a large number of micro-climates (Figure 4).

Mediterranean Climate

In Greece at low elevations a Mediterranean climate prevails. This is characterized by damp but moderate winters and long, hot and dry summers. The wettest months are November, December and January with the average November precipitation ranging from 171 millimetres at Chanea in the Aegean to 69 millimetres at Larissa and Salonika in Thessaly and Macedonia (Appendix 9, Table LXXVI and Appendix 10, Figures 22 and 24).

The highest amounts of winter precipitation fall on the islands of the Aegean, but summer rainfall is least there. Northern meteorological stations record less winter precipitation but rainfall is more evenly distributed throughout the year. The highest annual amounts of rainfall vary from 390 millimetres to 650 millimetres with the least precipitation falling in Attica.

Coldest winter temperatures range from an average of 5.6 degrees Celsius to an average of 12.6 degrees Celsius (Appendix 9, Table LXXXI and Appendix 10,

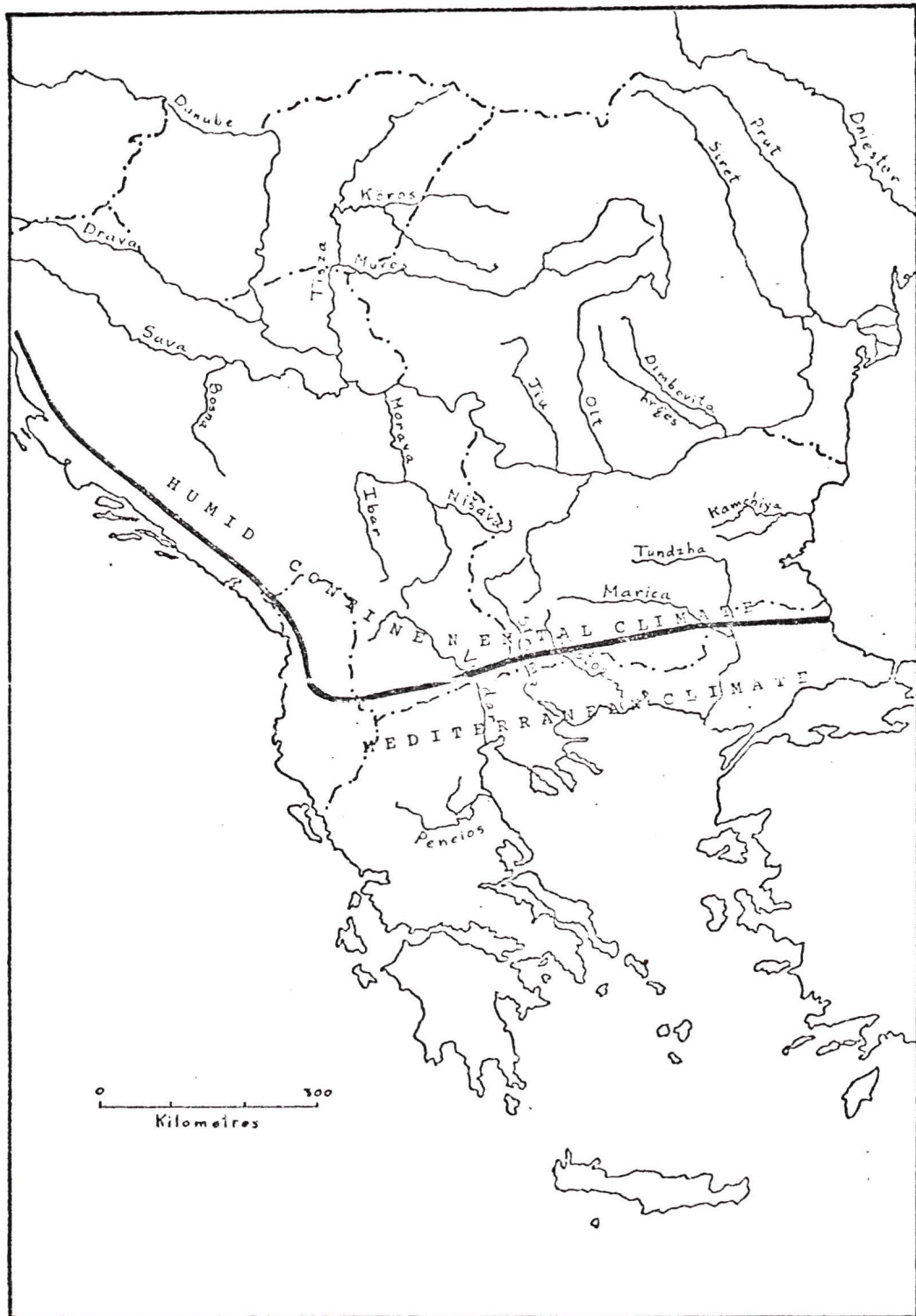


FIGURE 4 MAP OF BALKAN CLIMATIC ZONES

Figures 21 and 23). Those areas of northern Greece with the lowest winter temperatures and the highest annual precipitation are frequently classed as transitional between Mediterranean and Humid Continental climatic zones.

While the rainfall comes mainly in winter, it is not continuous. In fact rain usually falls on only ten or twelve days of each winter month (Trewartha 1954: 299).

Summer is almost rainless. As a result small streams dry up completely and rivers become mere trickles. What rain does fall comes in the form of thunderstorms, which, while doing little to water the parched earth can ruin crops, especially if there is hail (Turrill 1929:47; Fussell 1972:12).

The mountain zones within the Mediterranean region have climates more similar to those of central Europe (Theocharis 1974a:32). The vegetation of the mountain slopes, already described, reflects this tendency towards the continental climatic type. In winter precipitation in the mountains comes in the form of snow, and summer temperatures are lower than in the neighbouring lowlands.

Even in Crete, the most southerly region of this study, where temperatures are ameliorated by a maritime

environment, mountain pastures are snow covered in winter (Durrell 1978:93-94). Nevertheless, the periods of precipitation and drought come at the same time of year both in mountain and lowland districts.

Their marine environment has moderated the climate of the Aegean islands. Summer temperatures are a little cooler while winter temperatures are warmer and total amounts of rainfall are a little greater than in comparable mainland areas.

Despite variation, however, in the amounts of precipitation and in the range of temperatures in various regions, the typical Mediterranean pattern of wet winters and dry summers prevails throughout Greece. It is this seasonal pattern which is the significant characteristic of the Mediterranean climate (Semple 1932:85).

A second characteristic of this climate, which is of great significance to farmers, is the unpredictability of rainfall. There is a considerable variation in the amount of precipitation from one year to the next. Semple provides the following data for Athens. In 1883 Athens received 863.6 millimetres of rainfall, while in 1898 it received only 153 millimetres of rain (Semple 1932:92). This unpredictability of precipitation

was and still is of great concern to both farmers and herders. The former rely on the winter rains to ensure a good harvest; the latter to provide adequate pasturage, particularly for cattle. Fear of drought is not the only concern however. Particularly heavy winter rainfalls are no more to be desired. According to Semple:

Years of heavy rains do not bring commensurate benefit to field and pasture, because they are attended by violent downpours and rapid runoff, so that the soil soaks up relatively little of the moisture (1932:92).

Within the area under study the Mediterranean type of climate is not restricted to Greece. A small portion of inland Jugoslavia and the southern Rhodopes of Bulgaria are included in this zone, although winter temperatures are lower and summer precipitation is higher in these regions, than in Greece. Both areas, however, have the winter maximum precipitation typical of the Mediterranean climate.

Humid Continental Climate

The typical climate of continental interiors is the Humid Continental climate. It is characterized by cold winters and warm summers with rainfall maximums occurring in late spring (Appendices 9 and 10). In the

Balkans the lowest average winter monthly temperatures range from 0.8 to -3.8 degrees Celsius. In appendix 9 (Tables LXVIII and LXX) two lower temperatures are recorded, but these are for high altitude meteorological stations. Summer temperatures range from 23.5 to 16 degrees Celsius. Again the two high altitude stations have been excluded.

In the alpine zone summer temperature maximums can be as low as 10 degrees Celsius, while precipitation can be as high as 2001 millimetres annually.

Average annual precipitation ranges from 414 millimetres to 997 millimetres. In the Balkan region peak precipitation periods are usually May and June, and October, but there is considerable variation in this pattern (Appendix 9, Tables LXXII to LXXV).

1. Jugoslavia: Much of Jugoslavia is snow covered in winter. In the mountains snow lies on the slopes till late in the spring. Winters in the eastern mountains are more rigorous than in the west (Great Britain Naval Intelligence 1944:220-221).

The Danube lowlands are also cold in winter, with temperatures well below freezing and about thirty days of snow reported (Great Britain Naval Intelligence 1944: Figure 95). The possibility of late spring frosts,

destructive to newly sprouted plants and early autumn frosts, which reduce the quantity and quality of the harvest is an ever present threat to farmers here and throughout the Humid Continental zone.

In summer the Danube basin is hot. At this time of the year moisture comes in the form of heavy thunderstorms.

In the Morava-Vardar corridor the climatic differences between southern and northern Yugoslavia can be clearly observed. The Crna Gora mountain range marks the climatic boundary (Barker 1975:86).

The climate of the Vardar region is more like that found in the Mediterranean, but the precipitation figures for Skoplje show that rainfall maximums occur in May and June (Appendix 9, Table LXXIII). However, the total rainfall for this station is only 478 millimetres, the lowest in inland Yugoslavia. This region can truly be considered transitional between the Mediterranean, and Humid Continental climatic zones.

The Morava drainage system has a climate more like that of the Danube basin.

2. Bulgaria: Like Yugoslavia, Bulgaria has a number of different climatic regions. One meteorological station (Petritsch) on the Bulgaria-Greece border lies within the Mediterranean climatic zone (Appendix 9,

Tables LXX and LXXV).

Thrace lies in the zone of transitional climate. Summers are long with high humidity. Rainfall is greatest during spring but is relatively evenly distributed throughout the year. Yet, Keefe et al. report that years of summer drought are not uncommon in Thrace (1974:44).

Unlike the Aegean, the Black Sea is too small and shallow to offer much temperature amelioration, except immediately along its shoreline. Its affect is felt no more than forty or fifty kilometres inland (Gaul 1948:4). The Black Sea ports of Varna and Burgas have warmer winter temperatures than other Bulgarian cities and the precipitation pattern of Burgas is more like that of the Mediterranean zone (Appendix 9, Tables LXX and LXXV, and Appendix 10, Figures 19 and 20).

In the north the Danubian plateau and particularly Dobroudja receive less rainfall than other areas. These regions definitely fall within the zone of Continental climates. Rainfall comes in spring and early summer (Keefe et al. 1974:43) and winter temperatures are low.

In the Stara Planina and the Rhodopes altitude affects temperatures and precipitation. In the Rhodopes winter snowfall is particularly heavy and because summer

temperatures are low snow patches can be found at the highest levels throughout the year (Turrill 1929:53).

The Sofia basin falls within the region of continental climate. Like other polja it experiences summer temperature inversions, which cause dew and heavy morning mists to form (Dennell 1978b:77; Keefe et al. 1974:44). In winter snow covers the basin for as much as thirty days (Dennell 1978b:77).

3. Roumania: All of Roumania lies within the Humid Continental zone. The rainiest month is June, the driest February (Moraru et al. 1966:43). Dobrogea is the area of least precipitation, and of highest summer temperatures.

Throughout Roumania there are a number of days of frost. In the mountains freezing temperatures begin in September and last each year for more than two hundred days (Moraru et al. 1966:41). In the tablelands of Transylvania they last from one hundred to one hundred and fifty days and begin in mid-October, while in the Danube plain winters are short, lasting only from late November until March or early April (Moraru et al. 1966:41).

The river Olt forms a climatic boundary within the Wallachian lowlands. East of this boundary the

country is drier in summer but receives more rain in spring. West of the Olt, fall and winter are dry with spring and summer rains. The value of these are, however, reduced by high summer temperatures (Carrier 1932:124). The majority of Neolithic settlements have been discovered east of the Olt.

Except along the Black Sea coast winter precipitation is in the form of snow. The Danube in its lowest reaches can be expected to freeze over every five years or so (Mellor 1975:25, (Appendix 9, Tables LXIX and LXXIV, Appendix 10, Figures 13 and 14).

4. Hungary: In south-eastern Hungary a continental climate prevails with spring rains, warm summers, and cold winters. Total annual precipitation is not particularly great, less than 600 millimetres per annum. Winter precipitation comes in the form of snow. At Szeged there are about thirty days of snow each winter (Mellor 1975:25).

Within Hungary the Danube at Budapest can be expected to freeze over one year in every two. The Tisza and its tributaries also freeze regularly (Pécsi and Sárfalvi 1964:46-48).

Although precipitation is generally well distributed throughout the year, the Hungarian Puszta lies

in a rain shadow caused by the Alps, and summer drought can be a serious problem (Pécsi and Sárfalvi 1964:28).

The droughts exhibit a fair degree of periodicity in that they occur on the average every 3 to 5 years with an annual total of 400 to 500 mm. of precipitation. Years with an excess of precipitation (700 to 900 mm.) are similarly frequent (Pécsi and Sárfalvi 1964:37).

When years are excessively wet, large areas of the flood plain which would normally provide summer pasture are inundated all summer long (Pécsi and Sárfalvi 1964:37).

Temperature and precipitation data for Hungary are provided in Appendix 9, Tables LXVII and LXXII.

The basic climatic patterns vary considerably in the Balkans. But few regions are free from the threat of summer drought. The uncertainty as to what the season would bring was undoubtedly an important causal factor in the development of the mixed economy found throughout the region.

SUMMARY

Environmental factors have been discussed here at considerable length because it is believed that the interplay of these factors was important in the development of Neolithic economic strategies in southeastern Europe.

From the foregoing description of topography, soils, natural vegetation, and climate one can see that, although the Balkans can be divided into a number of unique regions, two major environmental zones can be delineated, separated from one another by a transitional zone. In general the soils and natural vegetation as well as the climate of the Mediterranean climatic zone are different from those found in the Humid Continental zone.

Characteristic soils of the Mediterranean zone are the rendzinas, while chernozems, smolnitzas and meadow soils are common in the Humid Continental zone. In the Mediterranean zone the natural vegetation is evergreen: in the Humid continental zone it is mixed deciduous and evergreen.

Because of the close relationship between climate and the other environmental factors, in relating subsistence economies to climatic zones, one is also relating them to virtually congruent soil and natural vegetation zones.

VI. PLANT AND ANIMAL REQUIREMENTS AND HABITS

Not all domesticated plants and animals used by the Neolithic populations of south-eastern Europe were equally well adapted to all regions of the Balkans. Some were derived from wild forms thought to have been native to the Near East but not to Europe, while others were derived from species thought to have been native to Europe. But the prehistoric distribution of these wild creatures was quite possibly and even likely different from modern distributions.

The precursors of domesticated sheep and goats are thought to have been forms native to the Near East but not found to Europe, although wild goats are found on Crete and in the Cyclades (Zeuner 1963:130). Wild cattle and pigs, however, are common to both areas (Murray 1970: Figure 1; Bökönyi 1974:157-159, 190; Clark and Piggott 1965:161; M. Jarman 1969; Zeuner 1963: 130, 15-, 211-215; Payne 1968).

The view regarding native European grain species has changed recently. It was thought that barley was not native to Europe (J. Renfrew 1973b:69; Clark and Piggott 1965:160), but a recent analysis of the floral remains from Franchthi Cave indicates that wild barley was being used there in Palaeolithic times (Hansen and H. Renfrew 1978:349).

Wheat is also thought to have been native to south-eastern Europe (J. Renfrew 1973b:43-46; Clark and Piggott 1965:160). In the present day Triticum boeoticum ssp. aegilopoides grows wild in the Balkans. This is thought to be the precursor of Triticum monococcum L. or domesticated einkorn wheat (J. Renfrew 1973b:41-45).

Broomcorn millet is a European grain and the earliest Neolithic finds are from central and eastern Europe (J. Renfrew 1973b:99), while wild oats grow all along the Mediterranean (J. Renfrew 1973b:88).

PLANTS

Wheat

Relatively warm winter temperatures and an annual rainfall of between 508 millimetres and 762 millimetres are necessary to obtain successful wheat harvests. It is important that the rain come during the growing season. Well drained clay loams are the preferred soils (J. Renfrew 1973b:65-66). Wheat planted on poorly drained soils is subject to rust (Brehaut 1966:xxix). Cato advised farmers of the Roman era to sow wheat "on high ground" (Brehaut 1966:xxix).

Wheat is a heavy user of nitrogen, thus if it is grown year after year in the same field the soil will soon be exhausted (J. Renfrew 1973b:66). During Roman

times it seems probable that legumes were sown on the poorer parts of the grain land. According to Brehaut (1966:xxix), Cato understood the importance of legumes in maintaining soil fertility. Friedl (1962:22) writes that in modern Greece lentils and beans are grown in a corner of the grainfield.

Barley

Barley is more tolerant of heat and drought than wheat (Oates 1973:153). In addition it will grow on a wider variety of soils (Wheeler et al. 1955:182; J. Renfrew 1973b:81), but it grows best on well drained deep loam.

A long and cool ripening season is required. Some domesticated barleys can be grown at higher elevations and at more northerly latitudes than any other grain (J. Renfrew 1973b:80-81), but wild barley is not so tolerant. It is better adapted to hot, dry areas.

The type of millet found in Neolithic contexts is broomcorn millet. It has a short growing period, well adapted to flood-plain agriculture, since it can be planted late in the spring (Kosse 1979:130; J. Renfrew 1973b:100). If spring-planted it will mature in sixty to sixty-five days. However, the weather during this period must be warm and free from frost. Although

millet requires less water than other grains, it is more susceptible to severe drought because of its shallow root system. It will grow well on almost any soil other than coarse sand (J. Renfrew 1973b:100).

Oats

Oats are best adapted to cooler, moister climates. At least three hundred millimetres of rain is required. During hot and humid weather the grain is susceptible to disease. It is less resistant than the other grains to cold winter temperatures. Temperatures of -12 degrees Celsius produce serious winter killing of oats. A wider variety of soils are suitable for the cultivation of oats than for either wheat or barley, but silt and clay loams are preferred (J. Renfrew 1973b:98).

Legumes

Among the legumes, lentils, vetch and peas have all been found in Neolithic contexts in south-eastern Europe.

Peas require a cool growing season, but cannot tolerate frost any more than they can tolerate very high temperatures or drought. They prefer a relatively humid climate and temperatures of between 13 degrees and 18 degrees Celsius. The preferred soil conditions are clay loams which are alkaline in character (J. Renfrew 1973b:111-112).

Lentils require warmer temperatures and a dry climate. Like peas, lentils prefer poor soils, in this case sandy soils (J. Renfrew 1973b:114).

The vetches prefer cool temperate climates and fertile loams (J. Renfrew 1973:117).

Cultivation Patterns

As a result of the different climatic zones there is some variation in the periods of sowing and harvesting in different regions in south-eastern Europe.

Throughout southern Europe wheat is usually winter sown (Semple 1932:383; Turnock 1974:219; Wheeler et al. 1955:182; Aschenbrenner 1972:51; DuBoulay 1974:277; Pécsi and Sárfalvi 1964:246). Variations in winter temperatures and in the periods of precipitation mean, however, that in different areas the crops sprout and ripen at different times.

Whereas in Mediterranean lands winter wheat matures in early spring, in Hungary it is early summer before the grain ripens. In Greece the harvest takes place in May and June (Semple 1932:383; Aschenbrenner 1972:51). In Yugoslavia the wheat is just sprouting in early spring. Kindersley reports seeing newly sprouted wheat fields at Studenica in Serbia during April (1976:33). In July, according to Halpern (1958:66) the wheat

is harvested. Harvesting in Hungary must take place at about the same time, as by early August the harvest is complete (personal observation 1977). All that remains is the burnt stubble.

All the grains are planted in winter in Greece (Semple 1932:383-384; DuBoulay 1974:277), but in Hungary millet and oats are planted only in spring (Pécsi and Sárfalvi 1964:249).

In similar fashion the legumes, with the exception of peas, are planted in winter in Greece and in spring in Hungary. Everywhere peas are planted in spring (Semple 1932:383; DuBoulay 1974:277).

ANIMALS

While plants rely on soil and climatic conditions to further their development, animals, being higher in the foodchain must also rely on native and cultivated vegetation. Whether or not certain animals may be kept or hunted will depend not only on natural conditions, but also on how much of the land is given over to agriculture and pasture. The spread of farmlands is as destructive to native fauna as is extensive hunting, since farming destroys their habitat.

If land is at a premium it is more likely to be used for agriculture than for herding because plants produce more nutrients and calories per unit area than do animals (Chrispeels and Sadava 1977:36).

The conditions required for the successful breeding of different animal species are as varied as are those required for growing different plants.

Sheep and Goats

Sheep and goats are better suited to hot, dry climates; cattle and pigs to cooler, damper ones.

It can be observed in the temperate zone that on large plains, unless they comprise the steppes, the domestic animals are large species.... Among the karstic and dry mountains of Mediterranean or Sub-Mediterranean areas which provide only scanty pastures of a poor quality, sheep and goats are frequent and pigs are more important in wooded, humid and marshy regions (Bökönyi 1974:89).

In a hot, dry climate the opening up of forests to create grasslands favoured sheep and goats over cattle (Higham 1967:88). Sheep are more common than cattle on true steppes (Bökönyi 1974:89).

Sheep are particularly susceptible to disease during hot, humid weather. Blowfly and liver fluke attacks and foot rot are all factors which deter sheep herding in warm, damp regions (Higham 1967:88-89; Mount 1979:228).

Goats, too, suffer from foot rot. Wace and Thompson (1914:80) report that in 1911 "both sheep and goats throughout Macedonia and Thessaly suffered severely from some disease which seemed to take the form of an acute foot rot, and many died."

So long as the atmosphere is dry sheep are quite tolerant to both heat and cold. Goats, on the other hand, do not do well where temperatures are cold (Mount 1979:228, 235). Both can do without water if the water content of the pasture is relatively high (Mount 1979:259).

Because of the difficulty of deciphering the bones of the one from the other, sheep and goats are considered together in archaeological contexts (Payne 1968:371). Yet they are adapted to somewhat different environments. Sheep are found on dry plains, while goats are better adapted to mountains (Bökönyi 1974:95; Hyams 1972:62; Payne 1968:375). Grass is necessary for the keeping of sheep, but goats are leaf-eaters (Hyams 1972:62). DuBoulay (1974:26) reports that in present day Greece goats are fed on branches during the winter months. Foliage is also used to feed sheep (Brehaut 1966:14; Turrill 1929:207).

Sheep and goats have somewhat different behavioural patterns as well, undoubtedly as a result of the preferred habitat. "Goats are individualists: they range more widely on the steeper and more rocky ground.... Sheep tend to travel in a much more compact herd, on flatter ground (Payne 1968:375)." However, sheep and goats are herded together (Stillman 1964:34-35; Koster 1976).

Goats are better milk producing animals (Higham 1967:94), but sheep's milk is higher in protein, fat and calories (Dennell 1978b:223).

Both sheep and goats breed during the autumn and winter and lambs and kids are born in winter or early spring (Clegg and Ganong 1969:477,479; Wace and Thompson 1914:80). This means that in Greece where lambs are born in December or January the sheep can be driven to the upland pastures by the end of April (Wace and Thompson 1914:80).

Cattle

Cattle adjust well to a wide variety of climatic conditions. They are far more adaptable than sheep and goats, and dwell in both cold continental climatic zones and in tropical zones.

Cattle behaviour is not affected within a temperature range of 2 degrees to 21 degrees Celsius and in dry weather they can withstand even colder temperatures (Mount 1979:216; Hafez 1968:207). In winter cattle need no more than shelter from wind and rain, while in summer shelter from the sun is required. In temperatures of over 25 degrees Celsius dairy cattle become less productive (Mount 1979:226). "Milk yield declines during late summer, mostly as a result of the high temperature, but also in part because of the deterioration of the food supply (Campbell and Lasley 1975:335)."

Unlike sheep and goats, cattle cannot exist on a waterless pasture (Mount 1979:259; Terrill 1968:251). In addition, cattle require a better more moist pasture than do sheep and goats (Semple 1932:300-303).

Although cattle require a better pasture, in spring as much as one-third of their forage can be from the new shoots of bushes (Carrier 1932:12).

Where cattle and sheep and goats are pastured together they do not compete for the grazing, since each inhabits a different niche. "... the former eat only long herbage, leaving the latter to eat plants to the very roots (Higham 1967:98)." As a result of this

characteristic cattle are let into harvested fields to graze before sheep (Carrier 1932:14).

Pigs

Wild pigs are common in central and southern Europe. In prehistoric times they were among the most frequently hunted species (Bökönyi 1974:205). Woodlands and marshes are the natural habitat of pigs (Bökönyi 1974:89).

Unlike the other domesticated animals, pigs are rooters rather than grazers. In Thessaly there are separate pastures for pigs, but the animals are usually left in the woods to root for acorns (Boessneck 1955:33). The mast of beech and chestnut trees also serve as fodder for pigs (Semple 1932:301).

Pigs are poorly adapted for transhumant herding (Oates 1973:154; Bökönyi 1974:208; Krader 1955:315). They are extremely difficult to drive and will not stand being driven over long distances (Curwen 1946:84; Hyams 1972:67).

Pigs, like dogs, are scavengers and become easily attached to human groups (Tringham 1971:50; Hyams 1972:67). The pig can be useful in land clearance.

In forested Europe it was invaluable in the clearing and preparation of land for arable farming.... a herd working through a forest will destroy the undergrowth, prevent tree

regeneration by eating such tree seeds as beech nuts, acorns and fruits, destroy such pests of crops as snails and slugs and mice. So from Greece to Britain in the late Neolithic and Early Bronze Age the pig was as much a kind of living agricultural machine as a source of meat (Hyams 1972:72).

As meat animals pigs are particularly useful in times of shortage. Litters are large and as a consequence the size of the herd can be reduced drastically when the need arises with the assurance that the animals slaughtered can be quickly replaced (Higham 1967:94). This must have been a particularly important trait in south-eastern Europe where crop destroying droughts are frequent and where the caprovines were subject to epidemics.

Pigs, particularly the newborn, are more temperature sensitive than the other domestic animals. A temperature of 20 degrees Celsius is cool for baby pigs. Newborns are particularly sensitive and may die of hypothermia (Mount 1979:182). Adult swine, on the other hand, are sensitive to heat. Temperatures above 30 degrees Celsius are excessive for pigs (Mount 1979:185). In hot environments they must have water. In order to keep cool they require wet mud wallows. In cooler temperatures pigs will huddle to keep warm (Mount 1979:193,198).

Pigs breed at almost any time of year except January and February, but winter litters tend to be poor (Clegg and Ganong 1969:482). As a result a herd could be restored relatively quickly if it had to be decimated in a time of need.

Productivity of Domestic Animals per Unit Area

A comparison of the amount of grazing land needed for each species and their relationships in terms of the amount of meat each produces is of interest. Kosse writes that ethnographic data obtained by Györffy and Viski for the Alföld region of Hungary shows that one bovid requires as much pasture as either five sheep or five pigs (1979:137). However, Bökönyi estimates that it takes four or five pigs, or seven sheep or goats to produce the equivalent amount of meat obtained from one bovid (1973:168). Therefore per unit area, if meat production is the only consideration, cattle and pigs are equally productive, while sheep and goats are just a little less so. In terms of sources of nutritive value, however, sheep provide more protein than do cattle or pigs. The nutritional value of each of the species is shown in Table VI.

When productivity, amount of space required, and nutritional values of the different animals are

TABLE VI. NUTRITIONAL VALUES PER KILOGRAM OF BEEF,
PORK AND MUTTON

<u>MEAT</u>	<u>PROTEIN</u>	<u>FAT</u>	<u>CALORIES</u>
Beef	169.0	210.0	2180
Mutton	180.0	175.0	2300
Pork	164.0	250.0	2910

(after Dennell 1978b)

compared, it seems clear that factors other than these are of greater importance in deciding the number of each species that should be kept. The availability of suitable habitat for each species must be the controlling factor.

VII. ANALYSIS OF PROPOSED RELATIONSHIPS

Keeping in mind the differential ability of various plants and animals to adapt to different habitats and the environmental variation of south-eastern Europe, a number of relationships between environment and economy and between economy and settlement were proposed in chapter four. These suggested relationships are restated here:

1. In the Mediterranean climatic zone of south-eastern Europe, given the Neolithic technology and a subsistence strategy which included both agriculture and herding, there was very little reliance on wild animal species to supplement the diet.
2. In the Humid Continental climatic zone of south-eastern Europe, given the Neolithic technology and a subsistence strategy which included both agriculture and herding, wild animal species were an important means of supplementing the diet.
3. In the Mediterranean climatic zone, given the Neolithic technology and a subsistence strategy which relied on agriculture and herding, sheep and goats were the dominant domestic animal species.
4. In the Humid Continental climatic zone, given the Neolithic technology and a subsistence strategy which relied on agriculture and herding, cattle were the dominant domestic animal species.
5. Villages of the Balkan Neolithic which relied in large part on hunting to supplement the diet provided by agriculture and herding were less permanent than those which relied almost entirely on agriculture and herding.

Since the first two proposed relationships involve distinguishing between domestic and wild animal species it is necessary to discuss the problems involved in defining and recognizing domestication in plants and especially in animals before going on to discuss sampling and testing procedures and to test the relationships.

DEFINITIONS OF DOMESTICATION AND CRITERIA FOR IDENTIFYING DOMESTICATED ANIMALS

Unfortunately, the lack of a standard by which one can clearly segregate wild plants and animals from domesticated ones makes it exceedingly difficult to distinguish between these states. As Jarman and Wilkinson point out, "No universal agreement exists upon what precisely is meant by the term 'domestication' (1972:83)."

According to Payne (1968:375-376):

... the distinction between wild, feral, and domestic is unreal. First, there is no clear division between a wild and a domestic state. The range of man-animal relationships forms a graded series in which it is difficult, and probably unprofitable, to arbitrarily select a point where the extent of human control is such that the animal is domestic rather than wild. The two terms remain useful, however, as describing the two ends of a spectrum of continuous variation.

A similar view is held by Higgs and Jarman, who write that, "wild animals merge into domesticated

animals by imperceptible gradations (1969:32)."

Another view of domestication is that taken by Bökönyi, who says that domestication occurs when plants and animals are removed from their natural environment and when their "breeding conditions" are controlled by man. According to Richard and Patty Jo Watson, "the crucial feature of domestication is man's control over the breeding of his domesticates (1971:98).

Zeuner (1963:26) points out that domestication involves the intensification of human control over the natural processes of plants and animals.

To establish a distinction between wild and domestic specimens in the sample used here, the judgement of those analysts from whose published data this sample has been created has had to be relied upon. Yet reliance on published sources creates a number of problems of interpretation.

In part the difficulties involved in distinguishing wild from domestic species in archaeological contexts are related to the fact that a major characteristic of domestication is the symbiotic relationship which exists between man and his domesticates (Higgs and Wilkinson 1972; R. and P. Watson 1971). As Herre points out (1969: 259) domestication of animals involves the establishment

of a new social organization for both the animals and man. One cannot expect such symbiotic relationships to necessarily be evident in bone samples.

Berry (1969:214) claims that:

...it is not possible to recognize any traits which inevitably accompany domestication, and, even worse, most of the criteria by which domestication has been claimed to be recognizable, may occur as a result of processes which have nothing to do with domestication.... domestication should never be claimed from archaeological material unless there is a clear and continuous lineage with modern forms, or unless cultural remains provide incontrovertible evidence of domestication.

The criterion most frequently used to establish whether or not a species is domesticated, is a decrease in size; but Jarman and Wilkinson (1972:85,88) point out that this could be a result of climatic change or of the isolation of some wild stock. Ageing and sexing of samples have also been used in determining if a site represents a farming or a hunting and gathering population. Selectivity in killing animals of a particular age and sex has been considered as evidence of domestication, but studies of Palaeolithic hunters would suggest that these are not very reliable criteria either, since it appears that prehistoric hunters were also selective in killing animals (Jarman and Wilkinson 1972:94; Perkins and Daly 1968).

Size and physiological characteristics, such as the presence or absence of horns, and/or age and sex composition of the samples have been the techniques used by all analysts, who have described their methods, to determine whether specimens were wild or domestic. Bökönyi (1974), Jarman and Jarman (1968), Boessneck (1965), Miljčić, Boessneck and Hopf (1962) and Higgs, Clegg and Kinnes (1968) set out clearly the criteria they have used. Unfortunately such information has not been provided by others.

SAMPLING RELIABILITY AND COMPARABILITY

The reliability of the samples is a problem little discussed. Bökönyi (1971:641) makes it clear that the interpretation by different analysts of the same general criteria will vary. As a result descriptions of fauna by different workers are not entirely comparable.

This variability is increased when the number of individuals rather than of bones are compared, since there are a variety of ways in which the latter figure can be arrived at (Bökönyi 1971:641).

Dennell (1978b:123) discusses the amount of variation which can occur as a result of collecting the sample in different ways. He reports that from a sounding

taken at Chevdar about fifty per cent of the cattle remains were recovered directly from the trench, while only twenty-four per cent of those from caprovines and nineteen per cent of those from pigs were recovered in this manner. In addition specimens of only eleven of the eighteen species found at Chevdar were recovered directly from the trench. The remainder of the sample was recovered by dry and wet sieving, the latter being the most productive for obtaining the bones of smaller species.

A comparison of this sample with the sample of ungulates reported from large scale excavations at the site is interesting (Dennell 1978b:241). If we compare only the percentage of bones of cattle, caprovines and pigs relative to one another the following results are obtained. In the large scale excavations cattle made up 37.77 per cent of the sample, which is a far higher proportion than Dennell reports from the sounding, where they made up only 2.7 per cent of the sample. Caprovines made up 47.34 per cent of the sample from the large scale excavations, from the sounding 79.28 per cent. Pigs formed 14.89 per cent of the large scale excavations sample and 18.02 per cent of the sounding sample.

The differences between the percentages of

caprovines and cattle in the two Chevdar samples is enormous. Unfortunately, Dennell does not mention the sampling procedure used in obtaining the large scale excavation sample. As it covered a wider area of the site, however, it is possible that it reflects better the actual situation at Neolithic Chevdar.

Uerpmann lists a number of factors which, in his opinion, characterize a good sample. The criteria which he sets out for sample collection are as follows: first, the bones must be in the site as a result of human activity; second, they must be from primary deposits, not accumulated over a long period of time - in other words, they must be associated with a living floor or distinct occupation phase; third, they must be collected from the site with the same thoroughness with which other finds are gathered; fourth, the bone sample must come from the whole site, not just from a partial excavation; fifth, the size of the sample must be large; and sixth, care must be taken in identifying and labelling the bones (Uerpmann 1973:307-309).

STATISTICAL TESTS

To test the various relationships, the data have been arranged in 2 x 2 tables. The strength of association for each table has been tested using Goodman and Kruskal's Tau.

The period in which the greatest amount of rain falls has been used as the climatic factor. The faunal factor used is the relative number of bones in the sample. The relationships are tested for three Neolithic periods - early (including aceramic), middle, and late (including eneolithic). The sites and data used for all tests are contained in Appendix 4, Tables XX to XXII. Figure 5 shows the distribution of these sites.

Tables VIIa to VIIc and VIIIa to VIIIc contain the test results obtained for the proposed relationships between the period of rainfall and the use of wild or domesticated animals.

The results show that in the majority of sites located where winter rains are prevalent fewer than ten per cent of wild animal bones are contained among the faunal remains. In sites in areas where precipitation occurs throughout the year it is common for more than ten per cent of the sample to consist of wild animal species and about one-half of these sites contain over twenty per cent.

For all tests Rug Bair and Anza, both in the Ovče Polje, in the Vardar river system, have been included amongst those sites having summer rains, but the Ovče Polje is noted for its long, dry summers (Weide 1976a).

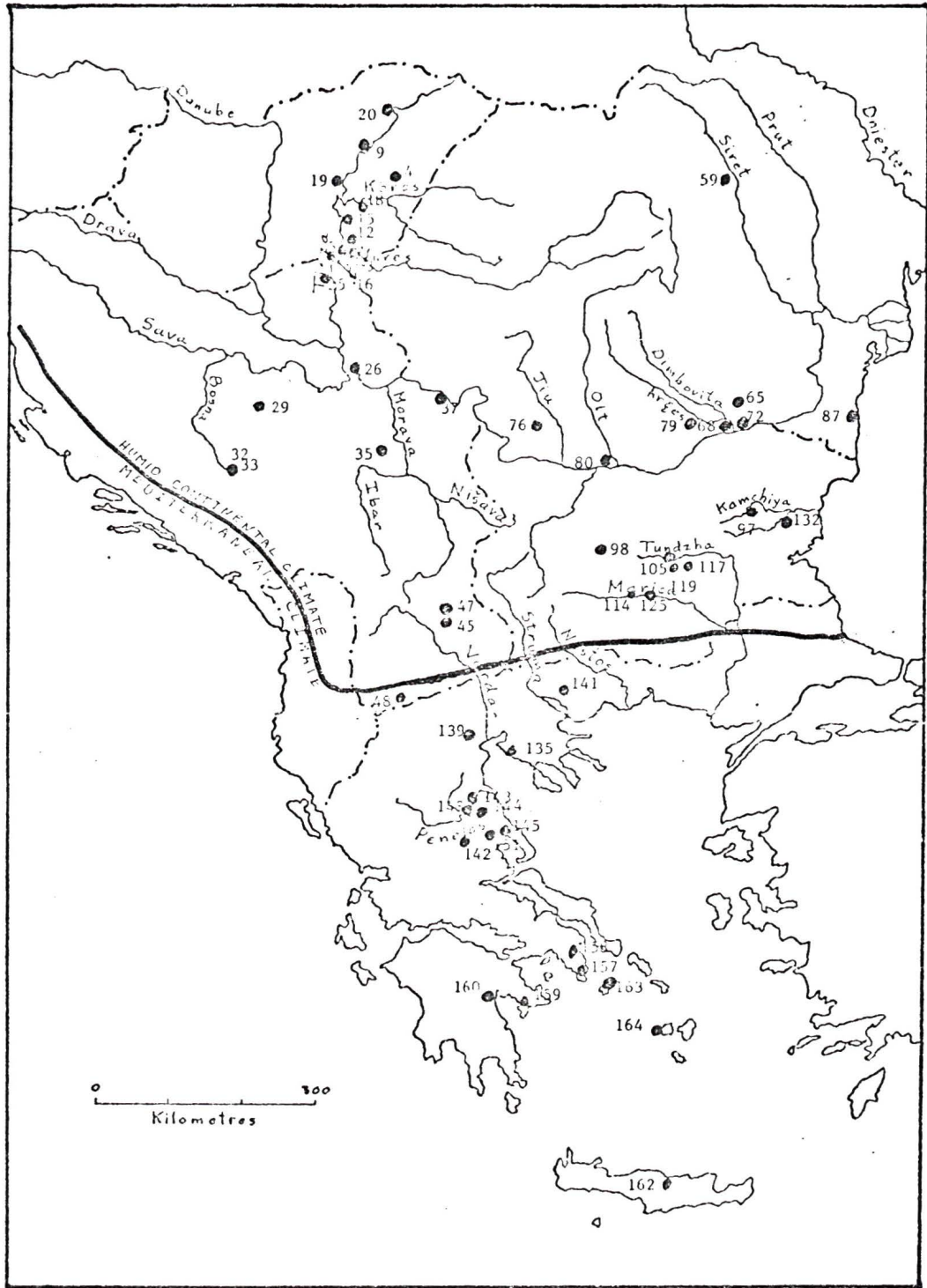


FIGURE 5 SITE DISTRIBUTION MAP

Tables Showing The Relationship Between Periods Of Rainfall And The Relative Importance Of Wild And Domestic Animal Species In The Economy. (Based on the relative number of bones)

Note. In all tables the data for Lerna, Kephala and Saliagos exclude molluscs.

TABLE VIIa EARLY NEOLITHIC

	<u>Per cent of Wild Animals</u>	<u>Period of Precipitation</u>		
		Winter	Year-round	
	$>10\%$	1	10	11
	$\leq 10\%$	4	4	8
		5	14	19

Tau = 0.21

TABLE VIIb MIDDLE NEOLITHIC

	<u>Per cent of Wild Animals</u>	<u>Period of Precipitation</u>		
		Winter	Year-round	
	$>10\%$	0	6	6
	$\leq 10\%$	4	1	5
		4	7	11

Tau = 0.88

TABLE VIIc LATE NEOLITHIC

	<u>Per cent of Wild Animals</u>	<u>Period of Precipitation</u>		
		Winter	Year-round	
	$>10\%$	1	8	9
	$\leq 10\%$	6	4	10
		7	12	19

Tau = 0.26

TABLE VIIIa EARLY NEOLITHIC

Per cent of
Wild AnimalsPeriod of Precipitation

Winter

Year-round

>20%

0

7

7

≤20%

5

7

12

5

14

19

Tau = 0.26

TABLE VIIIb MIDDLE NEOLITHIC

Per cent of
Wild AnimalsPeriod of Precipitation

Winter

Year-round

>20%

0

5

5

≤20%

4

2

6

4

7

11

Tau = 0.48

TABLE VIIIc LATE NEOLITHIC

Per-cent of
Wild AnimalsPeriod of Precipitation

Winter

Year-round

>20%

1

5

6

≤20%

6

7

13

7

12

19

Tau = 0.08

The Ovčje Polje lies in the zone of transition between Mediterranean and Humid Continental climatic zones, having hot summers and high rates of evaporation.

The second pair of relationships to be tested is concerned with the relative importance of caprovines and cattle in the two climatic zones. The test results obtained are found in Tables IXa to IXc. In addition to the sites in Tables XX to XXII the following sites taken from Appendix 4, Tables XVII to XIX are also included in the sample: from Table XVII, Veluška Tumba, Devetaska, Nea Makri, Knossos, Franchthi Cave and Otzaki; from Table XVIII, Vădăstra; and from Table XIX, Gornja Tuzla, Glăvănești Veche, Salcuța, Troyanov, Ezero, Bikovo, Vinitsa, Kitsos, Kritsana and Franchthi Cave.

It is not expected that if the number of cattle bones is smaller than the number of bones of caprovines that this will mean that caprovines are of greater economic importance than cattle, but simply that the economic importance of each varies relative to one another from region to region.

The results of the tests show that sheep and goats are indeed found in greater numbers in the Mediterranean zone, but that the situation in sites of the Humid Continental zone is more equivocal. Sheep and goats are

Tables Showing The Relationship Between Periods Of Rainfall And The Relative Importance Of Caprovines And Cattle Among Domestic Animals. (Based on the relative number of bones)

TABLE IXa EARLY NEOLITHIC

<u>Predominant Species</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
Caprovines	9	12	21
Cattle	0	4	4
	9	16	25

Tau = 0.11

TABLE IXb MIDDLE NEOLITHIC

<u>Predominant Species</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
Caprovines	5	1	6
Cattle	0	6	6
	5	7	12

Tau = 0.72

TABLE IXc LATE NEOLITHIC

<u>Predominant Species</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
Caprovines	10	4	14
Cattle	0	15	15
	10	19	29

Tau = 0.64

dominant there during the early Neolithic, but from the middle Neolithic on cattle predominate.

By combining the factors of wild versus domestic animals and caprovines versus cattle it was thought that the results might be improved. Tables Xa to Xc show the effect of treating these two classes of information together. The effect of this has been to improve the results greatly, especially for the sites of the early Neolithic.

The same set of sites was used to relate economy to settlement longevity. Since only a handful of the sites were known to have originated during the middle Neolithic, longevity was tested in the following way. All early Neolithic sites were included in the sample. These were then divided into two groups, those for which there was evidence that they existed only during the early Neolithic and those for which their existence beyond the early Neolithic was attested.

Tables XIa and XIb show how economy and site longevity are related. The results show that there is a strong correlation between economic pattern and site longevity.

In table XIa the relationship between the relative importance of wild animals in the economy is related

Tables Showing The Relationship Between Periods Of Rainfall And The Relative Importance Of Wild And Domestic Species Combined With The Dominance Of Caprovines Or Cattle Among Domestic Species. (Based on the relative number of bones)

Note. Data for Lerna, Kephala and Saliagos exclude molluscs.

TABLE Xa EARLY NEOLITHIC

<u>Relative Importance Of Animals</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
>10% wild or cattle dominant	0	13	13
≤10% wild or caprovines dominant	9	3	12
	9	16	25

Tau = 0.61

TABLE Xb MIDDLE NEOLITHIC

<u>Relative Importance Of Animals</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
>10% wild or cattle dominant	0	8	8
≤10% wild or caprovines dominant	5	1	6
	5	9	14

Tau = 0.74

TABLE Xc LATE NEOLITHIC

<u>Relative Importance Of Animals</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
>10% wild or cattle dominant	0	16	16
≤10% wild or caprovines dominant	9	1	10
	9	17	26

Tau = 0.85

Tables Showing The Relationship Between Economy And Settlement Longevity.

TABLE XIa RELATIONSHIP BETWEEN RELIANCE ON WILD ANIMAL SPECIES AND LONGEVITY OF HABITATION

<u>Site Longevity</u>	<u>Percentage of Wild Animals</u>		
	<u>>10%</u>	<u>≤ 10%</u>	
EN only	8	1	9
EN and later levels	3	7	10
	11	8	19

Tau = 0.35

TABLE XIb RELATIONSHIP BETWEEN RELIANCE ON CAPROVINES OR CATTLE AND ON WILD ANIMAL SPECIES AND LONGEVITY OF HABITATION

<u>Site Longevity</u>	<u>Animals Relied Upon</u>		
	<u>Cattle or >10% Wild Animals</u>	<u>Caprovines or ≤10% Wild Animals</u>	
EN only	9	0	9
EN and later levels	0	10	10
	9	10	19

Tau = 1.00

to site longevity. The relationship is moderate. But if the relative importance of caprovines and cattle are added to the equation the result with this small sample is perfect. No test was made based on domestic animals alone, because during the early Neolithic few sites showed variation in this aspect of their economies. However, by combining the domestic and wild elements of the animal aspect of the economy, we can see that where variation in the domestic components occurred, it was related to site longevity.

As a check to see if the factor controlling site longevity was economy and not simply habitat, a test of the direct relationship between climate and site longevity was made. Table XII using the same sites as those of Table XI shows the results. It is not at all clear that economy rather than climate is the important factor in determining site longevity.

Using a sample of 259 sites for which I had information related both to site longevity in the very broad sense used here, and to climatic zone, the results were similar to those achieved using the smaller sample although Tau only equals 0.08. If, however, we compare the percentage of misplaced sites using the larger sample with the percentage of misplaced sites from the

TABLE XII RELATIONSHIP BETWEEN SITE LONGEVITY AND CLIMATE

<u>Site Longevity</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
EN only	0	9	9
EN and later levels	5	5	10
	5	14	19

Tau = 0.32

TABLE XIII RELATIONSHIP BETWEEN SITE LONGEVITY AND CLIMATE USING A LARGER SAMPLE

<u>Site Longevity</u>	<u>Period of Precipitation</u>		
	Winter	Year-round	
EN only	14	151	165
EN and later levels	28	66	94
	42	217	259

Tau = 0.08

original sample we find that twenty-six per cent of the sample of nineteen (Table XII) is misplaced in the 2 x 2 table, while in Table XIII, thirty-one per cent is misplaced. If we use Yule's Q as a measure of association for this test we find that Q equals 0.64, which indicates a strong relationship.

While we cannot reject climate as the determining factor in site longevity, since economy has already been shown to be closely related to climate, one would expect an equally close relationship between climate and settlement longevity. The significant factor in site longevity must, I believe, be economy and not climate.

VIII. DISCUSSION

The results of the tests of the proposed relationships carried out in chapter seven indicate that there is some support for all the hypotheses.

1. The Relationship Between Climate and the Exploitation Of Wild and Domestic Animals

There is moderate and even strong support for the suggested relationship between climate and the hunting of wild animals, as a supplement to agriculture and herding. Tau values range from 0.21 to 0.88 for comparisons of sites which contain within their faunal samples either more than or less than ten per cent of wild animal bones. Two of the sites in the early Neolithic sample are within a marginal climatic region. During the Neolithic it is possible that this area might have had a Mediterranean type climate (Bökönyi 1975:6). If these two sites were shifted in this way the results would be greatly improved. For the early Neolithic Tau would equal 0.45 and for the middle Neolithic it would equal 1.00. Late Neolithic results would also be slightly improved.

2. The Relationship Between Cattle and Caprovine Exploitation

There is strong support for the proposed relationship between climate and the relative importance in the

economy of caprovines and cattle during the middle and late Neolithic with Tau values being 0.64 and 0.72 respectively. But there is no support for such a relationship during the early Neolithic.

By combining the relative importance of caprovines and cattle with the relative importance of wild animals, strong support was achieved for all tests. In this case Tau values range from 0.61 to 0.85. As with the other tests, if the two Ovče Polje sites, Anza and Rug Bair, had been considered as sites within the Mediterranean climate, the results would have been much improved with Tau again equalling 1.00 for the middle Neolithic. Figure 6 shows the relationship between the climatic zones and the boundary between the area in which caprovines would be expected to be predominant in faunal samples and the area in which cattle would be expected to predominate or where wild animals were important in the economy.

3. The Relationship Between Economy and Site Longevity

The support for the proposed relationship between economy and site longevity is moderate with Tau equalling 0.35. But as has already been pointed out similar results were achieved by relating site longevity to environment.

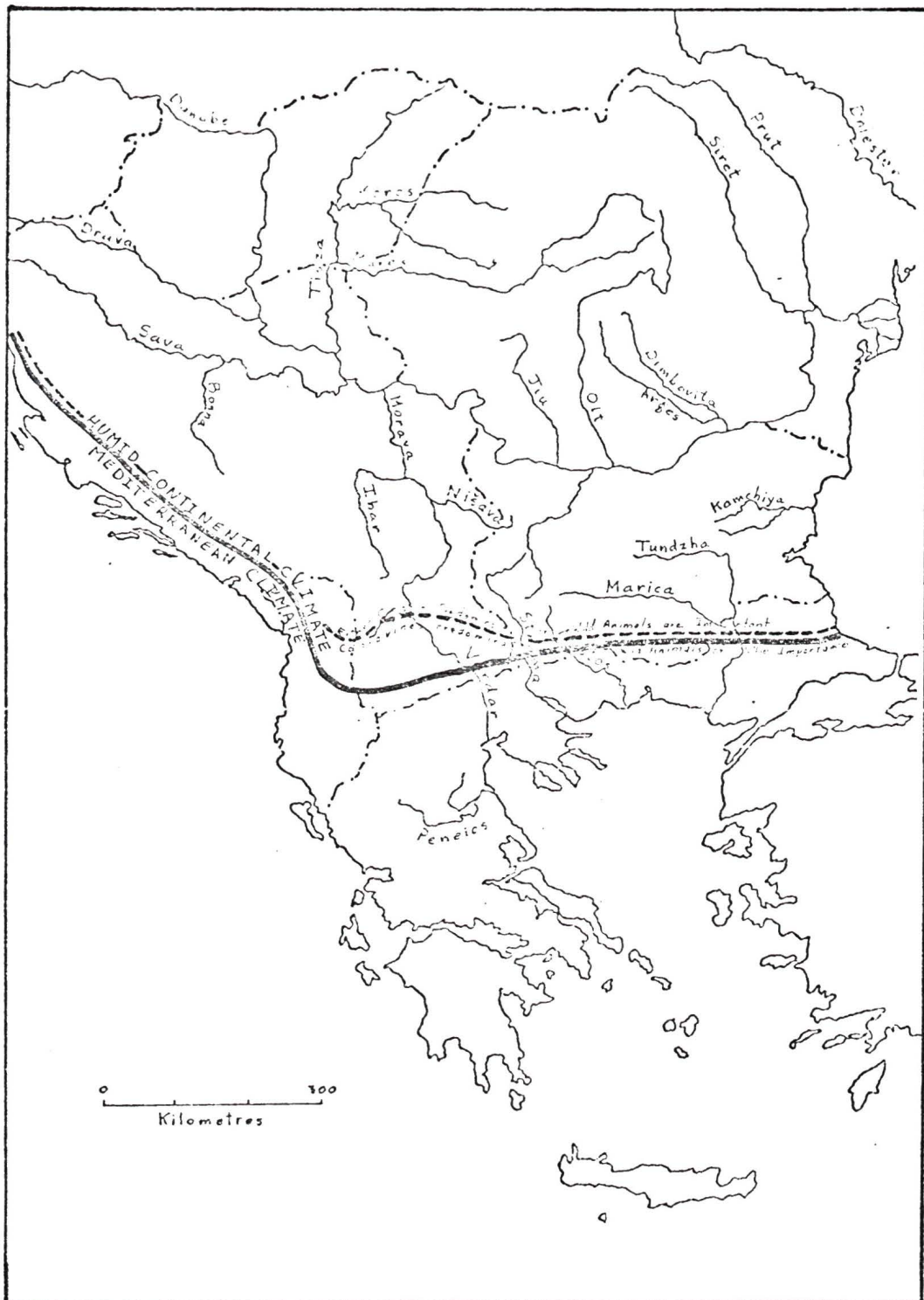


FIGURE 6 MAP COMPARING BOUNDARY BETWEEN CLIMATIC ZONES IN THE BALKANS WITH BOUNDARY BETWEEN NEOLITHIC ECONOMIES BASED ON CAPROVINES AND THOSE BASED ON CATTLE AND WILD ANIMALS

Despite the moderate and even strong support shown for some of the suggested relationships one might be reluctant to accept their validity. The site sample used is not random and, as a result of a lack of available data, not all areas of the Balkan peninsula are represented.

In addition, the faunal samples themselves are in no way random. They depend on the preservative qualities of the soils in which they are found, and on the differential qualities of preservation of skeletal parts based on the density of the bone and on the animal's age (Maltby 1980:215).

Further, the possibility of skewed test results as a consequence of poor sample collection and a lack of comparability of the criteria used in the collection and analysis of data have already been mentioned.

With so many factors contributing to the uncertainty of the faunal samples one is certainly justified in questioning the validity of the test results. However, a study of the economies and settlements in relation to a number of other geographical factors as they relate to climate provides additional evidence in support of the proposed relationships. Topography, soils, and natural vegetation, as has already been shown have regional

distributions very closely allied to the climatic zones.

An important factor in the relationship between economy and settlement is the relative importance to the economy of agriculture and herding. There is no way to state with any certainty what this may have been during the Neolithic in the different regions of south-eastern Europe, yet it may be possible, by studying ethnographic data both from south-eastern Europe and from other regions of the world in conjunction with technological data and with the various geographic factors which relate to economy to suggest probable variations in this relationship.

The Neolithic economies of all parts of south-eastern Europe involved four different subsistence strategies: agriculture, herding, hunting, and gathering. The relative importance of each was dependent upon the environment and varied from region to region. Further the relative importance of each was important in creating settlement patterns.

THE MEDITERRANEAN CLIMATIC ZONE - GREECE

Herding

The tables of Appendix 4 show that caprovine bones are found in greater numbers in the Mediterranean zone

than elsewhere. In Greece with its long, hot, and dry summers and its very small arable area this is the situation which prevails today. Keefe et al. (1977:126) report that one-third of present day animal production is from cattle, with sheep and goats next in importance. But, as the production of one bovid is many times that of one sheep or goat, this suggests that, in fact, many more caprovines than cattle are kept; and indeed in modern Greece sheep are ubiquitous.

1. Cattle: Cattle are less well-suited to the Mediterranean climate than are caprovines. In order for them to be kept in great numbers, large areas of moist pasture are required, with surface water available. In Greece this is a difficult condition to meet. Summer droughts destroy the lowland pasturage, except in marshy areas, for two to six months of the year (Semple 1932: 297-298). The mountain pastures of the Mediterranean zone are not as rich in grasses and herbs as are those of more northerly regions. Animals pastured in the mountains during summer must rely on green shoots and twigs to supplement the sparse grasses (Semple 1932:298).

According to Semple:

The ancients discriminated between the choice lowland pastures suited to milk cattle and horses and the scant forage of the mountain range whose typical Mediterranean vegetation,

macchia and phrygana, yielded poor grazing for sheep and goats; for their pigs they valued in turn the mast found in the hardwood forests of chestnut, oak and beech clothing the higher ranges or rainy western slopes (1932: 300-301).

Because lowland meadows which were moist year round were required for the pasturing of cattle, only a few regions of Greece were suitable for maintaining these animals. The best pastures of Greece are those found in Thessaly and Boeotia where old lake basins, marshy in winter, retain considerable moisture throughout the summer (Semple 1932:304). In addition, suitable pasturage is to be found on the coastal plains of Thrace and Macedonia and in Messenia, the Argolid, and the highlands of Arcadia, all in the Peloponnese. In the highlands of Arcadia there are small intermittent lakes formed in the mountain basins. In summer as they dry up they leave behind rich meadows which provide excellent pasturage for transhumant animals (Semple 1932:317-322).

Today sheep and goats pastured in Arcadia during the summer descend to the lowlands of the south-western Argolid for the winter. The region around the Franchthi Cave is used primarily for this purpose (Bintliff 1977: 215; Koster 1976).

Attica and the Greek islands are unsuited to the keeping of cattle (Semple 1932:307), although cattle were kept on Crete in considerable numbers during the Neolithic (Jarman and Jarman 1968). During classical times "cattle, were scarce in Athens, where climate, relief and the composition of the soil were all adverse to good pasturage (Semple 1932:307)."

It is interesting to note that less than one per cent of the bone sample from Saliagos in the Cyclades comes from cattle (Evans and C. Renfrew 1968:79). Of domesticated animals cattle represent only three and a half per cent of the sample. In the Cyclades of the present day cattle make up 1.9 per cent, pigs 5.6 per cent and caprovines between forty-three and fifty per cent of the domestic animals kept (Evans and C. Renfrew 1968:79).

It is clear that the combination of climate and topography have placed severe limitations on the numbers of cattle that it is possible to maintain in Greece.

2. Sheep and Goats: On the other hand, since sheep and goats are not so dependent on moist meadow lands, they could be kept in much larger numbers through the use of upland pastures for summer grazing. The pattern of transhumant herding has been long established in

Whether or not transhumance was an important pattern associated with animal keeping during the Neolithic, the availability of pastures would have been less of a limiting factor with regard to the herding of sheep and goats than it would have been with regard to the keeping of cattle. But the better pastures for the caprovines were probably to be found, then as now, at the higher elevations, where the moisture brought by the winter's rains and snow evaporates less quickly than it does in the plains. The mountain pastures of the north-west would have been the most productive with those of the south-east much less so (Semple 1932:299).

To increase the amount of pasturage, periodic burning of the woodlands may have been practised. Mellars (1976:25) shows that wild animals feeding on burned over pastures are larger than those which feed in areas of mature vegetation growth. During classical times Semple says that:

Fires were often started, either intentionally or accidentally, by the herdsmen who ranged the mountain forests with their sheep and goats in the dry season. Burning improved the pasturage because the ashes temporarily enriched the soil, and the abundant shoots from the old roots furnished better fodder (1932:290).

Stewart (1956:123) confirms this use of fire to improve or create pastures, not only in Greece, but throughout the Balkan region.

3. Swine: Techniques of pig keeping are quite different in nature from those employed in the herding of caprovines and cattle. In the first place, as has already been mentioned, pigs are not easily herded over great distances. They are animals of sedentary peoples (Bökönyi 1974:208; Forde 1934:446; Oates 1973:154; Curwen 1946:84).

The woods surrounding the Neolithic sites of Greece would have provided suitable places for the pigs to forage in. The number of pig bones in the samples is usually quite small. In some cases, although they are greater in number than those of cattle, it is obvious because of the size difference that cattle were of much greater importance.

Since swine are best adapted to swamps and woodlands and poorly adapted to hot, dry climates a large portion of Greece must be considered unsuitable for the keeping of pigs. Right around the settlements, however, conditions for swineherding would have been available.

Animal keeping in prehistoric Greece would have been greatly affected by the amount of land given over to agriculture. If the greater part of the lowlands was devoted to farming then the transhumant herding pattern of later eras is very likely to have already begun

during the Neolithic. Unfortunately, without reliable population figures it is impossible to estimate the amount of land which would have been required to maintain the population. According to Theocharis (1974) there were more settlements on the Thessalian plain during the Neolithic than there are today.

Farming

It seems highly likely that herding in Neolithic Greece was associated with a relatively intensive agriculture. Intensification of agriculture does not necessarily imply the use of the plough⁵, but rather the continued use of the same fields under a short fallow system.

According to Boserup:

When long fallow is replaced by short fallow, food consumption usually becomes concentrated on cereals which require a smaller input of labour but also yield much less per hectare in terms of calories (1965:32).

David Harris claims that:

As the mid-latitude climatic deserts are approached and the dry season lengthens, swidden cultivation becomes less and less feasible... (1972:252).

5 For example, the Kofyar of Nigeria practise intensive agriculture without the use of the plough, but utilize animal manures for fertilizer (Netting 1974:56-57).

Further evidence of a fairly intensive agriculture is provided by Cranstone (1969:247), who claims that:

Among peoples who practise shifting cultivation and who lack the plough the number of animals kept and their economic importance tends to be relatively small, for the level of agricultural technique is not sufficiently high to produce a surplus of food to support them.

Under a forest fallow system, requiring a period of at least twenty to twenty-five years fallow the population must be "thinly spread over the territory, grouped in relatively small communities (Boserup 1965:70)."

When one considers that the rate of forest regeneration in Mediterranean lands is slower than in temperate climates, it seems even more likely that a short fallow or rotational cropping system was probable, at least after the early Neolithic. Davies (1969:146) says that in a Mediterranean climate the minimum fallow period required for swidden agriculture based on forest clearance would be forty years. The rate of regeneration of oaks ranges from thirty to sixty years (Quitta 1967:269). With the limited amount of arable land available in Greece, and a need for some forest land near settlements, such long fallows would not have permitted a very large population.

Theocharis (1974:64) points out that even in the early Neolithic, villages were numerous in fertile regions,

and on average contained twenty to thirty houses or an average population of about one hundred and fifty. By the middle Neolithic some of the villages had grown into small towns (Theocharis 1974:68). By this time Sesklo probably contained over three thousand inhabitants (Theocharis 1973:68).

Dennell (1978b) suggests that in Bulgaria during the Neolithic a system of three field rotation was used. He bases this conclusion on a number of factors. First, he interprets the presence of commensals in all seed samples found in Chevdar from the most mixed, to those representing a fully cleaned crop of a specific grain, as the result of a crop rotation involving emmer wheat, barley and legumes. In Dennell's view:

It seems a reasonable observation that such repeated occurrences of commensals in crops would not have arisen if they had been grown repeatedly on the same land, or under a system of slash-and-burn in which each crop was grown for a short while on the same land. If grain had been grown within a simple alternation of grain and fallow, such regular amounts of legumes in cereal crops would also have been rarer (1978b:92).

According to Dennell, samples taken from recent Bulgarian crops grown on a rotational basis show similar proportions of commensals (1978b:93).

The presence of cysts of the nematode species Heterodera latipons, Dennell also interprets as evidence

of crop rotation. He quotes Webley as saying that this particular species of nematode "infests wheat, limits yields considerably and causes crop failure if present in large numbers when rotations are short (Dennell 1978b:93)."

If a system of crop rotation was practised during the Neolithic in Bulgaria, it seems likely that the land use pattern of Greece, where the percentage of arable land is less, may have been similar.

In Greece, however, a system of short fallow such as is presently practised may have been more likely (Semple 1932:386; Slicher von Bath 1963:59). According to Davies (1969:147) the cropping of fields for several years in a row in the Mediterranean can result in an irreversible destruction of soil fertility.

It was Childe's opinion that agriculture in Neolithic Greece was intensive. He wrote that:

The cultivable areas in most peninsulas are narrow and separated from one another by difficult mountains, marshes or gulfs. In general, but most insistently in the Balkan peninsula, the first neolithic farmers had to remain firmly settled in fertile but narrow valleys and coastal plains (1969:39).

Childe equated permanence of occupation with permanence of fields.

Now tell formation implies a rural economy advanced enough to maintain the fertility of the fields, if not orchard husbandry that ties the farmer to his fruit trees (1957:60).

If, in fact, agriculture was intensive, some method of maintaining soil fertility would have been required. One possible method is the three field rotation suggested by Dennell, making use of legumes to restore nitrogen to the soil. Another is that reported by DuBoulay(1974: 242) for a village in Euboea. In this village both sheep and goat herding and agriculture are practised.

... a system of leaving areas for the animals to graze ... coincided with the interests of both shepherding and farming, for it stipulated that all the crops sown in the autumn should be collected in one area from which beasts were prohibited until the harvest from mid-June to July, and all those sown in the summer in another, where animals were allowed until planting began of the maize and chickpeas in May. The following year the order was reversed (DuBoulay 1974:242-243).

Thus while the land was lying fallow, the domestic animals were let into the fields to graze on the stubble of the last year's crop and at the same time their manure was providing fertilizer for the subsequent season's crop.

The relationship between the different crops grown at various sites in Greece is unknown. But geographical factors and the location of settlements give us some clues to the likely predominance of certain crops in particular regions.

Climatic and soil conditions of different areas must have had similar effects on the crops cultivated in prehistoric times as they have today. During classical times, Thessaly, where the majority of Neolithic sites are located, was known for its excellent wheat crops (Semple 1932:352).

Knossos, on Crete, is also situated in a favourable location for the growing of wheat and wheat continues to be grown on Crete today (Keefe et al. 1977:57), although it is not the principal cereal crop. In modern Crete about equal proportions of land are devoted to wheat, barley, and oats or maslin, a mixed crop (Colin Renfrew 1972:302).

... the distribution of neolithic tell settlement in Greece shows a close correlation with that of modern intensive wheat cultivation (C. Renfrew 1972:302).

Wheat is the only crop for which we have evidence at all aceramic Neolithic sites, and in early Neolithic sites wheat was apparently more abundant than barley in the samples (C. Renfrew 1972:270; J. Renfrew 1966:24). It is obvious then that wheat must have been the most important of the Neolithic grain crops, particularly during the aceramic and early Neolithic periods (J. Renfrew 1973a:161).

But barley was also an important crop and was grown in preference to wheat where the climate was particularly dry (J. Renfrew 1973a:163). At Lerna in Argos and Tsani in eastern Thessaly the remains of barley but not of wheat have been found in Neolithic levels (Hopf 1961; Murray 1970:235). Barley is also reported as very abundant at the sites of Dikili Tash in eastern Macedonia and at Pyrasos in Thessaly near Volos. At Dikili Tash wheat finds were rare.

Why barley should have been prevalent at Tsani, Pyrasos, and Dikili Tash, all located within the region most suited to wheat growing, is unknown. Perhaps a study of the soils or micro-climates at these sites would provide the answer.

At Saliagos in the Cyclades and at Kephala on the island of Keos finds of barley were much more numerous than finds of wheat. Barley continues to be of greater importance than wheat in the Cyclades (J. Renfrew 1973b: 149).

Thus the main features of the Late Neolithic agriculture in Greece are the predominance of wheat crops in Thessaly, the importance of both wheat and hulled six-row barley in the plain of Drama, and the predominance of barley as the chief cultivated cereal in the Cyclades (J. Renfrew 1973b:163).

In addition to the grains, lentils, vetch and peas were found in most sites. Jane Renfrew reports that they were almost as important as cereals (1973a:162).

Deposits in early Neolithic sites in Thessaly were apparently more mixed than those of late Neolithic sites.

The number of species found in each deposit leads one to wonder whether they were all grown together in mixed fields, such as one can observe even today in parts of the Cyclades, or whether they were mixed together after harvesting in the preparation of food (J. Renfrew 1966:26).

The growing of such a mixture of grains and pulses would have been beneficial in maintaining soil fertility (J. Renfrew 1973a:162).

Hunting and Gathering

The gathering of fruits and nuts was an important adjunct to agriculture and herding. Not only was it of nutritional importance, but it provided variety in the diet. Acorns, pistachios, wild olives, cornelian cherries and plums were all collected and at seaside sites molluscs were also gathered (J. Renfrew 1973a:162; Gejvall 1969; Shackleton 1968; Coy 1977).

Acorns may have been gathered as fodder for pigs but it seems more likely that they were collected for food. Some oaks which grow in Greece produce edible nuts and these are eaten today in times of want (Polunin and Huxley 1965:55). Pigs in all likelihood

were left to forage for themselves throughout the year, as is the present practice (Slicher von Bath 1963:45; Boessneck 1955:33).

Gathering of wild bulbs and greens and of both marine and terrestrial molluscs continues to be an important means of supplementing the diet in present day Greece (M. Forbes 1976a and 1976b).

While gathering was important, hunting seems to have been much less so. This may be an indication that the agricultural lands were fairly extensive and that wild animal species were now being crowded out by crops and by herds of domestic animals.

A comparison of the faunal samples from different periods at Franchthi cave is interesting in this regard (Appendix 5, Table XLIII). During the Mesolithic the principal mammal hunted was red deer. During the Neolithic the presence of deer seems to have been small or even doubtful. At nearby Lerna red deer were present but only in small numbers. Here cattle were of great importance especially during the middle and late Neolithic. For these periods they make up eighteen and a half and twenty-four per cent respectively of the domestic animals in the sample.

It is interesting to compare the feeding requirements of cattle and red deer. Fleming (1972:181) presents the following information for modern Britain:

Although the size ratio between deer and cattle has not remained constant, today at any rate cattle require less food than deer in the New Forest, Hampshire (Tubbs 1968:13). Here deer represent three feeding units each, cattle only one.

Thus by increasing the number of cattle in any area the amount of territory remaining for the maintenance of wild deer, whose feeding habits are similar to those of cattle, but whose requirements are greater, would have been considerably decreased. Fleming points out that:

... it should be remembered that the density of each species is not an independent variable, but must fluctuate with that of competing species... (1972:182).

Another factor contributing to the reduction of feed for the native ungulates would have been the introduction in considerable numbers of new species from outside. Domestic sheep and goats are thought to have been introduced species in Europe. They were clearly kept in considerable numbers in Greece during the Neolithic, since they form anywhere from forty-three to eighty-three and a half per cent of the total faunal samples from sites of this period.

The keeping of sheep and goats probably greatly affected the amount of forage available to wild animals. According to Narr, "Sheep, if locally concentrated can provide a grazing pressure which exceeds even that of cattle(1956:146). And Ruth Whitehouse (1975:164) points out that:

The practice of allowing animals to graze on cultivated land after harvesting... in the long run prevented effective regeneration of the vegetation, as grazing animals, especially goats, destroy all growing matter above ground level.... The replacement of forest or woodland vegetation by pasture in this manner would have exposed some areas, especially in the hilly Mediterranean regions to the eroding forces of wind and water, further discouraging regeneration of vegetation.

However, as has been mentioned previously (P.144-145) many authorities now believe that grazing pressure has played a lesser role in forest destruction than was once thought. In addition, Hutchinson shows, in a study of Epirus, in western Greece, that agriculture has played a minimal role in soil erosion.

It thus appears that the naturally high rate of erosion in this region has not been significantly increased by man's agricultural activities, and that the effect of erosion on the agricultural potential of the region has been substantially favourable. Little good land has been lost and a large and productive area of new land of high natural fertility has been gained by the silting of the gulf of Amvrakia (1969:89-90).

Whether agriculture and herding had a destructive effect on the landscape as suggested by Whitehouse or whether, as in Hutchinson's opinion, landscape changes were primarily the result of natural causes, as the practices of agriculture and herding increased the amount of pasture and woodland available for the support of wild stock would have been gradually reduced.

Thus the changes in the relationship of native animal and plant species to their environment, brought about by reducing the land area available to wild plant and animal species and devoting it to the domestication of crops, and by the introduction of new domesticated animal species likely led to a reduction during the Neolithic in the numbers of wild animals that the Greek landscape could support.

It is interesting to note that in the Near East from which the farming and herding economy is thought to have been derived, wild animals continued to be of considerable economic importance (R. Whitehouse 1975: 150-151; Braidwood 1960:134; Perkins and Daly 1968; Mellaart 1964:97).

Settlement

Settlements in Neolithic Greece were of the nucleated type, forming tells. These are found mostly in the plains

(Wace and Thompson 1912:4). The preferred locations in the plains of Macedonia and Thessaly were on rock outcrops, which provided protection from spring flooding (Semple 1932:111-112; Theocharis 1973; Heurtley 1932).

According to Mellor (1975:163) in a discussion of modern settlement patterns of eastern Europe:

Some crude relationship exists between quality of land and degree of nucleation, for the richer farming lands all show nucleated settlement. In the mountains the pastorally based economy generally displays dispersal or only loose nucleations.

Netting (1974) suggests three reasons for maintaining nucleated settlements: the need for co-operative labour, the threat of military attacks, or the fragmentation of farm land. During the early Neolithic there is no evidence to suggest that any of these three factors were operating to maintain nucleated settlement, but by the late Neolithic both Dhimini and Sesklo provide evidence in their defensive structures of at least the threat of warfare. Theocharis (1973:60) believed there was considerable evidence to suggest defensive constructions as early as the middle Neolithic.

It seems unlikely that irrigation was practised during the Neolithic. Even today only twenty per cent of the agricultural land is irrigated (Keefe et al. 1977: 126), and much of the land is unsuitable for irrigation

due to a tendency toward salinization.

In present day Greece farmland is highly fragmented (Keefe et al. 1977:126), but there is no reason to believe that this was so during the Neolithic. Nevertheless, the possibility exists that land was divided up in a way which gave each family access to both suitable arable lands and to adequate pasturage for their animals.

Nucleated settlement may be simply the result of the desire to build villages above the flood-plain on rocky outcrops and away from the threat of periodic natural destruction.

There is considerable evidence even from the earliest Neolithic sites to suggest that settlement was of a permanent nature. According to Theocharis at aceramic sites "without exception, the development was to continue during the ceramic Neolithic phase that followed (1973:35)."

There is evidence at a number of sites, among them Sesklo, Knossos, Saliagos, and Otzaki of the repair and rebuilding of structures (J. Evans 1968,1974; Theocharis 1973; Evans and C. Renfrew 1968).

In addition to tell sites a number of caves were inhabited particularly during the late Neolithic

(Theocharis 1973:109; McDonald and Hope Simpson 1969:171; Pendlebury 1963:44-45). In the south-western Peloponnese these have been found high up in river gorges away from any arable land (McDonald and Hope Simpson 1969:171). It seems possible that these may represent the sites of transhumant herders. McDonald and Hope Simpson seem to think that they may only have been occupied during the rainy season.

Some of the numerous caves occupied in Crete were probably associated with herders too. Late Neolithic sites have been found at both inland and coastal locations on Crete. They are found atop gentle hills, on the slopes of rugged mountains and in caves and rock shelters (Theocharis 1973:135). Some are burial sites (Pendlebury 1963:44-45). One contained a horde of stone axes, which may represent an industrial site. Nearby is a rock shelter containing the bones of animals, which was possibly occupied by hunters or herdsmen (Theocharis 1973:135-136).

The pastoral pattern of Minoan Crete has been described by Carrier:

The herdsmen... planned their villages in duplicate, the flocks roaming at large over the uplands in summer, the population being established in definite encampments among the

hills during the interval between the reaping and the vintage. The lowland homes were set in the midst of agricultural activities, with grain and vine, fig and olive as the main crop harvested (1932:5).

This is the usual approach to the combination of agriculture and herding in agricultural villages dependent upon rainfall. The household is divided into two parts, one farmers, the other herders, which separate at various times of the year depending upon the needs of the two occupations (Lees and Bates 1974:188).

An ethnographic example of such an approach is that of the Karimojong of Uganda, where permanent settlements are built on alluvial deposits along the rivers and inhabited by the women. Here they plant and tend their crops. The men of the tribe are cattle herders and spend much of the year away from the village in temporary camps (Dyson-Hudson 1966:33-34).

But dividing the household into two parts is not the only way to deal with the problem of maintaining both herds and crops. The Kurds and Lurs of Luristan in Iran also have an economy based on agriculture and herding. However they have a settlement pattern quite different from that described for the Karimojong and one which may date back to Biblical times (Edelberg 1967:395-396). The Kurd and Lur communities are flexible and change with the

season. Seasonal communities are comprised of migration groups. Each migration group has dwellings in four village sites, each occupied at a different season of the year (Edelberg 1967). The particular group studied by Edelberg actually had two summer villages, each occupied every other year in accordance with the cropping and fallowing of their lands (1967:376). Construction techniques used in village building were different for each season, with winter dwellings being built of less perishable materials than those used in the dwellings of the other seasons.

Despite the fact that everyone moves from season to season, and that in many cases all four of a migration group's sites are within sight of one another there is some evidence for the segregation of the occupations of farming and herding. According to Edelberg when the population moves from the winter village, "They pitch their tents on the plain or in the mountains, some migration groups staying near the arable land, others grazing their flocks and herds in the mountains (1967:384)."

Semple (1932:300) claims that in ancient Greece farming and herding were "almost divorced". This pattern may have been more like that described by Barth (1965) for

Swat, Pakistan , than like the settlement patterns of either the Karimojong or of the Kurds and Lurs. This pattern, already described (p.102), is the result of three separate ethnic groups, each with a different economy, all living together in close proximity. One group were farmers, another herders, and a third transhumant farmers and herders. Although in Pakistan occupations are associated with ethnic groups, if a similar pattern occurred in prehistoric Greece occupational specialization need not have been so associated.

Although it is not possible to determine how the population of prehistoric Greece organized their agricultural and herding pursuits it seems likely that the tells in the fertile plains of lowland Greece represent year round agricultural settlements, while caves and upland sites probably sheltered seasonal shepherds' communities.

Saliagos Cultural Tradition

Another form of economy, accompanied by a different settlement pattern, developed in the Mediterranean region during late Neolithic times. The Saliagos cultural tradition of the Aegean islands has been identified primarily on the basis of a unique technology (Evans and

Renfrew 1968:74-76). So far only a few sites of this cultural tradition, which concentrated on fishing have been identified (Bintliff 1977). While fishing was of major importance none of the known sites relied exclusively on fishing. At the eponymous site all the domestic animals are represented in the sample (Higgs, Clegg and Kinees 1968). But forty-five per cent of the faunal remains are from fish, particularly tunny. Renfrew and Evans (1968:79) show that tunny provided more meat than any other animal species (Appendix 5, Table XLVIII). There is no evidence for hunting (Renfrew and Evans (1968:78)).

The cultivation of grains was also carried out. Jane Renfrew has identified barley and wheat, of which barley was the more important (Evans and Renfrew 1968:77).

The location of Saliagos was on a promontory of the narrow land bridge between the islands of Paros and Antiparos, which offered excellent beaching for boats.

The chipped stone technology of tanged and triangular points of obsidian clearly sets this cultural tradition apart from other Aegean traditions. And it seems most likely that the cultural differences are based on the different economic pattern. But as Evans and Renfrew point out, "It remains to be shown that tunny fishing

was an important occupation at other sites of the culture (1968:77)."

Bintliff (1977:117-122) describes fishing in the Aegean as being of a seasonal nature. Tunny, sardine, and mackerel, are all migratory.

At regular times of the year, chiefly spring and autumn, these migratory fish form compact shoals of considerable size and move into the bays and shallow straits of the Mainland and islands (Bintliff 1977:117).

Links between the islands of the Cyclades and the mainland, particularly in the Peloponnese have existed since Mesolithic times, as attested by the finding of Melian obsidian at Franchthi Cave. Franchthi also relied heavily on fish during the Mesolithic. Bintliff believes that the connections between the mainland sites and the Cyclades is related to fishing because he says:

Prehistoric sites with strong cultural links between the Cyclades and the Mainland are located beside key fish-run shallows (bays and straits) now exploited by migrant fishermen moving between both zones (1977:121).

Some of the Saliagos culture sites, like Mavrispilia on Mykonos and Agrilia on Melos were apparently only occupied seasonally. Mavrispilia is located on a ridge of bare rock and exposed to cold winds from the north.

Water is not readily available. But Mavrispilia:

... overlooks a Bay well-known and visited for its May fish run catches (in which migratory fish such as tunny feature prominently), and close to the site a sheltered beach provides a base for the boats (Binfliff 1977:595).

The only likely explanation for the occupation of such a site is the seasonal fish-runs.

Other Saliagos culture sites, like Phylakopi on Melos were more permanent. At Phylakopi there was plenty of arable land which could be used to establish a permanent agricultural and herding community in a location which also provided excellent fishing opportunities.

It would seem that the sites of the Saliagos cultural tradition maintained the basic agricultural and herding pattern of mainland Greece, but added to it, fishing. As a consequence settlements are located not only in regions suited to agriculture and herding but also in places suitable for taking full advantage of the seasonal fish-runs.

THE HUMID CONTINENTAL CLIMATIC ZONE

The Pannonian Plain of Hungary and Jugoslavia

The only other area for which comprehensive economic and settlement data are available is the Pannonian plain.

1. Herding: In the Pannonian plain a herding pattern based on sheep and goats was established during the early Neolithic. However, unlike the situation in the Mediterranean, where once agriculture and herding were established, the basic economic pattern remained the same throughout the Neolithic, in the Pannonian plain during the early Neolithic an attempt was clearly made to develop a herding economy based on species, which could not easily adapt to the prevailing geographic conditions. As a consequence the population at first relied heavily on hunting and fishing to supplement the diet, and later, while continuing to keep the same domestic animals, stressed those species which were better adapted to the region - cattle and pigs.

Kosse describes the pattern of animal keeping in the Alföld region of Hungary:

Until recently livestock in the Alföld were mostly kept in the open all the year round. Until the end of April, sheep were kept near the settlements, mostly in the fields, to thin out the crop. In summer until mid-July, they were usually grazed on higher loess plateaus; after July, when the upper pastures began to feel the effect of drought, the flocks were transferred to the floodplains. In autumn, sheep were again kept near the villages, mostly on the stubble. Winter fodder was provided by the floodplains. It seems likely that the Körös farmers would have followed a similar schedule (1979:150).

It is clear from the above description that the sheep were kept away from the wettest places at all times.

Based on the work of Trogmayer at Rösztke-Ludvár, Kosse suggests that the pattern of hunting and gathering was also seasonal. Fishing was a summer activity; hunting took place in fall and winter; and shellfish were gathered in spring (Kosse 1979:150).

It is interesting to note that these two occupational patterns could not have been carried out by the same people, provided, of course, that the seasonal round of Neolithic herders was the same as that of recent times. Fishing was a summer occupation, carried on from the riverside settlement while the flocks and herds were in the upland pastures. Hunting apparently didn't take place on the uplands until the flocks and herds had returned to the flood-plains and fields.

It seems likely that the competition for fodder between domestic and wild species in the northern Balkans was less severe than it was in the Mediterranean zone. The newly introduced caprovines, ill-suited to this terrain were probably the losers, rather than the native species, in the competition for space and fodder. Certainly, as has already been pointed out, by the middle

Neolithic they were kept in far fewer numbers.

Increasing the herds of domestic cattle must have reduced the number of wild animals which could find adequate fodder, particularly around settlements. But the available land area for the support of both domestic and wild animals was considerably greater than in the Mediterranean. Fleming, citing Eadie (1970), claims that within limits "the quantity and quality of the grassland increases with grazing pressure (1972:187)."

The forest-steppe was eminently suitable for the pasturing of cattle (Kosse 1979:151). The lack of water and of rich pastures which made it impossible to maintain large herds of cattle in the Mediterranean region did not apply in the north. Suitable pastures for both summer and winter grazing were readily available.

The detrimental effects on the environment of sheep and goat herding, even during the early Neolithic, must have been less in Pannonia than in the Mediterranean, in part because the number of animals kept was smaller, but also as a direct result of the climatic and topographic conditions.

The amount of undergrowth in the mixed forests of the northern Balkans is greater than that found in the Mediterranean (Turrill 1929:141), and the rate of forest

maturation was probably faster. The elm, a tree of the mixed forest, for example, matures in thirty to forty years, compared to from thirty to sixty years for oaks (Quitta 1967:269), while the poplars and willows, the common flood-plain species, are noted for their quickness to mature (Canada Department of Forestry 1963:86). In addition on the flat plains, with their thick alluvial deposits, there was no threat of soil destruction as a result of deforestation, which, it is claimed by some, is a constant problem on Mediterranean hillsides.

The large size of prehistoric swine is an indication that the woodlands remained intact during the Neolithic. Bökönyi cites Herre as saying that the decrease in size of wild swine was a result of the expansion of agriculture and the destruction of the forests (1974:207).

2. Farming: The continuing availability of wild fauna is an indication, too, that agriculture was of less importance on the marshy northern plains than it was in the Mediterranean. The area suitable for agriculture was extremely limited here, consisting only of the narrow band of land along the levees (Kosse 1979:129).

Although the amount of land suitable for agriculture throughout the Balkans was small, it is probable that in Greece, southern Bulgaria and southern Jugoslavia

agriculture played a greater role than it did on the northern flood-plains. Here herding and fishing were probably the dominant features of the economy during the early Neolithic, with herding alone being dominant during the middle Neolithic (Kosse 1979:138; Tringham 1971:93; Barker 1975:101 Novaki 1975:70). Bökönyi suggests the possibility that at that time livestock may have been the basis of wealth (1974:28).

Agriculture is more productive of food per unit area of land than is herding (Chrispeels and Sadava 1977). As a consequence the latter can only become a dominant feature of the economy where the total land area is not a limiting factor. In Greece not only agricultural land, but land suitable for grazing animals is not particularly abundant. But on the broad plains of the Danube and Tisza river systems grazing land is plentiful. Agricultural land, on the other hand, is very restricted, even more so than in Greece, for there were no broad plains suitable for farming (Kosse 1979:131). Nevertheless, the levees did provide a suitable soil for crop growing. The levee soils combine features of loess and river alluvium. Such soils are called "infusion loess" and are very fertile (Kosse 1979:90). Kosse describes the many advantages of the levees for

agriculture:

They were usually safe from flooding; had light easily worked soils and favourable drainage conditions. High ground water table during the critical vegetative period would have ensured good crops even in periods of drought. Besides being easily worked levee soils were also very fertile (1979:129).

According to Kosse (1979:129) ethnographic evidence supports the view that the levees would have been the prime agricultural land, and the location of the Neolithic sites on the levees would also lead one to conclude that it was on these that fields were located.

The crops of the northern Balkans were basically the same as those grown further south, but there is so far no evidence of legumes. Wheat and barley were the mainstays. The finding of a species of Bromus among the weed seeds at Gyálarét-Szilágyi would suggest that these crops were likely winter sown, as is the modern practice (Kosse 1979:150). Millet, discovered at Nosza-Gyöngypart, was probably sown in spring on the levee slopes or on the flood-plain. As it matures quickly, it may have been grown to ensure that at least one crop would be successful (Kosse:129). Winter sown crops would have been susceptible to particularly high spring flooding, which would, on occasion, inundate even the levee tops. In years

of drought the crops grown on the levees would suffer more than the millet or spring sown barley grown on the flood-plain. Winter sown crops also suffer during years of low snowfall and heavy frosts (Kosse 1979:32).

Most wheat and barley crops in present day Hungary are sown in fall, but to reduce risk it is possible that prehistoric farmers planted their crops in both fall and spring.

The lack of evidence for legumes is surprising. Further research into botanical remains from Neolithic sites may reveal their presence. If fields were permanent, as Kosse believes them to have been (1979:129), their ability to enrich the soil would have been an important reason for growing legumes. However, in Hungary it has been a practice in the Tisza region to grow the same crop year after year on the same field, and the fields were given names according to the crops grown in them (Kosse 1979:129). In present day Hungary legumes are not grown in the Tisza-Körös region, with the exception of lucerne, which is a crop unreported from Neolithic contexts (Pécsi and Sárfalvi 1964: 254-255).

Planting of legumes or the use of animal manures may not have been necessary in maintaining soil fertility.

The annual flooding of the rivers could be relied upon to add new and fertile soil to the fields.

3. Hunting and Gathering: In contrast to the Mediterranean population, which, during the whole of the Neolithic, relied almost exclusively on domestic animal species, particularly sheep and goats, the inhabitants of the northern Balkans continued to hunt to supplement the foods provided by domesticated plants and animals. In addition fishing was very important along with the gathering of snails and freshwater mussels (Banner 1942:17; Bökönyi 1971:642, 1974:26, 1975:4; Kosse 1979:127; Gimbutas 1974c:19). Large shell dumps have been found at many early Neolithic sites (Kosse 1979:127). During the middle Neolithic, however, the use of mussels and snails declined considerably. For example, shell refuse at the Körös site of Hódmezővásárhely-Kopáncs Tanya was one-half metre thick, while at nearby Kőkénydomb, a Tisza culture site, very few shells were discovered (Kosse 1979:127).

Although the seed samples from this region are few, there is some evidence to suggest that nuts and fruits were gathered too. At Ludas-Budzsák and Nosza-Gyöngypart in Jugoslavia shallow pits containing acorns and beech-nuts have been found (Tringham 1971:93; Kosse 1979:128).

At Starčevo on the Danube there is evidence for the use of wild apples (J. Renfrew 1976), and at Méhtelek a pit containing charred hazelnuts was discovered (Kosse 1979: 128).

It seems likely, judging from the high proportion of caprovine bones found in the early Neolithic sites along the Tisza river and its tributaries, that the economy was one borrowed from the drier Mediterranean zone (Bökönyi 1971:642-643, 1974:26, 1975:4-6).

The proportion of domestic animals as opposed to wild animals lagged far behind that usual for Early Neolithic Greek settlements. This is because, first the domestic fauna brought by the southeastern Körös population was developed in the Balkan Peninsula, an area much drier than Hungary, and could not survive well in the swampy ecology of the Carpathian basin (Bökönyi 1971:642).

Evidence of the poor adaptability of the caprovines to the marshy landscape of the northern plains is provided by their size, which was considerably smaller than that of their Mediterranean counterparts (Tringham 1971:92).

In addition the predominance of caprovines in Pannonian sites was never as great as it was in the Mediterranean. During the early Neolithic the maximum percentage of caprovines in any site of the Pannonian plain is sixty-eight per cent. In the Mediterranean region sheep and goats make up as much as eighty-three

per cent of the faunal samples. By the middle Neolithic cattle replaced caprovines as the predominant domestic species in Pannonia, and pigs, which were relatively rare during the early Neolithic, also became more important than sheep and goats (Appendix 4, Tables XX and XXI). It is interesting that today the Tisza region may be characterized as a pig-breeding area (Enyedi 1964:96).

Although remains of wild animals are found with much greater frequency in these northern sites, the proportions of them represented in the deposits varies considerably, from as little as 8.28 per cent to as much as 62.17 per cent. At Tiszajenő-Szárazérpart, the site at which wild species form only 8.28 per cent of the faunal sample there are no fish bones, although net weights have been found. However, Kosse stresses that so far only a small portion of the site has been excavated (1979:126). It would seem that at those sites which contain a very high proportion of the bones of wild animals, a large proportion of these came from fish. Data from Kosse (1979) confirms this impression. At Deszk-Olajkút 16.7 per cent of the bone sample is from fish and, according to Kosse, at Maroslele-Pana 12.6 per cent of the sample comes from fish. In the data for this site taken from Murray (1970: 238) fish are not included. Therefore, wild species must

played a greater role here than is indicated in Table XX. Equally high proportions of fish bones are recorded for Gyálarét and Röske-Ludvár (Appendix 4, Table XX).

So far only two species of fish have been identified: the catfish (Silurius glanis L.), specimens of which would have weighed as much as two hundred kilograms; and the pike (Esox lucius) (Kosse 1979:126).

The bones of wild swine are found in the samples in numbers equal to or greater than those of domestic pigs. The aurochs is usually found in small numbers but at Nosza-Gyöngypart aurochs bones were frequent in the sample. At Röske-Ludvár red deer were important, while at Nosza-Gyöngypart roe deer were found in numbers equal to those of the aurochs. Local environmental factors must have been important in producing such economic variability.

By the middle Neolithic the reliance on fishing seems to have dropped, while the hunting of aurochs, wild swine, and possibly red deer increased (Appendix 4, Table XXI). Bökönyi (1969:226-227, 1974:111-112) explains the increased hunting as being closely tied to attempts to increase and improve domestic stock. Evidence for the domestication of the aurochs is to be found in the presence of transitional forms in Tisza culture

sites and in the absence of the bones of young animals. These, in Bökönyi's view, were captured for taming, while the older animals were killed in the pursuit of the young (1974:112). A similar pattern occurred with wild swine (Bökönyi 1974:205).

4. Settlement: The type of settlement location and the organization of sites in the Pannonian plain is quite different from that found in Greece. Those Greek sites associated with flood-plains are spread out over the plain. In the north, however, sites are clearly associated with the rivers, being regularly dispersed along them in a linear pattern (Kosse 1979:132). This, according to Netting (1974:35), is the typical arrangement "for villages located where flooding is frequent."

The villages themselves are long and narrow: strung out along the natural levees beside the rivers (Kosse 1979:125; Tringham 1971:87). Some sites are as much as three hundred to four hundred metres long, but only thirty to forty metres wide. The longest Körös site is Dévaványa-Katonaföldek, which is eight hundred metres long and fifty to one hundred metres wide (Kosse 1979:125).

The life span of settlements in Hungary was shorter than was that of the tell settlements of the Mediterranean. Kosse (1979:129) has suggested that settlements

probably lasted, on average, for about seventy-five years. As a consequence, it is probable that during the early Neolithic there were very few settlements in existence in this area at any given time. Based on the 169 known early Neolithic sites along the Tisza-Körös river system of Hungary (Kosse 1979:179-187), if the early Neolithic of this region lasted one thousand years and if each site had a life span of seventy-five years, there would have been only thirteen sites in existence at any one time. Even if we reduce the length of the early Neolithic period to six hundred years, to better reflect the time spread between the majority of early and middle Neolithic sites of the region (Appendix 3), the maximum number of sites at any one time would have been only twenty-one. Of course many undiscovered sites must have existed. Nevertheless, it seems likely that the early Neolithic population of the Tisza-Körös valley was relatively small. Unfortunately, no population estimates for any given sites are available.

Any one or several of a number of factors may have contributed to the relatively short life span of Pannonian settlements. As wild animal populations or fish stocks were reduced settlements may have been moved. Netting says that the Waiyana of Guiana, who depend

largely on fishing, move their villages up and down the river occasionally "because of land exhaustion, insect pests and declining fishing potential (1974:34)."

The lack of tells in the northern Balkans may be the result of a "semi-nomadic agriculture, involving periodic abandonment and reoccupation of sites (Gimbutas 1974c:19)." However, I have found little evidence to suggest that sites here were frequently re-occupied. Starčevo and Vinča are notable exceptions. But of a sample of fifty-eight early Neolithic sites in Hungary, only eight were occupied beyond the early Neolithic period. It is unknown if these were continuous or interrupted occupations.

If, as Kosse (1979:129) suspects, intensive cultivation of small plots of land near the villages was practised, soil exhaustion may have resulted, forcing communities to move to more fertile lands. It is also possible that sites may have been moved simply as a consequence of periodic extreme flooding which could have destroyed the settlements (Kosse 1979:130).

As was the case in Greece the settlements of the Pannonian plain appear to have been located where agricultural soils were fertile and easy to till and where there was suitable pasturage for their stock. In the

case of the northern inhabitants these locations had the added advantage of providing them with abundant fish and waterfowl.

The Central Balkans

The relationship between economy and settlement in the areas which lie between the Pannonian plain and the Mediterranean is at present not at all clear. For many regions economic information is not available. In addition, the information about settlement is frequently not complete enough to permit one to relate it in any way to economy. Where information is available, however, it indicates that settlements in southern Bulgaria and southern Yugoslavia are more similar in both economic and settlement patterns to those of Greece than to those of the Pannonian plain, while sites in all other regions appear to resemble those of the Pannonian plain more closely.

Bulgaria

1. Thrace: Unfortunately little information about the economy of Bulgaria is available. Most early Neolithic faunal information for Bulgaria comes from cave sites, and provides only minimal information about the presence or absence of certain species at these sites. Nothing at all is known about their relative importance to the economy (Tringham 1971:90; Bökönyi 1974:61).

i. Herding: The little available data for Thrace suggest that the economic pattern there, was different from that of Greece although the settlement pattern was similar. Late Neolithic faunal information from a sample of seven sites, while it is not quantified, shows that in four of the sites cattle bones were found in the greatest numbers. Todorova (1978:57) says that the economy of Eneolithic Bulgaria was based on farming and on cattle breeding. She claims that, "In all investigated sites the number of cattle was higher than that of any other type of herd animal (1978:60)." This statement is, however, contradicted by the data collected at Kazanluk in the Valley of the Roses (Appendix 4, Tables XX to XXII).

On the whole, however, the faunal component of the economy does seem to be more like that of settlements further north. But the relationship between herding and farming is likely to have been more like that of the Greek villages. That is to say, it seems likely that agriculture was at least as important as herding, if not more so.

An essential argument in its favour... [is the] law-governed manner in which the Eneolithic settlements were situated: a marked preference was observed for terrains suited to farming, and not to cattle-breeding (Todorova 1978:58).

Because of the availability of more extensive pasture land, it would likely have been possible to keep larger herds of cattle here than in Greece. In Bulgaria most of the rain comes in summer and although the possibility of drought is ever present in the Marica valley (Keefe et al. 1974:226), as it is in Greece, the predominance in Thrace of smolnitza soils, the heavy, moisture retentive soils suitable for pasture, but too difficult to till using a Neolithic technology (Dennell 1978b:62; Barker 1975:88; Mellor 1975:31) would have provided plenty of pasture suitable for the grazing of cattle.

If transhumant herding was practised, additional pastures would have been available in the Rhodopes and the Stara Planina. Tringham (1971:95) has suggested that caves such as Devetaška represent the summer sites of transhumant herders.

ii. Agriculture: The plants cultivated in Thrace during the Neolithic present an interesting pattern. At Tell Azmak in the early Neolithic floral sample, wheat appears with the greatest frequency (Appendix 6, Table XLIX). As this is the only Thracian site for which such information is provided for the early Neolithic, it is unknown how typical this may have been. By the middle

Neolithic barley and vetch had become more important than wheat at Tell Azmak and this pattern persisted in the late Neolithic (Appendix 6, Tables L and LI). Barley is also more common in the floral samples from the late Neolithic site of Donchovo Mogila, but at Kapitan Dimitriev wheat was more frequent, with vetch also abundant (Table L).

iii. Hunting: The importance of hunting as a supplement to the diet is thought to have been high, but quite variable. Its importance to the economies of Thrace is unknown, but a variety of wild species have been found in almost all sites where the fauna have been investigated (Appendix 4, Tables XX to XXII). The relative importance of hunting depended very much upon the location of settlements (Todorova 1978:60).

Neolithic sites in Thrace are to be found "away from rivers in the middle of the fertile plain or at the springline (Tringham 1971:90)." This she believes is an indication that hunting was of little importance. However, the data from Jaska Tepe shows a high proportion of wild animals (twenty-five per cent) in its faunal sample.

iv. Settlement: A review of settlement and economy in the Nova Zagora region of the Thracian plain has been

made by Dennell (1978b). This region lies at the foot of the Sredna Gora. Although rain falls year round, most, according to Dennell (1978:132), falls in winter. This information is contradicted, however, by the precipitation data from Karanovo, where the four wettest months are, in order, June, May, and July and August together.

The Nova Zagora region is drained by the Azmak river, a tributary of the Marica. It was formerly a meandering river whose flood-plain was poorly drained (Dennell 1978:131).

In the recent past the hills of the Sredna Gora to the north were used for the pasturing of sheep. In summer they become dry and parched so it is unlikely that cattle would have thrived there (Dennell 1978:131). But the poorly drained riverine clays and smolnitzas of the Azmak flood-plain would have provided ample pasturage for cattle (Dennell 1978:135).

The settlements of the Nova Zagora region are associated with large areas of arable land. While all known sites are tells the largest are found where the greatest amounts of arable land were available (Dennell 1978:137).

Villages in Thrace were nucleated with the houses arranged in well-planned series of streets (Tringham 1971: 87; Todorova 1978:48; Georgiev 1965; Mikov 1959). The

sites were smaller than those of Greece (Todorova 1978: 54-56), with an average population of about one hundred people . However, some sites were larger than this. Todorova (1978:56) estimates that late Neolithic Karanovo could have had a population of six hundred. The community at Varna would also seem to have been quite large (Todorova 1978:56). Still, when compared with an estimated middle Neolithic population of three or four thousand at Sesklo, the settlements of Bulgaria were comparatively small.

A map of Eneolithic sites in Bulgaria shows a dispersed settlement pattern in Thrace, similar to that of Greece (Todorova 1978: Map 3). Settlements were not restricted to the river banks as were those of the Pannonian plain. By the late Neolithic sites were relatively close together, with an average distance between them of about 5.2 kilometres (Dennell 1978b:138).

Although arable agriculture was probably a major factor determining the location, size and longevity of tells in this region, it is also likely that the economies of these sites included a mobile pastoral element which tapped the grazing potential of the Sredna Gora and the smolnitzas (Dennell 1978b:139).

2. The Sredna Gora: Settlements in the basin between the Stara Planina and the Sredna Gora were also situated where they could take advantage of a variety of

resources. The investigated sites of Chevdar and Kazanluk are located here. Both were long-term settlements, but economic information for Chevdar is available only for the early Neolithic.

In the basins between the Sredna Gora and the Stara Planina the climate takes on a more distinctly continental character. In winter the valleys are snow covered. The amount of snow and the length of the winter season varies from one valley to the next. The more open Valley of the Roses has a somewhat milder climate than the higher more enclosed valley in which Chevdar is located (Dennell 1978b:114).

i. Chevdar: Chevdar is on the upper reaches of the Topolnitsa river, not far from the sites of Čelopeč and Mirkovo. Dennell believes that arable land was scarce in this region. On the other hand, seasonal grazing in both the Stara Planina and Sredna Gora was plentiful. Access to these pastures was available by means of tributary valleys. All three sites were located so as to provide easy access both to the upland pastures, and to adequate arable lands around the sites themselves (Dennell 1978b:79).

ii. Kazanluk: Kazanluk is so far the only site known from the Valley of the Roses. It is located by a

large spring. Sheep and goats make up from twenty-four to forty-four per cent of the faunal samples during different periods of the Neolithic. Nevertheless, Dennell believes that about fifty per cent of the meat came from cattle, red and roe deer (1978b:125).

It is difficult to tell from the available data if the inhabitants of Kazanluk and Chevdar relied more on agriculture or on herding, but access to the upland pastures seems to have been a major factor in determining the locations of these settlements. It seems likely that this consideration would have been of secondary importance if agriculture was the prime concern. In addition the amount of arable land, particularly at Chevdar was evidently limited.

According to Dennell the territories around Kazanluk and Chevdar are quite similar in character, in both cases, combining areas suitable for arable and pasture lands. At Kazanluk the extent of arable land was greater. As a result Dennell estimates that the territory of Kazanluk could have supported about two hundred people (1978b:128), while the population of Chevdar was probably only about one hundred (1978b:11).

3. Dobroudja: The only other area of Bulgaria for which much work on economy has been done is the area

drained by the Luda Kamchiya river. At Golyama Deltschevo, in the lower flood plain of the Luda Kamchiya, faunal and floral information has been retrieved. The settlement was quite small. Todorova estimates a population of only sixty, with a period of occupation of less than five hundred years (1978:58).

Wild animals were very important at Golyama Deltschevo, making up forty-one per cent of the faunal sample. Pigs were the principal domesticated animal. The following information relating to the economy at Golyama Deltschevo is provided by Todorova (1978:161):

... the mean figures for a herd in one of Golyamo Delchevo's building levels will be quoted here: 30 head of cattle, 29.52 sheep/goats, 48.48 pigs.

Naked six-row barley was by far the most frequently found grain in the floral sample, but emmer and einkorn wheats were also discovered (Dennell 1978b:190).

The site location was a good one for agriculture.

The river forms a chain of small enclosed valleys here, which is famous for its very fertile soil. Regularly every 2-3 years large floods, which also inundate the valley of the Goljama Kamčija, bring down fertile soil from the Balkan mountains. This rich layer which remains after the retreat of the waters still influences the size of the harvest in this region today (Todorova 1973:226 - my translation from the German).

Aside from a number of sites in the Luda Kamchiya valley no Neolithic settlements are known in the dry steppe country of Dobroudja (Todorova 1978:12).

4. The Danube Plateau: On the Danube Plateau the cultural pattern was more like that of the Criş, cultural tradition of Roumania (Todorova 1978:12). "No settlement mounds were formed in this region during the Neolithic, and a certain lag in the economy in comparison with Thrace has been noted (Todorova 1978:12)."

Small mounds appear on the Danube plateau only during the early Eneolithic (Todorova 1978:12). The loess and smolnitza soils of the plateau (Mellor 1975:32) were not particularly well-suited to prehistoric agriculture. Of the nine early Neolithic sites of this region included on Comsa's excellent maps of the area (1962: Kapta I), five are located in river valleys. Of these four are caves; the rest are on the Danube shore.

Roumania

1. The Early Neolithic: Attempts to relate economy to settlement in Roumania can meet with little but frustration since descriptions of settlements are minimal and there is almost no economic information available, particularly for the early Neolithic. So far no studies of this region concentrating on the subject of settlement and economic patterns have been published in

English, French or German, although it is possible that the literature published in Roumanian or the Slavic languages provides information relating to the topic.

At the early Neolithic site of Verbița in south-western Wallachia a small faunal sample showed that domestic animals were of greater importance than wild animals and that among the domestic animals cattle predominated. Sheep and goats were of less importance and only a few pig bones have been found (Tringham 1971:95).

A long-term settlement concentrating on cattle breeding was found at Leț on a high terrace of the upper Olt (Tringham 1971:95). Long term occupation, such as this, is unusual in early Neolithic sites of Roumania (Tringham 1971:95).

Cave sites, which may represent summer herders' sites have been found in the Carpathians (Tringham 1971:95). The practice of transhumance has been carried on in Roumania at least since Roman times (Carrier 1932:122). Today flocks are driven from the Wallachian lowlands in summer up into the Carpathians. "The transition zone between the forest and the alpine prairies harbours almost the whole of the summer population (Carrier 1932:126)."

This transition zone provides pasture for both caprovines and cattle. The sheep graze on the alpine

meadows while the cattle feed in forest clearings or on the deforested lower slopes. In winter the herds return to graze on crop stubbles or on the marsh meadows along the Danube and its tributaries (Carrier 1932:125, 128).

At present there is no evidence from the early Neolithic for the cultivation of grains (Tringham 1971: 96). This may be a reflection of excavation techniques rather than of the actual situation prevailing during the early Neolithic, since there is a dearth of any economic information for the period.

Little more is known about settlement during the early Neolithic. In Wallachia most early Neolithic sites were beside major rivers (Comsa 1962: Kapta I). The preferred location for settlement was the low-lying land near the river (Berciu 1967:39; Daicuvicu and Condurachi 1972:29).

2. The Late Neolithic: For the late Neolithic slightly better economic information is available from sites located in Wallachia, Moldavia and Dobrogea. At all these sites cattle were the most important of domestic animals (Appendix 4, Table XXII).

i. Wallachia: a. Căscioarele: At two of the Wallachian sites, Bogota and Tangiru, domestic animals far outweigh the wild animals in importance. But at Căscioarele, an island site, domestic animals were of

very little importance. The island is very small, being less than one hundred metres in diameter. During the Neolithic it may have been somewhat larger (Dumitrescu 1965:37). Although Dumitrescu (1965) says that no plant remains were preserved here, Murray (1970:333) reports the remains of wheat. The only archaeological evidence from the site which is suggestive of agriculture is the presence of querns and mortars (Dumitrescu 1965:38), and of a piece of worked antler which Dumitrescu and Bănăţeanu interpret as a plough(1965).

As is to be expected from an island site, fish were of considerable importance, making up ten per cent of the faunal sample. Deer, both Cervus elaphus, and Capreolus capreolus, make up sixty per cent of the sample.

The settlement lacks the careful planning typical of the sites of Greece and the Thracian plain.

It seems conceivable that Căscioarele, which relied so markedly on hunting and fishing, exchanged wild products for the agricultural produce of other, nearby settlements. According to Peterson (1978:335), "a primary characteristic of relations is the exchange of non-domestic protein produced by hunters for domestic carbohydrate produced by farmers." Such a farmer-hunter exchange, in Peterson's opinion, probably began very

early in man's history:

If we calculate some form of horticulture in certain parts of the world as early as 10,000 B.C., we must acknowledge according to the actuality principle of geology and evolution that for the past 12,000 years at least a portion of the earth's population may have been engaged in highly significant intercultural exchange (Peterson 1978:347).

A modern example from Africa of such farmer-hunter exchange is that between the Mbuti Pygmies and their farming neighbours the Mangbetu (Turnbull 1977:103).

b. Gumelnița: At Gumelnița, a site nearby, domestic animals were of far greater importance than wild animals. Wheat stored in vases was found in two houses. No other plant remains have been discovered, but the presence of saddle querns and rubbers is indicative of the importance of grains in the diet (Dumitrescu 1925,1966).

Like Căscioarele, Gumelnița is a riverside site. As a consequence, fishing may have been of some importance. However, although a small copper fishhook was found there, no fish bones were reported (Dumitrescu 1925:135).

c. Settlement pattern: The settlement pattern of the late Neolithic in Wallachia followed closely that of Bulgaria. In fact, by the middle Neolithic "life took on a more markedly agricultural aspect, which is reflected in the more closely grouped permanent villages (Berciu 1967:49)."

Certainly late Neolithic sites are very numerous on these fertile plains (Comsa 1962: Kapta V).

R. Evans (1973:135) cites Morintz (1962) as saying that the sites of the late Neolithic Gumelnița culture were very crowded. Structures within the sites were built close together as they were in the late Neolithic sites of Bulgaria. The remains of these fortified settlements have left low mounds.

The sites are different from those of Thrace, however, in that they continue to be located on riverbanks. In fact, Berciu (1967:60) says that typical Gumelnița culture sites are "surrounded on three sides by water-courses or located in areas given to swamping (Vărăști, Căscioarele, etc.), near lakeshores (Teiu), or on terrace promontories."

Dumitrescu believes that without the plough, an example of which, he claims to have identified at Căscioarele, it would not have been possible for the Wallachian lowlands to support the growing population of the late Neolithic.

3. Vădastra: The only site in Roumania which provides economic data from all three Neolithic periods is the Wallachian site of Vădastra. Fortunately, for this site the economic data is accompanied by minimal

environmental information. The site is located on chernozem soils (Ghetie and Mateescu 1977:116), not the type of soil usually associated with prehistoric agriculture because of the difficulties involved in tilling it, but excellent for pasture lands (Ghetie and Mateescu 1974:13). The native vegetation is reported as sylvo-steppe (Ghetie and Mateescu 1974, 1977).

i. Agriculture: Although no seed samples have been found the cultivation of both barley and wheat is suggested by the imprints of seeds of these species found in chaff and ceramics (Mateescu 1965:259). The discovery of querns in the middle Neolithic level also supports the view that the use of grains was important.

Kosse (1979:136) says that large quantities of cereal grains have been discovered at sites of the Vădastra culture. At one site sixteen hundred kilograms were recovered from a single pit (Kosse 1979:136).

ii. Fauna: Mateescu (1965:259), who has studied the faunal assemblage from this site notes that:

The large number of bones indicates that the inhabitants of Vădastra, in contrast to those of Crușovu, granted special importance to herding (my translation from the French).

Crușovu is only twelve and a half kilometres from Vădastra. It therefore seems possible that these two sites may each have served a special purpose, one being

primarily agricultural, while the other was primarily a herding community.

About twenty per cent of the late Neolithic faunal sample consisted of the bones of sheep and goats (Ghetie and Mateescu 1974:6). Most of the identified bones and teeth were from adult animals, a fact which Ghetie and Mateescu believe indicates that these animals were used for purposes other than the obtaining of meat (1974:7). It is probable that they were kept for their wool and for their milk as well. The possibility of cheese making is attested by the presence at the site of ceramic collanders (Ghetie and Mateescu 1974:13-15). In addition the bones of sheep were used to make tools - points and needles.

Other domestic animals found at Vădastra were dogs, pigs and one bone from a domestic horse (Mateescu 1962:412).

Wild animals included in the faunal sample were fish, both the carp and the catfish, deer and wild goats (Mateescu 1962:259).

Cattle made up over fifty per cent of the middle Neolithic sample and were the predominant species in all levels. Ghetie and Mateescu have studied the cattle bones from Vădastra and a number of other sites, both

in Roumania and in Bulgaria, and it is their belief that cattle were used at these sites as traction animals (1977:116). The bones studied are from the middle Neolithic. Ghetie and Mateesco compared the angles of articulation of the leg bones of modern cattle to determine the characteristics of animals used for traction.

... among animals not utilized for traction the angle of the anti-brachial-carpal-metacarpal is smaller than among animals utilized for traction... (1977:125 - my translation from the French).

They then compared prehistoric cattle against these characteristics and concluded that:

...it is permitted to us to conclude that the cattle of the middle and late Neolithic were employed at a very young age for various jobs, sometimes arduous (Ghetie and Mateesco 1977:125 - my translation from the French).

If this assessment of the purpose of some of the cattle from Vădastra is correct, then the location of the site on the fertile chernozem soils must be viewed as a particularly favourable one, well suited to both agriculture and herding, and it would suggest that agriculture was at least as important here as herding, if not more so. It would also confirm Dumitrescu's belief that plough agriculture was essential to maintaining the late Neolithic population of Roumania.

4. Dobrogea: From Dobrogea economic information is available from the site of Techirghiol. The domestic fauna here follows the usual pattern outside Greece with cattle outnumbering sheep and goats (Murray 1970:268). Pigs were kept in only very small numbers, probably because the hot, dry steppes of Dobrogea were not a suitable terrain for them. They must have been restricted to the marshy banks of rivers and lakes. The wild fauna here, however, is most interesting. Evidence of deep sea fishing is provided by the discovery among the animal bones of those from a large fish, Aurata aurata, which lives far from shore (Berciu 1967:36). Murray (1970:268) reports the dolphin, but she and Berciu may be referring to the same animal. In addition a wild donkey and a small equoid, which Murray (1970:268) considers wild are included in the sample.

Settlement in this region was limited to small groups of people, who placed their villages on the low terraces of rivers (Tringham 1971:150). The tool kit, as described by Tringham (1971:151) offers little evidence for agriculture and there is no floral evidence. "Antler sleeves, and perforated antler 'picks' and 'axes' which form an important part of the equipment in the Boian and Maritsa cultures occur very infrequently (Tringham 1971:153)."

5. Moldavia: i. Settlement: The settlements of Moldavia follow a somewhat different pattern from those found elsewhere in Roumania. Here villages were larger, containing as many as one or two hundred dwellings (Brjussow 1957:269), defended by ditches, and situated on promontories (Tringham 1971:167; Gimbutas 1978:230; Petrescu-Dîmbovita 1965; Sulimirski 1970:173; Mongait 1959:108). The relationship in this area of sites to agricultural soils is unknown and there is no plant evidence. Therefore it is impossible to assess the relative importance of agriculture and herding. However, according to Gimbutas (1974c:33):

Subsistence was based upon the cultivation of einkorn wheat, domestication of cattle and pig, and intensive hunting of forest fauna and fishing. However, the forest environment made shifting agriculture necessary and consequently there was no accumulation of mound deposits such as are found in Bulgaria and southern Romania.

Such large settlements as those found in the Cucuteni-Tripolye culture of Moldavia, however, would be atypical for swidden agriculturalists. According to Boserup (1965:70) swidden farmers live in relatively small communities.

ii. Herding: Judging from the faunal evidence from sites in both Roumania and the Soviet Union, cattle seem

to have been of major importance. At twenty-three Cucuteni-Tripolye sites in both Russia and Roumania for which Milisauskas has collected data relating to the number of individual animals represented in the bone sample (1978: Table 6:3), cattle were found to be the most important species. They made up the greater proportion of the sample in twelve sites. Pigs were most important in five, wild swine in two, and red deer and sheep and goats in four each. These figures add up to more than twenty-three since at some sites there were equal numbers of two different species. In all twenty-three sites the bones of horses were found. This is in itself interesting since there are exceedingly few reports of horses at other sites of south-eastern Europe.

Fishing was important at some sites; at others it was not. This depended upon the site location. At riverside sites, such as Cetatuaia, fishing supplemented the diet obtained by herding, hunting and agriculture, but at upland sites few fish bones have been discovered (Tringham 1971:168).

At Troyanov, the only Roumanian site of the Cucuteni-Tripolye cultural tradition for which quantified faunal information is available, twenty-four per cent of the animals were cattle. Wild animals were also important,

making up thirty-seven per cent of the sample. Horses are reported but it is unknown if these were wild or domesticated. Their frequency in Cucuteni sites suggests that they may have been domesticated. This, however, could be simply an indication of specialized hunting. Nevertheless, both Bökönyi (1974:238) and Murray (1970:90) believe that the large number of horse bones found in late Cucuteni contexts were from domesticated animals. Samples from earlier contexts may also have come from domesticated horses.

In Russian Moldavia at Luka-Vrublevetskaya cattle made up thirty per cent of the domestic animal sample, but pigs were found in even greater numbers, making up 54.9 per cent of domestic species. Murray (1970:338) includes horses with the domestic stock in this sample. At Luka-Vrublevetskaya fifty-four per cent of the bones were from wild animals, most from red and roe deer, but the variety of wild animal bones found in the site is very great (Murray 1970:338). Durum, bread, club, and emmer wheats were all found at this site and there were barley and millet impressions in pottery and daub as well.

iii. Agriculture: From Cucuteni sites within Roumania wheat is the only grain which has been found,

except at Habașești, where vetch was also reported.

In Roumania outside of Wallachia, Moldavia and Dobrogea there is too little data available to assess either settlement or economic patterns.

Jugoslavia South of the Danube

The information relative to settlement and economy in Jugoslavia south of the Danube is variable. From many regions very little information is available. On the other hand there is a considerable amount of faunal and floral evidence from the sites of the Ovče Polje and site description for one of these sites (Anza) is fair.

1. The Ovče Polje: The Ovče Polje is a broad upland basin, surrounded by low, rolling hills and drained by a tributary of the Vardar, the Bregalnica, and its tributary the Sveti Nikole. The alluvial deposits of the Polje account for its present fertility. According to Gimbutas (1976:3), an abundance of water drains into the Polje from the surrounding hills. All other sources, however, stress the dryness of the Ovče Polje. Precipitation is low and evaporation high.

The region receives less than 500 (474.1)mm of precipitation and evaporation totals about 1200 mm; it is the driest region of our land, in which the best expressed features of the Mediterranean and continental climates are the negative ones (Micivski 1965 as quoted in Beug 1976:291 - my translation from the German).

Despite the continental pattern of summer rains, these come in the form of thunder showers which drop high amounts of precipitation in some areas, but none at all in others. As a result summer growth is restricted by regular droughts. Temperature extremes are greater here than in the Mediterranean. In summer, temperatures can be as high as forty degrees Celsius and in winter as low as minus fifteen degrees Celsius (Weide 1976a:285).

i. Native Vegetation: On the basis of charcoal (Beug 1976) and pollen analyses (Grüger 1976), it seems probable that during the Neolithic a mixed woodland of deciduous oaks, pine, juniper and elm were present somewhere near the Ovče Polje. However, Grüger interprets the pollen sample as evidence for the presence of a steppe-like vegetation in the basin (1976:295). Further evidence for such an environment is provided by the predominance in the basin of smolnitza soils which are believed to have developed "under grassland or semi-steppe conditions (Weide 1976a:283)."

A reconstruction of the native vegetation during the neolithic and post-neolithic periods ... consistent with the soils of the Ovče Polje suggests that most of the area was blanketed with open stands of grass with true stands of deciduous (and conifer?) forests confined to the higher slopes (perhaps above 600 meters) (Weide 1976a:284).

Because of the ever present threat of drought, Weide (1976a:285) believes that:

If a climatic pattern comparable to the modern regime were to have evolved during occupation, it is questionable whether any significant amount of agriculture could have been practiced along the flood plain of the Sveti Nikole River.

Nevertheless, two early Neolithic settlements are located on the Sveti Nikole river and there are three other sites not far away in other parts of the Bregalnica basin. The mean distance separating the five kilometre territory of each settlement from the site territory of its nearest neighbour is just over seven kilometres (Barker 1975: Figure 3).

ii. Anza: Anza is the best excavated site in the region. It is located right beside the Sveti Nikole river. Within the five kilometre territory of the site there are smolnitza, pasture woodland and sandy soils. (Barker 1975:93; Gimbutas 1976:18).

a. Settlement: The population of Anza was large. Gimbutas (1976:37) estimates that the early Neolithic village was inhabited by between one thousand and fifteen hundred people and that by the late Neolithic the population had reached a level of between four and seven thousand. For a Neolithic site, this is a very sizable settlement, larger than any reported from Bulgaria and larger even than Theocharis' estimate of the population of middle Neolithic Sesklo. In fact, the prehistoric

village of Anza was larger than the present village at the site (Gimbutas 1976:37).

b. Agriculture: With such a large population it seems likely that at Anza the inhabitants would have relied more on agriculture than on herding. This would explain why the importance of wild animals here was less than at almost any site for which we have information. Intensive land use would have resulted in the wild animal population being driven from the Polje itself and into the surrounding hills.

Seed remains at Anza have been studied by Jane Renfrew (1976). She reports that in all levels wheat was of the greatest importance. Emmer wheat occurs more frequently than either einkorn or club wheats in the sample studied.

In contrast to the Mediterranean region where crops are sown in fall and harvested in late spring, this is unlikely to have been the case in the Ovčje Polje. Wheat was probably autumn sown as it is today (Great Britain Naval Intelligence 1945:86), but as a result of colder winter temperatures it seems likely that the harvest would have taken place later than in Greece. As a result lands, which could in Greece have been used to pasture cattle in early summer, would still have been under crops in the Ovčje Polje.

c. Herding: The faunal samples from Anza and from nearby Rug Bair are similar to those found in the

Mediterranean zone. Wild specimens make up less than five per cent of the sample in any level at Anza (Bökönyi 1976) and less than three per cent of the sample at Rug Bair (Schwartz 1976:373), and in both cases the vast majority of domestic animal bones (about seventy per cent) come from caprovines.

The number of cattle in the faunal samples is small. The dry basin was probably unsuitable for pasturing them throughout the year, despite the moisture retentive qualities of the smolnitza soils.

Evidence for this is provided by the extent of summer droughts. The Sveti Nikole river dries up annually and becomes intermittent by late summer and the hills around the Bregalnica valley are generally dry (Great Britain Naval Intelligence 1944:117). In addition there is a scarcity of surface water (Great Britain Naval Intelligence 1945:112).

In present day Macedonia cattle are relatively unimportant. The rich meadow lands of northern Yugoslavia and of the Morava basin are here replaced by rough pasture. Poor grazing lands have resulted in cattle whose productivity in terms of both meat and milk is low (Great Britain Naval Intelligence 1945:108).

The only animals suited to such a landscape are the sheep and goats that graze on the upland plateaus leaving the polja free for agriculture and for the few

cattle which are kept (Great Britain Naval Intelligence 1945:112-113; Barker 1975:92).

In winter sheep and goats are returned to the polja to feed on the crop stubbles. Interestingly, the name Ovče Polje means sheep basin (Barker 1975:92).

It is unknown if the few cattle kept at Anza and Rug Bair during the Neolithic were kept essentially for meat or if they were traction animals. The age structure of the cattle, however, suggests their use for some purpose other than meat (Bökönyi 1976:321). Almost sixty per cent of the cattle bones found at Anza came from adult animals and another twenty-one per cent from subadults. These figures are interesting when compared with the bones of pigs, of which over eighty per cent were from juveniles and subadults. Even today the primary reason for keeping pigs is for their meat (Bökönyi 1974:201).

The situation regarding sheep and goats is uncertain. The age distribution of caprovine bones is apparently similar to that of cattle (Bökönyi 1976:Table xxx), but nearly ninety per cent of horn cores are from juvenile or subadult sheep (Bökönyi 1976:Table xxxviii). Unfortunately, Bökönyi's data and statements regarding the age distribution of caprovines is contradictory, for he says that immature sheep likely make up seventy to eighty per cent of the sample. He believes that sheep and goats were kept "exclusively" for their meat (1976:329). The presence of

spindle whorls, however, provides evidence which is contradictory to this point of view (Mount-Williams 1976:148).

It seems highly unlikely that the only purpose served by sheep and goats was a nutritional one and even less likely if in fact the primary purpose of keeping cattle was something other than meat, as Bökönyi suggests.

The possibility exists that cattle were kept as traction animals. The soil covering of well over one-half of the five kilometre territory of Anza is chernozem (Barker 1975:93; Weide 1976b:250), which, in Barker's opinion, was not cultivable without the use of a plough and traction animals (1975:93). But if cattle were used as traction animals the area suitable for cultivation would have been greatly increased.

There is unfortunately, no technological evidence to support such a view. However, even if ploughs were used the absence of any implements which might be interpreted as such from the technological remains is not too surprising, since prehistoric ploughs would probably have been constructed of wood and wooden artefacts are seldom preserved. Even today wooden ploughs are still occasionally used in Greece (Stillwell 1964:254) and they were used in Yugoslavia as recently as the last century (Halpern 1958:53). If wooden ploughs were employed during the Neolithic, those which broke in use probably would have been thrown away in the fields, and so would not be

found among the debris in the sites.

Whether or not cattle were used as traction animals during the Neolithic in south-eastern Europe must for the time being remain a matter open to question.

2. Bosnia: i. Obre I and Obre II: Neolithic sites in other regions of Yugoslavia generally support the view that in the Humid Continental zone cattle will be more important than caprovines and that sites will have a shorter life span than those found in Mediterranean zones. Sites for which information is available are located in Serbia and Bosnia. In Bosnia the sites which provide the best economic data are Obre I and Obre II, both located on the Bosna river about sixty kilometres from Sarajevo. Obre I was occupied during the early Neolithic while Obre II is a late Neolithic site (see Appendix 3 for radio-carbon dates). The two sites are only separated by about two hundred and fifty metres (Sterud 1976:36) and both are situated on old terraces above the river.

Already during the early Neolithic, in contradiction to the sites of this period in the Pannonian plain, cattle predominated at Obre I. The percentage of wild animal species is also high (Appendix 4, Table XX).

At Obre II the percentage of wild animals remained high but the pattern of hunting at the two sites differed. At Obre I the pattern was less discriminating, while that

at Obre II, possibly as a result of increasing attempts to domesticate the local fauna, concentrated on only a few species (Gimbutas 1970:290,297).

a. Herding: It is possible that Obre I was the summer site of transhumant pastoralists. Sterud (1978:286) draws attention to the fact that the Bosna is a tributary of the Sava, and that access to the sites of Obre I and Obre II from the Danube basin is relatively easy, In addition, he points out that the most common animal species represented in the samples from these two sites (cattle and caprovines at Obre I, and cattle at Obre II) are readily herded.

At Obre I pigs were few in number. This, Sterud takes as evidence for a pastoral economy based on "mobile stock" and against a year round settlement of sedentary people (1978:286).

Some contrary evidence in this regard, however, is offered by Carrier (1932:145):

Formerly this region had a transhumance of pigs, the 'pastures' consisting of forest land where acorns and beech-mast could be obtained. During autumn the swineherds took their herds quite lengthy journeys to the oak and beech forest....

The present day transhumant pattern of this region is interesting in that animals are driven from the Bosnian mountains to the Sava lowlands in spring and autumn, but return to the hills to winter under cover. According to Carrier (1932:144), "the rigorous winter experienced

in these plains precludes the possibility of winter pasture."

Tomasevich (1955:502) says that in much of Jugoslavia animals are stall-fed for four months in winter. In summer, not only is hay mown and straw gathered for winter fodder, but the branches of beech trees are also gathered as winter feed for cattle and sheep.

It is possible, then, that Obre I may have been the permanent home of transhumant herders, or as in Minoan Crete two villages may have been maintained.

b. Agriculture: The relationship between agriculture and herding at Obre I and Obre II is uncertain. Although a large number of cereal grains were recovered at Obre I (Gimbutas 1970:290), including three kinds of wheat, six-row barley, lentils and peas (Jane Renfrew 1976:Table xxx), it seems quite possible that herding was of greater importance than agriculture (Sterud 1978:398). There are unfortunately no reports of soil types surrounding the two sites.

At Obre II the evidence for agriculture is much greater than at Obre I and pigs, the animal of sedentary people, were more important (Sterud 1978:398). The introduction to the economy of barley, a crop better suited than wheat to the alkaline soils of the region is offered by Sterud (1978:398) as evidence for the

increasing importance of agriculture. With the introduction of barley, emmer wheat disappeared from the floral sample (J. Renfrew 1976:Table xxxi). An increase in the number of grinding stones at Obre II accompanying the introduction of the new crop pattern is in keeping with Sterud's view that there was a greater concentration on agriculture at Obre II than at Obre I, but not necessarily in keeping with his view that the occupation was more sedentary.

Sterud believes that early Neolithic food production in Bosnia was extensive in character but that during later Neolithic periods there was a change in resource strategies;

There is a suggestion of greater stability of population in the Middle Dinaric region as well as in the lowland zones, which may indicate the development of a more intensive food-producing strategy involving environmental alteration rather than the transportation of the consumers to the scattered resources (Sterud 1978:399).

3. Serbia: i. Divostin: One of the more extensively excavated sites of Serbia is Divostin on the Lepenica river, a tributary of the Morava. This part of Yugoslavia is known as Šumadija. It is a hilly country which was until recently covered with forests of oaks and beech. It is basically a plateau which was once the floor of a

tertiary sea, but which has been highly dissected by river action (Great Britain Naval Intelligence 1944:90).

The botanical investigations by Beug and Grüger of the Neolithic environment at Divostin showed a predominance of Quercus, Ulmus and Tilia among the tree pollens but the largest proportion of the pollen was from non-arboreal species (Mcpherron and Srejović 1971:10). Mcpherron and Srejović believe that a local village vegetation was sampled (1971:10).

There were two phases of occupation at Divostin, but these were separated by two thousand years (Mcpherron and Srejović 1971:2).

a. Herding: During the early Neolithic occupation cattle and sheep and goats were of about equal importance. Wild animal remains were few and made up less than ten per cent of the faunal sample from the early Neolithic.

It is possible that Divostin may have been an upland herding site, as the whole of its five kilometre territory is located on smolnitzas (Barker 1975:97). The site territory of Divostin and that of nearby Rajac, which overlaps Divostin's territory, are quite different from the territories of other sites in the lower Morava basin. The territories of the eight other known sites contain a variety of soil types, including alluvium and brown forest soils (Barker 1975:97). There is a danger,

however, in assuming these modern soil distributions are equivalent to those of the Neolithic.

It is interesting to note the dramatic increase in the number of cattle kept at the site in the later occupation. From the early Neolithic phase forty-five per cent of the animal bone recovered came from cattle, while during the late Neolithic the number had increased to sixty-three per cent (Mcpherron and Srejović 1971:12). The number of pigs kept also increased. At the same time the percentage of wild animals increased. Today the Šumadija continues to support a large number of cattle (Great Britain Naval Intelligence 1945:108).

There are no botanical remains and the technology reported by Mcpherron and Srejović (1971:13-14) provides small evidence of agriculture. No mortars or querns are reported. However, some of the blades were apparently used as sickle blades, but only after they had been put to some other use. Ground stone axe/adzes have also been found.

ii. Lepenski Vir: One Neolithic site in Serbia is unusual in both its location and economy. At Lepenski Vir the economies represented in the Mesolithic and Neolithic levels are considerably different (Appendix 5, Table XXXI). The Mesolithic economy was based on fish

and red deer. The only non-forest mammal included in the sample is the aurochs and its occurrence is infrequent. An interesting feature of the Mesolithic economy is the presence of a large number of domestic dogs. While they may have been kept as hunting dogs, it is also possible that they were used as pack animals, as well as for food.

During the Neolithic the importance of fish declined and cattle and sheep and goats began to be herded. The importance of red deer remained approximately the same throughout the life of the site.

Lepenski Vir is an interesting site in that it offers evidence of long-term occupation of a Mesolithic site. In fact, the Mesolithic settlement was better constructed and planned than the Neolithic village (Srejović 1972:139-140). The Mesolithic economy was undoubtedly better suited to this site located as it was in a gorge, whose access to uplands suitable for agriculture and herding was difficult.

Evidence for agriculture is minimal. There is scarcely any land available near the site for agriculture and no floral remains were discovered. There were large pithoi, possibly for the storage of grain (Srejović 1968b) but very few querns or mortars (Srejović 1972:151).

The 'raison d'etre' for the site seems to have been the whirlpools situated just below the site, which provided excellent fishing.

... and beyond the whirlpools the fishing was plentiful and easy, with rapids and shallows where the original inhabitants could have set dams and traps for sturgeon and smaller fish. 'Yes,' said Dušanka, 'the stretch of river just above is like that, too. Prince Lazar gave it to Ravanica monastery because it was good fishing' (Kindersley 1976:160).

A number of early Neolithic sites are located along the Iron Gate gorge, both in Yugoslavia and in Roumania. Unfortunately, at present there are no economic data available from these other sites. But, it would seem likely that, they too, were taking advantage of the excellent fishing available along this stretch of the Danube.

SUMMARY OF FINDINGS

The available economic data, supported by environmental information from various regions of the Balkans clearly indicates that in this area there was a considerable amount of variation in Neolithic economic strategies.

Early Neolithic Herding

During the early Neolithic there seem to have been three different strategies for utilizing the available animal species. In the Mediterranean zone, domesticated animals, particularly caprovines were relied upon. In

Pannonia, while caprovines remained important, wild animals, particularly fish and waterfowl were vital dietary supplements.

Unfortunately little information is available for the early Neolithic from sites between these regions. But the three sites of this period in central Yugoslavia, for which faunal data is available, display a third economic strategy. At Obre I, Divostin and Lepenski Vir cattle already outnumbered caprovines during the early Neolithic.

This suggests the possibility that the greater economic potential of cattle in the temperate zone than in the Mediterranean zone was first realized in this region and that this central Balkan economic strategy later spread to the peoples of the Pannonian plain. Of course, since the sample is so small, the possibility that the economies of these three sites are atypical cannot be rejected.

Although sheep and goats predominate in the majority of early Neolithic faunal samples it is probable that at almost every site, among domesticated animals, cattle provided more meat than sheep and goats. Table XXXIV (Appendix 5) shows that cattle provided more meat than any other species at the early Neolithic site of Anza, despite the fact that the number of cattle in the

sample was smaller than that of caprovines.

At a few sites (early Neolithic Lepenski Vir, and Nosza-Gyöngypart, middle Neolithic Devavanya, and late Neolithic Căscioarele and Saliagos) wild species provided more meat than domestic animals (Tables XX, XXI, XXII, XLVIII).

During the later Neolithic periods, for which more data are available, it is clear that animal utilization throughout the Humid Continental climatic zone was different from that of the Mediterranean and transitional climatic zones.

Middle Neolithic Herding

In the Mediterranean zone sheep and goats continued to be the most numerous domestic species, and pigs usually outnumber cattle. In Pannonia by the middle Neolithic cattle had become the most important animal, followed by pigs, with the previously preferred caprovines now relegated to third place.

Late Neolithic Herding

Within climatic zones there is also considerable variation in the relative importance of different animals. During the late Neolithic it is possible that some specialization in animal keeping began. The island location of Căscioarele, for example, and its very high proportion of wild animals suggest that it may have had

a specialized economy.

The very high percentages of domestic cattle relative to the other domestic animals at Divostin and Obre III in Jugoslavia and at Traian, Gumelnița, Vădastra and Bogata in Roumania suggest a specialization in cattle herding at these sites. The uniqueness of its site catchment, entirely on chernozem soils, is supportive of this view for the site of Divostin, and the site of Vădastra is also associated with chernozem soils. Site catchment studies are needed for the other sites.

Two other sites seem to have had specialized animal economies: one, Kephala, based on caprovines; the other, Saliagos, based on fish and caprovines. In both cases the keeping of cattle in any numbers was not possible because of the lack of good pastures.

Relationship Between Agriculture and Herding

Since there are few quantified floral data for the greater portion of the Balkan peninsula and little environmental information which can be related directly to particular sites, we can do no more than offer an extremely tentative view of the total pattern of economic preferences and practices in the different Balkan regions during the Neolithic.

In the Mediterranean the location of sites in the most fertile plains and on the best agricultural soils

suggests that in this region agriculture was relatively intensive, possibly involving a rotational cropping or short-term fallow system. There is no evidence, however, for the use of the plough, but the practice of ploughing cannot yet be ruled out.

In Yugoslav Macedonia the association of sites with fertile polja soils and poor pastures also suggests an intensification of agricultural practices.

The situation in Bulgarian Thrace is less clear. Here suitable areas for both agriculture and the herding of all the domestic animals were available. It is possible that agriculture and herding were given equal weight in the economy.

In Pannonia the constriction of arable lands may have led to a small scale intensive agriculture (Kosse 1979:129), but geographic factors here probably encouraged a greater reliance on animal keeping than on agriculture.

It is interesting that with the exception of Starčevo, which was a long-term settlement, lasting from the early Neolithic right through to the late Neolithic, and of Obre I, at none of the investigated early Neolithic sites of the northern Balkans were legumes reported. Their presence in later Neolithic sites, and in the sites of Greece, Bulgarian Thrace and

Jugoslav Macedonia suggests their possible use as soil revitalizing crops in association with grains, and thus an association with intensification of agricultural production.

While there are very few data relating to the relative importance of agriculture and herding in different regions, those which we do have point to an increasing intensity of agriculture as one moves from north to south and from the early to the late Neolithic.

Settlement Patterns

Settlement patterns, as well as economic ones, can be seen to have varied in the Balkans during the Neolithic, although for some regions the information about sites is too poor to allow a reconstruction of settlement patterns.

In Greece settlements were numerous, particularly in Thessaly. The majority were long-term settlements, which have formed tells. By the middle Neolithic some had reached a considerable size. In Bulgarian Thrace and southern Jugoslavia this was also the case, although the Thracian sites were probably smaller than those of Greece and southern Jugoslavia. In all other regions early Neolithic settlements are thought to have been of short duration, although in much of Jugoslavia many early

Neolithic locations were evidently reoccupied in later periods (Tringham 1971:91).

In Greece and Thrace settlements were nucleated: in Pannonia they were linear. The organization and size of sites in the central Balkans is unknown. But some evidence for village planning is evident at Lepenski Vir, Vinča, Padina, Grivac and Butmir in Jugoslavia, at Cetatuia, Căscioarele, Habașești, Ariușd and Trușești in Roumania, and at Golyama Deltschevo in Bulgaria. The plans of these sites vary considerably, some being carefully organized with dwellings arranged in circles or semi-circles (Vinča, Habașești, and Goljamo Deltschevo), or with houses in rows and squares (Lepenski Vir, Grivac, Padina, Ariușd, Trușești and Butmir), while others lack such systematic organization (Căscioarele and Cetatuia). Many were fortified.

Despite the lack of data relating settlement to economy some consistent patterns can be seen. The long-term nucleated sites are all associated with fertile plains or polja. In Bulgaria the largest sites are associated with the largest areas of arable lands. Short-term sites seem to have had limited agricultural potential.

When it is known, locations of settlements in relation to soil types indicate that site locations

were probably determined with a mixed agricultural and herding economy in mind since both arable and pasture lands are usually included in the site territories. Hunting and gathering were notable adjuncts to the economy in some regions. All sites in the sample studied which contained high percentages of wild animal species in their faunal samples were located along watercourses or sea coasts. The sites with fewest wild animal remains are those located in fertile plains or polja.

Although the amount of available data relating to both economy and settlement is small (in some regions totally lacking) and its reliability is sometimes questionable, it is reasonable to conclude, on the basis of that data, that environmental variation, especially climatic variation, has had an important impact on economic adaptations in the Balkans, and that these economic adaptations have affected settlement longevity, location and organization.

SUGGESTIONS FOR FURTHER RESEARCH

Until recently, little work in economic archaeology has been undertaken in south-eastern Europe so the field remains wide open. To improve our understanding of the relationship between settlement and economic patterns two things are required. One is a change in excavation

goals from those designed to establish cultural relations to ones aimed at discovering economic strategies and settlement organization: the other is environmental studies aimed at the reconstruction of prehistoric environments, as well as studies relating to specific sites.

The use of site catchment and locational analysis techniques are badly needed for sites in Jugoslavia, northern Greece and especially Roumania. Such studies seem the most likely method of establishing the relationship between agriculture and herding at any given site, although this, of course, requires in addition the concrete evidence of faunal and floral remains.

The retrieval and analysis of faunal and floral data must be greatly improved if we are to achieve a successful reconstruction of prehistoric economies.

The reporting of faunal distributions within sites would provide a better basis for understanding the relative importance of different animal species in the economy. We need a clearer understanding of why certain species are found in sites. The association of certain species and types of bone with hearths would indicate their use as food. The role of dogs in distributing bones throughout a site cannot be overlooked. Some of the

bones of smaller animals may in fact have been brought into the site by dogs.

Of particular interest where the bones of wild and domestic animals are found in the same site is the relationship which pertains between them. Some of the wild carnivores, such as the wolf, wild cat, and lynx, which are found in Neolithic sites, may have been killed primarily because they were preying on the domestic stock. Wild herbivores may have presented a threat to crops. Once slaughtered these animals could have been eaten and their pelts and bones used, but the prime reason for killing them may not have been their usefulness, but rather their destructiveness.

We need a better understanding of the relationships which pertain between the various animals kept and hunted, between the plants grown and gathered, and between the various members of the complex of plants and animals used in the economy.

The establishment of a way to quantify floral remains in some meaningful manner, which would reflect the actual economy and not just the stage of processing is also essential to understanding the relationship between plants and animals in the economy. Dennell (1972,1974, 1976,1978a, 1978b), who reports the contexts in which

plant remains have been discovered and who has studied the composition of crops at various stages of processing, is leading the way in this regard.

Neolithic technology is another area where research is badly needed. In south-eastern Europe there is at present no consistency in the technological typologies used, and there has been a tendency to label certain types with the names of present day tools, without examining them for signs of their actual use. The typologies which have been established, have been established with chronology rather than economy in mind. A better understanding of Neolithic technology, in terms of its use, could do much to improve our understanding of the relative importance to the economies of various sites of agriculture and herding.

A comprehensive study of settlement patterns would also aid in understanding economy. The presence during the Neolithic of a pattern of transhumant herding, for example, is suspected. When combined with agriculture this economic strategy would be expected to produce a pattern of both year-round and seasonal settlements. Such a pattern cannot be discovered by investigating tell sites alone. Clearly these are associated with agriculture, for they are located in fertile plains.

Nor is it likely that investigation of non-tell sites associated with easily tillable, fertile soils will yield evidence of this economic strategy. Herders' sites must be sought in the hills, and upland basins as well as in lowland regions.

Although seasonality of site occupation has become a question of vital concern to Palaeolithic archaeologists, it has remained a marginal one in studies of Neolithic economies. Yet, a study of sex and age distributions of domestic animals as well as of wild animals found in Neolithic sites might also provide evidence for a pattern of transhumant herding.

In the last ten years economic archaeology in south-eastern Europe has come a long way, but it remains a long way from its goal of reconstructing the economic and settlement patterns of the region during the Neolithic.

IX. CONCLUSIONS

It was the primary objective of this research project to collect and compare materials which would allow a picture of the varying economic and settlement patterns over the whole of south-eastern Europe to begin to emerge. Two basic principles guided the research. The first was a belief that regional and local economic variability, resulting from the marked environmental variation, particularly climatic variation, of south-eastern Europe, must have been considerable, and that this would become evident through a comparison and contrast of the plants and animals used at different sites in various regions. The usual approach to Neolithic economy in this area has been to treat it as a unified whole. An attempt would also be made to discover possible ways in which the different economic strategies of agriculture, herding, hunting and gathering could have been organized in different regions to produce a reliable subsistence economy.

The second principle was the belief that settlement construction, organization and location are directly related to economy, and therefore that variation of economic and settlement patterns would occur together.

The principal difficulty encountered in this undertaking was the collection of enough suitable data to

allow regional comparisons to be made. The research goals of archaeologists working in south-eastern Europe have not been ones related to either economy or settlement organization and location. Therefore it is not particularly surprising that in this area the type of data required for economic and settlement studies is not plentiful.

Because of the quality and quantity of available data the exploitation of animals has been studied here in greater detail than has the exploitation of plants. As a consequence it has been difficult to examine the total economic pattern, but a picture of economies varying according to environment has begun to appear.

The study of settlement patterns is as complex as that of economy and in this study it proved possible to consider settlement in only the simplest of terms. At the outset of the research it was hoped to be able to find evidence for economic practices in the organization of settlements. But many of the sites which have been excavated are tells and excavations of these have uncovered only small portions of the settlements. In northern sites very little seems to be known about settlement structures and their organization. The existence of many of these sites is known only from surface scatters. As a consequence

only settlement duration and locational patterns could be studied.

Despite the difficulties encountered in obtaining data appropriate to the problem, by analyzing in a systematic manner those which were available, it has been possible to show that a relationship between economy and environment, and between economic and settlement patterns does exist in south-eastern Europe.

In order to understand to what extent climate, rather than other environmental factors, played the major role in determining economic variation in this region, similar studies in other parts of Europe where Mediterranean and Humid Continental climatic zones meet, would be useful in providing either corroborative or contradictory evidence.

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APPENDIX 1

LIST OF NEOLITHIC SITES IN SOUTH-EASTERN EUROPE

The following list of Neolithic sites in south-eastern Europe includes only sites for which faunal or floral information or radio-carbon dates were available.

In this appendix as in all tables found in this thesis the time scale has been divided into early, middle and late Neolithic periods. Aceramic Neolithic sites are included among sites of the early Neolithic and eneolithic sites are included among late Neolithic sites. This was done in order to have a workable sample for testing economic and settlement relationships, and is justified because the only differences between these periods and the one which either follows or precedes it are unrelated to subsistence or settlement patterns.

South-eastern European cultural traditions have been classified as early, middle, or late Neolithic in the following manner:

EARLY NEOLITHIC
c. 6800 B.C. - 4200 B.C.

Karanovo I
Kremikovci
Starčevo
Körös
Cris
Aceramic

MIDDLE NEOLITHIC

c. 4200 B.C. - 3800 B.C.

Early Vinča
 Vinča Tordos
 Vădastra I
 Dudești
 Turdas
 Veselinovo
 Tisza
 Sesklo

LATE NEOLITHIC

c. 3800 B.C. - 3000 B.C.

Marica
 Karanovo V
 Boian
 Vădastra II
 Pre-Cucuteni
 Cucuteni
 Hamangia
 Vinča-Pločnik
 Sălcuța
 Gumelnita
 Petrești
 Dhimini
 Butmir

Whenever the information provided states simply that a site belongs to either the Vinča or Vădastra traditions it has been classified as a late Neolithic site though it could just as easily belong to the middle Neolithic. Some archaeologists (Gimbutas, Garašanin) classify the sites of the Northern Balkans into only two Neolithic periods - early and late. Thus it seems not unreasonable when in doubt to classify sites which belong to either the middle or late Neolithic periods as late Neolithic.

In some cases the sources of my information have not stated to which cultural tradition a site belonged,

but have stated whether the site is, in their opinion, early, middle or late Neolithic. This is particularly so for sites in Greece where few cultural traditions have been specifically identified. In these cases I have classified sites in the same manner as my source.

The list has been arranged according to the country and region in which sites are located. The following abbreviations have been used throughout.

Mesolithic -- Meso
Aceramic Neolithic -- AN
Early Neolithic -- EN
Middle Neolithic -- MN
Late Neolithic -- LN

SITE LIST

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>HUNGARY</u>				
1. Csöka	MN		x	
2. Bukovapuszta	EN		x	
3. Deszk-Olajkút	EN	x	x	
4. Dévaványa-Sártó	MN		x	
5. Gyalaret	EN	x	x	x
6. Hódmezővásárhely-Bodzáspart	EN		x	
7. Hódmezővásárhely-Gorsza-Kovács Tanya	EN		x	x
8. Katalaszeg	EN	x		
9. Kisköre	MN		x	
10. Kotacpart-Vata	EN	x		
11. Lebo	EN, MN →		x	
12. Maroslele-Pana	EN		x	
13. Obessenyó	EN		x	
14. Opoljenik	EN		x	
15. Oszentivan VII	MN	x		
16. Röske-Ludvár	EN		x	x
17. Szarvas-Szappanosi Szölok	EN		x	x
18. Szegvar-Túzkoves	MN		x	
19. Tiszajenő-Szárazerpart	EN		x	
20. Tiszaluc-Vályogos	MN		x	
21. Tiszaug-Topart	EN		x	
<u>JUGOSLAVIA</u>				
<u>Vojvodina</u>				
22. Banjica	LN	x		
23. Bapska (Vukovar)	MN-LN	x		
24. Ludaš-Budzsák	EN		x	x
25. Nosza Gyöngypart	EN		x	x
26. Starčevo	EN-LN	x	x	x
<u>Bosnia</u>				
27. Butmir	LN		x	x
28. Donja Dolina	LN?			x
29. Gornja Tuzla	EN-LN	x	x	x
30. Kakanj	?		x	

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>Bosnia (cont'd)</u>				
31. Nebo	LN		x	
32. Obre I	EN	x	x	x
33. Obre II	LN	x	x	x
34. Ripač	LN?		x	x
<u>Serbia</u>				
35. Divostin	EN, LN	x	x	
36. Grivac	LN	x		
37. Lepenski Vir	Meso-EN	x	x	
38. Lug	EN-LN			x
39. Medvednjak	MN	x		x
40. Predionica	MN, LN	x		
41. Staro Selo	MN	x		
42. Valaç	LN	x		
43. Vinča	EN-LN	x		x
44. Žarkovo	MN		x	
<u>Macedonia</u>				
45. Anza	EN-LN	x	x	x
46. Porodin	EN-LN	x		
47. Rug Bair	EN, MN		x	
48. Veluška Tumba	EN →		x	
49. Vršnik	EN-MN, LN?	x		x
<u>ROUMANIA</u>				
<u>Transylvania</u>				
50. Cașolt	LN			x
51. Ocna Șibiului	LN		x	
52. Tordas	MN, LN		x	
<u>Moldavia</u>				
53. Frumusica	LN			x
54. Habașești	LN	x	x	x
55. Izvoare	LN		x	x
56. Liubcova	EN, LN		x	
57. Mindrișca	LN		x	
58. Troyanov	LN		x	
59. Traian	LN		x	

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>Moldavia (cont'd)</u>				
60. Trusești	LN		x	
61. Valea Lupului	EN, LN	x	x	
<u>Transylvanian Alps</u>				
62. Cuina Turcului	Meso, EN		x	
63. Valea Răii	EN		x	
<u>Wallachia</u>				
64. Aldeni	LN		x	x
65. Bogota	LN		x	
66. Boian-Varaști	MN-LN		x	
67. Brăilița	LN			x
68. Căscioarele	LN		x	x?
69. Cernica	MN-LN		x	
70. Crușovu	LN		x	
71. Dudești	MN-LN		x	
72. Gumelnița	LN	x	x	x
73. Hotărani	LN		x	
74. Malul Roșu	MN, LN		x	
75. Radovanu I	MN, LN		x	
76. Sălcuța	EN, LN		x	x
77. Slobozia	LN		x	
78. Spantzov	LN		x	
79. Tangîru	LN		x	
80. Vădastra	EN-LN		x	x
81. Verbița	EN		x	
<u>Dobrogea</u>				
82. Baia-Hamangia	LN	x		
83. Ceamurlia de Jos	LN		x	
84. Cernavoda	LN		x	
85. Cetatuia	LN		x	
86. La Adam	Meso, LN		x	
87. Techirghiol	LN		x	
88. Tîrgușor	AN?-LN		x	
<u>Region Unknown</u>				
89. Dealu Ruschi	MN		x	
90. Glăvănești Veche	LN		x	

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>Region Unknown (cont'd)</u>				
91. Nandor	MN		x	
92. Petreni	LN		x	
93. Priesterhügel	LN		x	
<u>BULGARIA</u>				
<u>Danube Plateau and Dobroudja</u>				
94. Kubrat	LN		x	x
95. Ruse	LN		x	x
96. Sadovets	LN			x
97. Vinitsa	LN		x	
<u>Stara Planina</u>				
98. Chevdar	EN →		x	x
99. Chotnica	LN	x		x
100. Devetaska	EN, LN		x	
101. Golemata Peštera	Meso, EN		x	
102. Gradesnitsa	LN		x	
103. Hissarlik (Razgrad)	LN		x	
104. Hotnita	LN			x
105. Kazanluk	EN-LN		x	x
106. Krivodol	LN			x
107. Lovetch	EN, LN		x	
108. Okolglava	LN		x	
109. Polyanitsa	MN-LN			x
110. Morovitsa	LN		x	
<u>Rhodopes</u>				
111. Imamovka Dupka	EN, LN			x
112. Kodjadermen	EN-LN		x	x
<u>Thrace (Marica Valley)</u>				
113. Tell Azmak	EN-LN	x		x
114. Bikovo	LN	x	x	
115. Deve Bargan	MN-LN		x	
116. Dončovo Mogila	LN			x
117. Ezero (Dipsis)	MN →	x	x	x
118. Kapitan Dimitriev (Banyata Mogila)	EN-LN			x

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>Thrace (Cont'd)</u>				
119. Karanovo	EN-LN →	x	x	x
120. Kostievo I (Monastirska Mogila)	MN-LN			x
121. Metchkur	LN			x
122. Ploska Moghila	LN		x	
123. Sveti Kirilova	EN-LN		x	x
124. Unatcité (Pazardžik)	LN			x
125. Jasa Tepe	MN-LN	x	x	x
126. Zagortsky	LN			x
<u>Thrace (East of the Tundzha River)</u>				
127. Denev (Salmanovo)	LN		x	
128. Karnobat (Polianovgrad)	LN			x
129. Mađara (Podgrada)	LN		x	
130. Rašev (Yambol)	LN			x
131. Sava	LN			x
132. Goljamo Deltschevo	EN, LN		x	x
<u>Region Unknown</u>				
133. Provertenkata	LN		x	
134. Vasil Levski	?		x	
<u>GREECE</u>				
<u>Chalcidice</u>				
135. Kritsana	LN		x	
136. Olynthus	LN		x	x
<u>Macedonia</u>				
137. Dikili Tash	MN-LN			x
138. Haliakmon	EN-LN			x
139. Nea Nikomedeia	EN, LN	x	x	x
140. Servia	EN-LN			x
141. Sitagroi (photolivos)	MN-LN	x	x	x
<u>Thessaly</u>				
142. Achilleion	AN-MN	x	x	x
143. Arapi Magula	LN		x	

SITE	TIME PERIOD	RADIO-CARBON DATA	FAUNAL DATA	FLORAL DATA
<u>Thessaly (Cont'd)</u>				
144. Argissa	AN-LN	x	x	x
145. Dhimini	LN			x
146. Ghediki	AN-LN		x	x
147. Marmariani	LN →			x
148. Otzaki	MN-LN		x	x
149. Pyrasos	EN, LN			x
150. Rachmani	LN			x
151. Sesklo	AN-LN	x	x	x
152. Soufli	AN-LN			x
153. Tsani	MN			x
154. Visvike Magoula	LN			x
<u>Boeotia and Euboea</u>				
155. Dhrakhmani (Elateia)	EN-LN	x		
156. Orchomenos	LN →		x	
<u>Attica</u>				
157. Kitsos	LN	x	x	
158. Nea Makri	EN-LN		x	
<u>Pelponnese</u>				
159. Franchthi Cave	→ Meso-LN	x	x	x
160. Lerna	EN-LN		x	x
<u>Crete</u>				
161. Katsambas	MN		x	
162. Knossos	AN-LN →	x	x	x
<u>Aegean Islands</u>				
163. Kefala (Keos)	LN	x	x	x
164. Saliagos (Anitparos)	LN	x	x	x
165. Maroula (Kythnos)	AN	x		

APPENDIX 2

REGIONAL DISTRIBUTION OF KNOWN NEOLITHIC SITES

<u>COUNTRY</u>	<u>REGION</u>	<u>NUMBER OF SITES</u>	<u>TOTAL</u>
HUNGARY	Tisza-Körös	105	105
JUGOSLAVIA	Vojvodina	23	
	Slavonia	12	
	Bosnia	25	
	Serbia	86	
	Macedonia	29	
			165
ROUMANIA	Crişava (Körös)	2	
	Banät	8	
	Transylvania	47	
	Moldavia	35	
	Transylvanian Alps	14	
	Wallachia	243	
	Dobrogea	31	
			380
BULGARIA	Danube Plateau and Dobroudja	43	
	Stara Planina	57	
	Sofia Basin	18	
	Rhodopes	16	
	Thrace (Marica Basin)	102	
	Thrace (Coastal Plain)	26	
			262
GREECE	Thrace and Chalcidice	11	
	Macedonia	29	
	Thessaly	85	
	Boeotia and Euboea	12	
	Attica	16	
	Peloponnese	33	
	Crete	51	
	Aegean Islands	25	
			262

APPENDIX 3

TABLES OF RADIO-CARBON DATES

TABLE XIV RADIO-CARBON DATES FOR EARLY NEOLITHIC SITES
IN SOUTH-EASTERN EUROPE

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
<u>HUNGARY</u>			
Deszk-Olajkút	Bln 481	4655 ± 100	
	Bln 584	4500 ± 100	
	Bln 583	4460 ± 100	
	Bln 582a	4440 ± 100	
	Bln 582	4310 ± 100	
Kotacpart	Bln 115	4500 ± 100	5400
Katalszeg	Bln 86	4420 ± 100	5300
Gyalaret	Bln 75	5140 ± 100	
<u>JUGOSLAVIA</u>			
Gornja Tuzla	GrN 2059	4690 ± 75	5500
		4720 ± 75	
Porodin	H1486/987	5160 ± 170	6000
Vršnik	H595/485	4915 ± 75	5000
Anza	LJ2181	5320 ± 140	6100
	LJ2330/31	5220 ± 60	
	LJ3032	5260 ± 50	
	LJ3183	5200 ± 50	
	LJ3186	5190 ± 70	
	LJ2332	5160 ± 120	
	LJ2341	5280 ± 170	
	LJ2339	5170 ± 80	
	LJ2342	5150 ± 80	
	LJ2333	4890 ± 100	
	LJ2157sc	5020 ± 290	

TABLE XIV (continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE</u>	
			<u>TRUE AGE</u>	<u>B.C.</u>
Obre I	UCLA1605I	5290 ± 60	6250	
	Bln 636	4845 ± 150	5780	
	UCLA1605G	4730 ± 60	5750	
	UCLA1605F	4480 ± 60	5450	
	Bln 659	4280 ± 80	5150	
	UCLA1605H	4200 ± 70	5060	
Starčevo	GrN 6626	4660 ± 65		
	GrN 6627	4595 ± 105		
	GrN 6628	5665 ± 50		
	GrN 6629	4665 ± 65		
	GrN 7154	4660 ± 100		
	GrN 7155	4885 ± 70		
Divostin	Bln 886/931	5150 ± 100		
	Bln 862/899	5150 ± 100		
	Bln 823	5125 ± 100		
	Bln 826	5075 ± 100		
	Bln 896	5000 ± 100		
	BM 573	5000 ± 100		
	Bln 827	4950 ± 100		
Grivac	Bln 869	5300 ± 100		
Banja	Bln 873	5100 ± 100		
<u>BULGARIA</u>				
Tell Azmak	Bln 293	5353 ± 150	6350	
	Bln 291	5208 ± 150	6200	
	Bln 292	4938 ± 100	5900	
	Bln 294	4818 ± 100	5800	
	Bln 296	4829 ± 100	5800	
	Bln 295	4770 ± 100	5750	
	Bln 299	4862 ± 100	5850	
	Bln 297	4725 ± 100	5700	
	Bln 298	4590 ± 100	5550	
	Bln 224	4702 ± 150	5700	
	Bln 301	4533 ± 100	5500	
	Bln 300	4476 ± 150	5450	
	Bln 430	4329 ± 120	5300	
	Bln 203	4930 ± 100		
	Bln 267	4808 ± 100		

TABLE XIV (continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
Karanovo	Bln 293	5330 ± 150	
<u>GREECE</u>			
Argissa	UCAL1657A	6180 ± 100	7200 AN
	UCAL1657D	6040 ± 95	
	UCAL1657E GrN 4145	4850 ± 130 5500 ± 90	
Dhrakhmani	GrN 3039	6257 ± 110	
	GrN 2973	5530 ± 70	
	GrN 3037	5410 ± 90	
	GrN 3041	5240 ± 90	
	GrN 3502	5090 ± 130	
	GrN 2454	4420 ± 80	
Knossos	BM 124	6100 ± 180	AN
	BM 278	5989 ± 130	
	BM 436	5790 ± 130	
	BM 272	5620 ± 150	5620
	BM 126	5050 ± 180	
		4260 ± 150	
	BM 274	4190 ± 150	
	BM 273	4620 ± 150	
	BM 577	3934 ± 188	
	BM 279	3730 ± 150	
Nea Nikomedeia	Q 655	6215 ± 150	
	P 1203	5331 ± 74	
	P 1202	5607 ± 91	
Achilleion	LJ3184	5330 ± 50	
	UCLA1896A	5510 ± 177	
	P 2118	5521 ± 77	
Sesklo	P 1682	5533 ± 72	AN
	P 1681	5805 ± 97	
	P1680	5350 ± 93	

TABLE XIV (continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
Sesklo	P 1679	5661 ± 83	
	P 1678	5477 ± 78	
Franchthi Cave	P 1394	5844 ± 140	AN
	P 1525	5754 ± 81	
Maroula		5925 ± 500	AN

TABLE XV RADIO-CARBON DATES FOR MIDDLE NEOLITHIC SITES
IN SOUTH-EASTERN EUROPE

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>	
<u>HUNGARY</u>				
Oszentivan VIII	Bln 480	4100 ± 100	5000	
<u>JUGOSLAVIA</u>				
Vinča	GrN 1546	4240 ± 60	5200	
Anza	LJ2337	5130 ± 60	5800	
	LJ2409	4900 ± 50		
	LJ2351	5110 ± 80		
	LJ2405	4990 ± 80		
	LJ2345	4650 ± 110		
	LJ2338	4850 ± 140		
	LJ2343sc	5100 ± 280		
	LJ2344sc	4850 ± 270		
		UCLA1705C		4750 ± 80
		LJ2345		4650 ± 110
	UCLA1705B	4590 ± 120	5500	
	LJ2185	4560 ± 110		
Predionica	Bln 435	4330 ± 100	5200	
Medvednjak	LJ2523	4150 ± 100	5000	
Staro Selo	LJ2521	4150 ± 100	5000	
<u>BULGARIA</u>				
Karanovo	Bln 152	4851 ± 100		
	Bln 201	4623 ± 100		
	Bln 234	4550 ± 150		
	Bln 158	4410 ± 100		
Jasa Tepe	Bln 338	4130 ± 80		
Ezero	Bln 530	4320 ± 80		

TABLE XV(continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
<u>GREECE</u>			
Sitagroi	Bln 885	4080	+ 150
	BM 648	4315	+ 70
	Bln 779	4675	+ 170
	Bln 778	4475	+ 100
Knossos	BM 580	3572	+ 88
Achilleion	LJ3180	5560	+ 50
	UCLA1896C	5380	+ 95
	P 2120	5392	+ 95
	P 2117	5323	+ 76
	LJ3186	5300	+ 50
	LJ3201	5260	+ 80
	LJ3180	5250	+ 50
	P 2121	5231	+ 85
	UCLA1896B	5230	+ 155
	P 2124	5136	+ 85
	LJ3200	5080	+ 80
	LJ2943	5070	+ 150
	UCLA1896E	5330	+ 105
	UCLA1882A	4980	+ 155
Sesklo	P 1674	5014	+ 92
	P 1677	4791	+ 103
	P 1675	4744	+ 87
	P 1672	4554	+ 95
	P 1676	4367	+ 84
Franchthi Cave	P 2234	4880	+ 60
	P 1399	5244	+ 112
	P 2235	4800	+ 88

TABLE XVI RADIO-CARBON DATES FOR LATE NEOLITHIC SITES
IN SOUTH-EASTERN EUROPE

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE</u>
<u>JUGOSLAVIA</u>			
Gornja Tuzla		3630 ± 60	
Anza	LJ2329	4270 ± 60	5200
	LJ2178	4150 ± 250	
	LJ2411	4120 ± 190	
Divostin	Bln 865	4050 ± 100	
	Bln 898	3900 ± 100	
	Bln 863	3875 ± 100	
	BM 574	3300 ± 100	
	Bln 867	3300 ± 100	
Grivac	Bln 870	4375 ± 100	
	Bln 871	4250 ± 100	
	Bln 368	4125 ± 100	
	Bln 872	3975 ± 100	
Valac	Bln 436	3945 ± 80	
Obre II	Bln 639	4225 ± 80	
	GrN 5683	4160 ± 65	
	Bln 792	4125 ± 100	
	UCLA1605A	4070 ± 60	
	LJ2327	4070 ± 150	
Bapska		4005 ± 80	
Banjica	GrN 1542	3760 ± 90	
<u>ROUMANIA</u>			
Cernavoda	GrN 1986	3930 ± 70	4800
Gumelnita	Bln ?	3915 ± 50	4800
	Bln ?	3725 ± 80	4500
	Bln ?	3450 ± 120	4350
	GrN 3025	3765 ± 70	4550
	GrN 3028	3450 ± 90	4350
Habasesti		3132 ± 80	
Valea Lupului		2750 ± 60	

TABLE XVI (continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
Căscioarele	Bln ?	4030 + 100	4900
	Bln ?	3910 + 100	4800
	Bln ?	3620 + 100	4400
	Bln ?	3668 + 120	4450
	Bln ?	3535 + 120	4350
Baia-Hamangia	Bln 29	2140 + 160	2580
	Koln 38	2110 + 160	2560
<u>BULGARIA</u>			
Tell Azmak	Bln 136	3890 + 100	
	Bln 143	3787 + 150	
	Bln 150	3680 + 150	
	Bln 151	3879 + 100	
	Bln 148	3810 + 150	
	Bln 142	3853 + 150	
	Bln 137	3747 + 100	
	Bln 147	3269 + 150	
	Bln 149	3938 + 100	
	Bln 145	3440 + 100	
	Bln 146	3085 + 150	
	Bln 131	3767 + 100	
	Bln 139	3753 + 100	
	Bln 144	3647 + 120	
	Bln 135	3750 + 100	
	Bln 138	3671 + 200	
	Bln 141	3670 + 100	
Bln 134	3570 + 200		
Karanovo	Bln 154	3899 + 250	
		3085 + 150	
Ezero	Bln 425	3630 + 80	
Bikovo	Bln 337	3640 + 80	
Chotnica	Bln 125	3610 + 100	
<u>GREECE</u>			
Sitagroi	Bln 884	4290 + 100	
	Bln 777	3970 + 120	
	BM 649	3954 + 66	

TABLE XVI (continued)

<u>SITE</u>	<u>LABORATORY NO.</u>	<u>DATE b.c.</u>	<u>APPROXIMATE TRUE AGE B.C.</u>
Sitagroi	Bln 882	3845 + 100	
	Bln 776	3770 + 100	
	Bln 881	3605 + 100	
	Bln 883	3595 + 100	
	BM 650b	3417 + 85	
	Bln 774	3150 + 120	
Kitsos		4850	
		3800	
		3700	
		3700	
		3600	
		3520	
		3400	
Kephala	P 1280	2876 + 56	
Knossos	BM 571	3686 + 94	
	BM 585	3638 + 145	
Sesklo	P 1671	3672 + 80	
Saliagos	P 1311	4408 + 78	
	P 1396	4307 + 81	
	P 1333	3999 + 87	
	P 1368	4137 + 90	
	P 1393	3938 + 88	

INFORMATION SOURCES

1. For sites in Hungary

Gimbutas 1976
 Deszk-Olajkút, Kotacpart, Katalaszeg, Oszentivan VIII
 Srejović 1972
 Gyalaret

2. For sites in Jugoslavia

Gimbutas 1974
 Valac
 Gimbutas 1976
 Anza, Porodin, Obre I, Obre II, Medvednjak,
 Staro Selo, Vinča, Predionica
 McPherron and Srejović 1971
 Divostin, Grivac, Banja
 Weinberg 1965
 Gornja Tuzla
 Dimitrijevic 1971
 Bapska
 Todorovic and Cermanovic 1961
 Banjica

3. For sites in Roumania

Gimbutas 1974
 Cernavoda, Gumelnița, Căscioarele
 Berciu 1967
 Baia Hamangia
 Piggot 1960
 Habășești, Valea Lupului

4. For sites in Bulgaria

Gimbutas 1976
 Jasa Tepe, Karanovo
 Dennell 1978
 Tell Azmak, Karanovo, Jasa Tepe, Ezero, Chotnica,
 Bikovo

5. For sites in Greece

Gimbutas 1974
 Achilleion
 Gimbutas 1976
 Sitagroi

Theocharis 1973
Dhrakhmani, Sesklo
J. Evans 1965
Knossos
Van Zeist and Bottema 1971
Nea Nikomedeia
Jacobsen 1974 and 1976
Franchthi Cave
Stuckenrath, Jr. 1968
Saliagos
Coleman 1977
Kephala
Milojčić 1973
Argissa

APPENDIX 4

FAUNAL DATA FOR NEOLITHIC SITES IN SOUTH EASTERN-EUROPE

The following series of tables, based on actual bone and shell remains found in Neolithic sites of south-eastern Europe, provides all the faunal data presently available for this time period and region from French, German and English sources.

The choice of animals for the tables is based on the relative frequency of their appearance in faunal lists and is in no way an exhaustive list of animals known from the Neolithic sites of this region. More complete faunal lists from a few sites will be found in Appendix 5.

Tables XVII, XVIII and XIX show the presence or absence of different animal species in each site and if known the species whose remains occur with the greatest frequency in that site.

Tables XX, XXI and XXII show the relative bone quantities of each species in each site, plus if known the sample size.

Tables XXIII, XXIV and XXV show the relative number of individuals of each species in each site, and if known the sample size.

For tables XX to XXV where data have been provided in terms of the actual number of bone or individual animal

remains I have provided my own percentage calculations. In some cases where the per cent of domestic and wild species has been provided, but where there is no breakdown of wild species, and where the relative importance of each of the domestic species has been stated on the principle that the domestic species represent the total sample, I have recalculated these percentages to make them represent their relative importance in terms of the entire sample, both domestic and wild. This makes these figures consistent with the rest of my sample, so far as that is possible given that I do not have adequate information as to how the samples were obtained.

Scientific names are used here although in most cases my sources have reported their findings in common names. The following is a list of equivalents.

SCIENTIFIC NAME	COMMON NAME
<u>Bos taurus</u> L.	Cattle (domestic)
<u>Bos primigenius</u> Boj.	Aurochs
<u>Sus scrofa dom.</u> L.	Pig (domestic)
<u>Sus scrofa fer.</u> L.	Pig (wild)
<u>Ovis aries</u> L.	Sheep always combined in tables
<u>Capra hircus</u> L.	Goat as Caprovines
<u>Canis familiaris</u> L.	Dog
<u>Cervus elaphus</u> L.	Red deer
<u>Capreolus capreolus</u> L.	Roe deer
<u>Pisces</u> sp.	Fish
<u>Aves</u> sp.	Birds

TABLE XVII

ANIMALS FOUND IN EARLY NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>HUNGARY</u>												
Tiszaug- Topart	x	x		x	x		x	x	x			
Maroslele- Pana	x	x		xx	x	x	x	x	x	x		x
Deszk- Olajkút	x	x		xx	x							x ¹
Röszke- Ludvár	x	x		xx	x	x	x	x	x	x	x	x
Gyalaret	x	x		xx	x	x	x	x	x	x	x	x
Tiszajenő- Szárazer- part	x	x		xx	x							x ²
Szarvas- Szappanosí- Szölok	x			x								
Hódmezővásár- hely-Gorsza- Kovács Tanya	x	x										
Hódmezővásár- hely-Bodzá- spart	x			x		x			x			x
Obessenyo	x			x	x		?	x	x			x
Opoljenik	x			x				x				
Bukovapuzta	x							x				

TABLE XVII

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>JUGOSLAVIA</u>												
Gornja-												
Tuzla	x						?	x				
Anza	x	x		xx	x	x	x	x			x	x
Obre	xx	x		x	x	x	x		x			x
Nosza-												
Gyöngypart	x			x		x	x	x	x		x	x
Ludaš-												
Budzsák	x	x		xx	x	x	x	x	x	x	x	x
Starčevo	x			x	x	x	x	x	?	x	x	
Divostin	xx	x		xx		x	x	x	x	x	x	x
Lepenski-												
Vir	xx	x		x	x	x	x	x	x	x	x	x
Veluška-												
Tumba	x	x		xx				x				
Rug Bair	x	x		xx	x	x	x	x			x	x
<u>ROUMANIA</u>												
Valea-												
Râii				x						x		
Vădastra	xxx	x		x								
Cuina-												
Turcului					x							
Tîrguşor				x								
Verbita	x	x		x	x							

TABLE XVII

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>BULGARIA</u>												
Karanovo	x		x				?	x	x			
Golemata- Peshtera	?	?	x		x	?	?	x	x	x	x	x
Kazanluk	x		xx		x		x?	x	x	x	x	x
Chevdar	x		xx		x		x?	x	x	x	:	x
Lovetch	x	x	x		x	x	x	x	x	x		
Devetaška	x	x	xx		x	x	x	xx	x	x	x	x
Vasil- Levski	x		x		x		x	x	x		x	x
<u>GREECE</u>												
Nea Makri	x	x	xx									x
Knossos	x	x	xx		x							x
Nea Nikomedeia	x	x	xx		x			deer		x	x	x
Argissa	x	x	xx		x	x	x	x	x		x	x
Achilleion	x	x	xx		x							x
Sesklo	x	x	xx				x	deer		x		x
Franchthi Cave	x	x	xx			?	?	x		x		x
Ghediki			x									
Lerna	x	x	xx		x	x	x	x			x	x

x - present

xx - most frequent domestic species or most frequent wild species

1 and 2 - species unknown

3 - Bos bones have been found in this site but it is unknown if they are wild or domestic

TABLE XVIII

ANIMALS FOUND IN MIDDLE NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervas</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>HUNGARY</u>												
Lebo	xx	x	x		x							
Tiszaluc- Vályogos	xx	x	x			x	x	x	x			
Kisköre	xx	x	x		x	x	x		x			x
Dévaványa- Sarto	xx	x	x			x	x	x	x	x		
Szegvár- Túzköves	xx	x	x		x	x	x	x	x	x	x	x
Csöka	x	x	x									
<u>JUGOSLAVIA</u>												
Anza	x	x	xx		x	x	x	x	x		x	x
<u>ROUMANIA</u>												
Vădastra	xx	x	x					deer		x		x
Malul Roşu	x	x	x									
Dudeşti	x	?										
Radovanu	x		x									
Tordas			x									
Dealul Ruschi	x		x									
Nandor	x		x									
Cernica	x		x									

TABLE XVIII

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>BULGARIA</u>												
Kazanluk	x	x	xx		x			x	x		x	x
Gradesnitsa	x											
Vinitsa	xx?	xx?	x		x							
<u>GREECE</u>												
Sitagroi	x	x	xx		x		x	x	x		x	x
Otzaki	x	x	xx		x		x	deer				x
Argissa	x	x	x					x				
Achilleion	x	x	xx		x							x
Franchthi Cave	x	x	xx			?	?	x		x		x
Katsambas	x		x									
Lerna	x	x	xx		x	x	x	x		x	x	x

x - present

xx - Most frequent domestic species

1 Domestic horse is reported for this site

TABLE XIX

ANIMALS FOUND IN LATE NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>JUGOSLAVIA</u>												
Gornja Tuzla	x	?	x									
Anza	x	x	xx		x	x	x	x				x
Crvina Stijena			x									
Divostin	xx	x	x		x	x	x		x		x	x
Zarkovo ¹		?										
Nebo	x	x	x		x							
Obre 11	xx	x	x		x	x	x		x			x
Butmir	x	x	x			x		x				
<u>ROUMANIA</u>												
Valea Lupului	x		x									
Glăvănești Veche	xx	x	x									
Cernavoda	x	x	x		x			deer				x
Habașești	x	x	x		x		x		x			
Trusești	x	x	x							x		
Traian	xx	x	x		x		x		x			x
Cetatuia	x	x	x		x			x		x		
Vădastra			x		x							
Sălcuța	x	xx	xx		x		x		x			x
Crușova	x		x		x							
Gumelnița	xx	x	x		x	x	x		x			x
Căsciorele	xx	x?	x		x		?		x	x		x
Boian Varăști	x	x	x		x							
Hotărani	x		x									
Cernica	x		x									
Spantzov	x	x	x		x							

TABLE XIX

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>ROUMANIA (cont'd)</u>												
Ceamurlia de Jos	x	x	x		x							
Aldeni	x	x	x		x							
Bogata	xx		x		x			x				x
Tangiru	xx	x	x		x	x	x		x			x
La Adam	x	x	x					x				
Priesterhügel	x	x	x				x	x		x		
Izvoare	x		x				x					
Troyanov	xx	x	x		x		x	x		x		x
Techirghiol	xx	x	x		x		x			x		x
Ocna Sibiului	x	x	x									
Slobozia	x		x									
Mindresca	x	x	x									
Petreni	x											
Vidra	?					?	x	x		x		x
<u>BULGARIA</u>												
Karanovo ³	xx?	x	x		x		x	x		x		x
Kazanluk	x	x	xx					x		x	x	x
Jasa Tepe	xx	x	x		x							
Devetaska	x	x	x		x	x	x	x		x		x
Kodjadermen	?	x	x		x	?		x		x		x
Golyamo-												
Deltschevo	x	xx	x									x
Morovitsa		?	x			?	?	?		?		
Ploska Mogila	x											
Deve Bargan	?		x			?						

TABLE XIX

- SITE -	----- DOMESTIC SPECIES -----					----- WILD SPECIES -----						
	<u>Bos</u>	<u>Sus</u>	<u>Ovis</u>	<u>Capra</u>	<u>Canis</u>	<u>Bos</u>	<u>Sus</u>	<u>Cervus</u>	<u>Capreolus</u>	<u>Pisces</u>	<u>Aves</u>	<u>Other</u>
<u>BULGARIA (cont'd)</u>												
Denev	x?		x		x	?	x	x	x			x
Rousse	x?		x		x	?	x	x	x	x		x
Hissarlik			x		x	x		x	x	x	x	x
Kubrat	x											
Sveti Kirilovo	x	x						x	x			
Ezero	xx											
Bikovo	xx	x	x		x	x		deer				x
Vinitsa	xx	x	x		x							
Okol Glava	x		x		x	x	x	x	x			x
Provertenkata			?		x							
<u>GREECE</u>												
Sitagroi	x	x	xx				x	x				x
Arapi	x	x	xx				x	deer				x
Otzaki	x	x	xx		x		x	deer				
Kitsos			xx				xx	xx		x	x	x
Kephala	x	x	xx					x		x		x
Kritsana	x	x	xx					deer				
Orchomenos			x									
Olynthus	x		x				x					
Argissa	x	x	xx			x?		x				x
Franchthi Cave	x	x	xx			?	?	x		x		x
Saliagos	x	x	xx		x							x
Lerna	x	x	xx		x		x			x	x	x

x - present

xx - most frequent domestic species or most frequent wild species

1 - Sus bones have been found in this site but it is unknown if they are wild or domestic

2, 4, and 5 - Bos bones have been found in these sites but it is unknown if they are wild or domestic

3 - domestic horse is reported for this site

TABLE XX

ANIMAL BONES FOUND IN EARLY NEOLITHIC SITES IN SOUTH-EASTERN EUROPE
(in per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES					WILD SPECIES						
		Bos	Ovis Capra	Sus	Canis	Domestic Total	Bos	Sus	Cervus	Capre- olus	Pisces	Aves	Wild Total
<u>Hungary</u>													
Maroslele Pana	206	23.30	61.80	1.40	1.40	87.90	3.90	0.50	0.50	2.50			12.10
Rószke-Ludvár	2088	7.32	31.16	0.67	1.63	40.78	3.45	3.59	14.70	2.59	20.16	8.53	59.22
Deszk-Olajkút	?	23.56	56.11	0.16	0.16	80.16							19.84
Gyalaret	393	16.54	34.61	2.55	0.76	54.45	3.31	9.41	2.80	3.31	14.5	7.63	45.54
Tiszajenő-Száraserpart	?	24.12	66.44	0.44	0.22	91.22							8.28
<u>Jugoslavia</u>													
Anza	1198	9.60	78.30	8.26	0.42	96.58	1.25	0.58	0.33			0.08	3.42
Obre I	3128	45.05	32.00	1.60	0.22	81.87	1.02	6.71	6.49	1.06			18.13
Nesza-Gyöngypart	59	15.25	22.03			37.29	10.17	5.08	6.78	10.17		5.08	62.17
Ludaš-Budzsák	2735	10.38	68.12	0.29	0.29	79.08	1.17	0.26	1.02	0.95	1.94	7.17	20.92
Divostin	2225	45.40	42.24	3.55	0.45	91.64	4.31	1.30	1.62	0.49	0.09	0.04	8.35
Lepenski Vir	2369	15.83	3.42	0.34	5.91	25.50	7.34	8.91	36.39	1.52	17.30	0.42	74.50
Rug Bair	693	13.90	67.60	14.70	1.00	97.20	0.60	0.10		0.40		0.10	2.80
<u>Roumania</u>													
<u>Bulgaria</u>													
Kazanluk	336	2.08	23.51		1.19	26.79		17.56	5.95	5.95	3.87	2.69	73.21
Chevdar	149	2.01	59.66		6.71	67.78		13.42	1.34	2.01	0.67	2.01	32.21
<u>Greece</u>													
Nea Nikomedeia	?	13.53	65.52	13.73	0.21	93.00							7.00
Argissa (A.N.)	2195	4.70	83.50	9.90	0.20	98.30	0.50	0.20	0.10	0.20		0.20	1.70
Achilleion	?	3.78	82.68	6.51	0.84	93.81							6.19
Setklo	?	10.20	62.70	19.20		91.60		0.60	(deer 4.10)				8.40
Lerna (excluding molluscs)	174	10.30	54.60	20.60	0.60	81.61	4.90	2.40	1.20			2.40	13.22
Lerna (including molluscs)	313	5.43	28.75	10.86	0.32	45.37	2.56	1.28	0.64			1.28	54.00

TABLE XXI

ANIMAL BONES FOUND IN MIDDLE NEOLITHIC SITES IN SOUTH-EASTERN EUROPE
(in per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES				Domestic Total	WILD SPECIES						Wild Total
		Bos	Ovis Capra	Sus	Canis		Bos	Sus	Cervus	Capre- olus	Pisces	Aves	
<u>Hungary</u>													
Lebo	905	57.60	1.40	2.00	2.10	63.10	15.20	7.50	5.40	2.00	5.60		36.90
Tiszaluc-Vályogos	85	74.10	3.50	9.40		87.10	4.70	2.40	2.40	1.20	2.40		12.90
Kisköre	76	44.70	10.50	10.50	1.30	67.10	9.20	13.20		7.90			32.90
Déaványa-Sártó	70	12.90	5.70	7.10		25.70	7.10	5.70	48.60	10.00	2.90		74.30
Szegvár-Tűzköves	821	38.60	3.70	10.20	3.90	56.40	16.70	7.30	6.60	2.20	1.70	0.20	43.60
<u>Jugoslavia</u>													
Anza	2052	9.26	74.95	9.21	1.85	95.27	0.54	0.29	0.39	0.63		0.39	4.73
<u>Roumania</u>													
<u>Bulgaria</u>													
Kazanluk	127	6.30	44.09	18.11	3.15	71.65			3.94	6.30		3.15	28.35
<u>Greece</u>													
Sitagroi (MN and LN)	34,473	27.20	48.50	14.10	1.60	91.40							8.60
Otzaki	464	26.94	43.97	27.16	0.86	98.92		0.22	(deer	0.65)			1.08
Achilleion	?	4.10	77.72	10.16	1.16	93.14							6.86
Lerna (excluding molluscs)	631	17.60	50.10	26.50	1.00	95.22	0.50	0.20	1.90		0.60	1.00	4.44
Lerna (including molluscs)	2207	4.17	13.41	7.11	0.27	25.51	0.14	0.05	0.50		0.14	0.27	74.49

TABLE XXII

ANIMAL BONES FOUND IN LATE NEOLITHIC SITES IN SOUTH-EASTERN EUROPE
(In per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES				Domestic Total	WILD SPECIES					Wild Total	
		Bos	Ovis Capra	Sus	Canis		Bos	Sus	Cervus	Capre- olus	Pisces		Aves
<u>Hungary</u>													
<u>Jugoslavia</u>													
Anza	3068	16.17	67.40	11.44	1.17	96.18	0.72	0.16	0.68				3.82
Divostin	10,412	63.43	10.06	10.06	0.75	85.36	6.46	4.62	2.81	0.40		0.03	14.64
Obre II	23,422	66.63	6.95	12.40	0.88	86.86	3.25	2.48	5.46	1.16			13.14
<u>Roumania</u>													
Traian	1331	68.52	4.51	4.51	0.30	77.84		3.23	16.68	0.68			22.16
Gumelnița	2391	61.23	11.25	9.42	3.17	85.07	1.12	6.07	3.77	0.66			14.93
Ciscioarele	?	7.71	1.26	2.38	6.53	17.90	9.00		(deer 59.40)	10.00			81.90
Bogota	203	78.80	12.80		3.40	95.00			0.50				5.00
Tangiru	677	49.75	21.38	17.57	4.35	93.05							6.80
Teohirghiol	1094	50.30	41.70	2.10	0.60	94.70		0.30		0.20			5.30
<u>Bulgaria</u>													
Kazanluk	98	9.18	33.67	21.43		64.29			6.12	17.35	3.06	2.04	35.71
Golyamo Deltschevo	?					58.75							41.25
Jasa Tepe	?	45.00	15.00	10.00	5.00	75.00							25.00
<u>Greece</u>													
Sitagroi	?	26.11	48.12	18.02		94.21							5.79
Arapı	131	9.16	45.04	36.64		90.84		7.63	(deer 0.76)				9.16
Kephala(excluding molluscs)	1069	---	82.60	9.26		91.86	7.95		0.09		0.09		8.14
Kephala(including molluscs)	1319	---	66.94	7.51		74.45	6.44		0.08		0.08		25.54
Otzaki	135	14.81	48.15	32.59	3.70	99.26			(deer 0.74)				0.74
Argissa	124	16.94	59.68	19.35		95.97	1.61		1.61				4.03
Lerna (excluding molluscs)	423	22.93	43.03	27.19	1.89	95.04		0.24	2.60		0.24		4.96
Lerna(including molluscs)	1993	4.87	9.13	5.77	0.40	20.17		0.05	0.55		0.05		79.83
Saliagos(excluding molluscs)	5011	0.64	51.79	1.92		54.34						45.66	45.66
Saliagos (including molluscs)	7411	0.43	34.69	1.28		36.40					30.58		63.60

TABLE XXIII

RELATIVE NUMBER OF INDIVIDUALS OF ANIMAL SPECIES FOUND IN EARLY NEOLITHIC SITES OF SOUTH-EASTERN EUROPE
(in per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES				Domestic Total	WILD SPECIES						Wild Total
		Bos	Ovis Capra	Sus	Canis		Bos	Sus	Cervus	Capre- olus	Pisces	Aves	
<u>Hungary</u>													
Röszke-Ludvár	230	6.52	27.83	1.54	2.17	38.26	5.22	6.09	10.43	4.35	11.30	9.13	61.74
Gyalaret	130	13.02	28.47	4.07	0.81	46.37	4.07	8.13	4.07	7.86	11.38	13.83	53.63
<u>Jugoslavia</u>													
Anza	215	10.62	70.80	7.08	1.77	90.27	1.40	0.93	0.93			0.47	9.73
Nosza-Gyöngypart	25	16.00	16.00			32.00	3.00	8.00	12.00	8.00		4.00	68.00
Ludas-Budzsák	261	9.58	47.51	1.15	1.15	59.39	3.07	1.15	3.07	2.68	3.44	11.11	40.61
<u>Roumania</u>													
<u>Bulgaria</u>													
Chevdar	31	13.00	45.00			58.00		29.00	4.00	9.00			42.00
<u>Greece</u>													
Argissa (AN)	113	7.08	47.79	16.81	1.77	73.45	4.42	0.88	0.88	1.77		0.54	26.55

TABLE XXIV

RELATIVE NUMBER OF INDIVIDUALS OF ANIMAL SPECIES FOUND IN MIDDLE NEOLITHIC SITES OF SOUTH-EASTERN EUROPE
(in per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES				Domestic Total	WILD SPECIES						Wild Total
		Bos	Ovis Capra	Sus	Canis		Bos	Sus	Cervus	Capre- olus	Pisces	Aves	
<u>Hungary</u>													
Lebo	219	40.00	4.40	4.40	0.95	50.00							50.00
Tiszaluk-Vályogos	31	58.10	6.50	12.90		77.40	6.50	3.20	6.50	3.20	3.20		22.60
Kisköre	29	20.70	13.80	13.80	3.40	51.70	13.80	17.20			10.30		48.30
Bévaványa-Sártó	35	22.90	8.60	8.60		39.90	11.40	8.60	28.60	8.60	2.90		60.10
Szegvár-Tuzkőves	231	29.00	5.60	14.30	3.00	51.90	14.30	10.00	9.10	6.10	3.40	0/90	48.10
<u>Jugoslavia</u>													
Anza	210	10.48	63.81	8.57	3.81	86.67	1.90	1.43	1.90	1.90		1.43	13.33
<u>Roumania</u>													
<u>Bulgaria</u>													
<u>Greece</u>													
Otzaki	116	24.14	38.79	30.17	3.45	96.55		0.86	(deer 1.72)				3.45

TABLE XXV

RELATIVE NUMBER OF INDIVIDUALS OF ANIMAL SPECIES FOUND IN LATE NEOLITHIC SITES IN SOUTH-EASTERN EUROPE
(in per cent)

SITE	SAMPLE SIZE	DOMESTIC SPECIES				Domestic Total	WILD SPECIES					Wild Total
		Bos	Ovis Capra	Sus	Canis		Bos	Sus	Cervus Capre- olus	Pisces	Aves	
<u>Hungary</u>												
<u>Jugoslavia</u>												
Anza	269	17.84	59.85	11.90	2.60	92.19	1.86	0.74	1.49			7.81
<u>Roumania</u>												
Traian	97	42.27	9.28	9.28	3.09	63.92		6.19	19.59	4.12		36.08
Bogota	102	58.80	24.50		6.90	90.20			1.00			9.80
Tangiru	518	46.99	25.92	21.67	5.50	92.45						7.38
Troyanov	54	24.07	12.96	11.11	5.56	53.70		7.41	7.41	3.70		46.30
Techirghiol	372	44.60	39.80	3.50	1.60	89.50		0.50		0.50		10.50
Gumelnita	314	40.13	13.38	13.70	6.06	73.24	2.86	7.65	5.09	2.22		23.89
<u>Bulgaria</u>												
Jasa Tepe	?	61.00	12.00	10.00	1.00	84.00						16.00
<u>Greece</u>												
Arapi	39	15.38	38.46	35.90		89.74		5.13	(deer 2.56)			10.26
Otzaki	35	17.14	40.00	31.43	2.86	91.43			(deer 2.86)			8.57
Kephala(excluding molluscs)	51	---	74.51	11.76		96.08	9.80		1.96		1.96	3.92
Kephala(including molluscs)	280	---	13.57	2.14		17.50	1.79		0.36		0.36	82.50
Saliagos (excluding molluscs)	70	1.43	24.29	5.71		31.43					68.57	68.57
Saliagos (including molluscs)	2495	0.04	0.68	0.16		0.88					1.92	99.11

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Bökönyi 1974

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Bökönyi 1975

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APPENDIX 5

TABLES OF FAUNAL REMAINS FROM SEVERAL SITES
REPRESENTING ALL AREAS OF SOUTH EASTERN-EUROPE

In Appendix 4 tables were produced comparing bone remains found in all the Neolithic sites of south-eastern Europe for which such data were available. In this appendix more complete data are produced for many of the sites found in Appendix 4. These tables serve to show the wide variety of species, particularly wild species, which have been discovered at Neolithic sites in the region. In addition, some of the tables serve to provide more detailed information on the relationships between the animals found at a given site.

In many cases only common names have been provided by my sources. When possible the most likely scientific names have been inserted in brackets.

TABLE XXVI THE FAUNAL REMAINS FROM THE EARLY NEOLITHIC SITE OF RÖSZKE-LUDVÁR, HUNGARY
(source: Bőkónyi 1974)

	<u>NO. OF</u> <u>BONES</u>	<u>% OF</u> <u>BONES</u>	<u>NO. OF</u> <u>INDIVIDUALS</u>	<u>% OF</u> <u>INDIVIDUALS</u>
<u>DOMESTIC SPECIES</u>				
Cattle (<i>Bos taurus</i>)	153	7.32	15	6.52
Caprovines	631	31.16	64	27.83
Pig (<i>Sus scrofa dom.</i>)	14	0.67	4	1.54
Dog (<i>Canis familiaris</i>)	34	1.63	5	2.17
Total Domestic	852	40.78	88	38.26
<u>WILD SPECIES</u>				
<u>Mammals</u>				
Aurochs (<i>Bos primigenius</i>)	72	3.45	12	5.22
Red deer (<i>Cervus elaphus</i>)	307	14.70	24	10.43
Roe deer (<i>Capreolus capreolus</i>)	54	2.59	10	4.35
Wild swine (<i>Sus scrofa fer.</i>)	75	3.59	14	6.09
Wild ass (<i>Asinus hydruntinus</i>)	17	0.81	5	2.17
Wild cat (<i>Felis sylvestris</i>)	2	0.10	1	0.04
Mustelid	10	0.49	2	0.87
Badger (<i>Meles taxus</i>)	1	0.05	1	0.04
Wolf (<i>Canis lupus</i>)	7	0.33	2	0.87
Fox (<i>Canis vulpes</i>)	15	0.72	7	3.05
Beaver (<i>Castor fiber</i>)	8	0.38	3	1.30
Brown hare (<i>Lepus europaeus</i>)	7	0.33	2	0.87
<u>Birds</u>				
Cormorant (<i>Phalacrocorax sp.</i>)	2	0.10	1	0.04
Grey heron (<i>Ardea cinerea</i>)	2	0.10	2	0.87
Wild goose	3	0.14	1	0.04
Mallard (<i>Anas platyrhynchos</i>)	12	0.57	2	0.87
Grey lag goose (<i>Anser anser</i>)	1	0.05	1	0.04
Tufted duck (<i>Aythya fuligula</i>)	1	0.05	1	0.04
Short-toed eagle (<i>Circus gallicus</i>)	1	0.05	1	0.04
Black grouse (<i>Lyrurus tetrix</i>)	1	0.05	1	0.04
Demoiselle crane (<i>Anthropoides virgo</i>)	1	0.05	1	0.04
Great bustard (<i>Otis tarda</i>)	2	0.10	1	0.04
Curlew (<i>Numenius arquata</i>)	1	0.05	1	0.04
Wood pigeon (<i>Columba palumbus</i>)	1	0.05	1	0.04
Aves sp.	106	5.08	4	1.74
<u>Fish</u>				
Catfish (<i>Silurus glanis</i>)	1	0.05	1	0.04
Pike (<i>Esox lucius</i>)	1	0.05	1	0.04
Pisces sp.	400	19.16	26	11.30
European pond tortoise (<i>Emys orbicularis</i>)	123	5.89	11	4.78
Total Wild	1236	59.22	142	61.74
TOTAL	2088		230	

Note. Bőkónyi did not provide scientific names. These are the most likely

TABLE XXVII THE FAUNAL REMAINS FROM THE EARLY NEOLITHIC SITE OF GYALARET, HUNGARY

	<u>NO. OF BONES</u>	<u>% OF BONES</u>	<u>NO. OF INDIVI- DUALS</u>	<u>% OF INDIVI- DUALS</u>
<u>DOMESTIC SPECIES</u>				
<u>Canis familiaris</u> L.	3	0.76	1	0.81
<u>Sus scrofa dom.</u> L	10	2.55	5	4.07
<u>Ovis aries</u> L. and <u>Capra hircus</u> L.	136	34.61	35	28.47
<u>Bos taurus</u> L.	65	16.54	16	13.02
Total Domestic	214	54.46	57	46.37
<u>WILD SPECIES</u>				
<u>Silurius glanis</u> L. (Catfish)	1	0.25	1	0.81
<u>Esox lucius</u> L. (Pike)	1	0.25	1	0.81
<u>Pisces</u> sp.	55	14.00	12	9.76
<u>Emys orbicularis</u> L. (European pond tortoise)	13	3.31	6	4.86
<u>Aves</u> sp.	30	7.63	17	13.83
<u>Lepus europaeus</u> Pall. (Brown hare)	4	1.02	2	1.62
<u>Asinus hydruntinus</u> Reg. (Wild ass)	1	0.25	1	0.81
<u>Sus scrofa fer.</u> L (Wild swine)	37	9.41	10	8.13
<u>Capreolus capreolus</u> L. (Roe deer)	13	3.31	6	7.86
<u>Cervus elaphus</u> L. (Red deer)	11	2.80	5	4.07
<u>Bos primigenius</u> Boj. (aurochs)	13	3.31	5	4.07
Total Wild	179	45.54	66	53.63
TOTAL	393		123	

(Source: Bökönyi 1975)

Note. For the common names of the domestic species see Appendix 4.

TABLE XXVIII THE FAUNAL REMAINS FROM THE MIDDLE NEOLITHIC SITE OF KISKÖRE, HUNGARY

	<u>NO. OF BONES</u>	<u>% OF BONES</u>	<u>NO. OF INDIVI- DUALS</u>	<u>NO. OF INDIVI- DUALS</u>
<u>DOMESTIC SPECIES</u>				
<u>Canis familiaris L.</u>	1	1.3	1	3.4
<u>Sus scrofa dom. L.</u>	8	10.5	4	13.8
<u>Ovis aries L. and Capra hircus L.</u>	8	10.5	4	13.8
<u>Bos taurus L.</u>	34	44.7	6	20.7
Total Domestic	51	67.1	15	51.7
<u>WILD SPECIES</u>				
<u>Ursus arctos L.</u>	1	1.3	1	3.4
<u>Vulpes vulpes L.</u>	1	1.3	1	3.4
<u>Sus scrofa fer. L.</u>	10	13.2	5	17.2
<u>Capreolus capreolus L.</u>	6	7.9	3	10.3
<u>Bos primigenius Boj.</u>	7	9.2	4	13.8
Total Wild	25	32.9	14	48.3
TOTAL	76		29	

(Source: Bökönyi 1974)

TABLE XXIX THE FAUNAL REMAINS FROM THE EARLY NEOLITHIC SITE OF NOSZA-GYÖNGYPART, JUGOSLAVIA (Source: Bökönyi 1974)

	<u>NO. OF BONES</u>	<u>% OF BONES</u>	<u>NO. OF INDIVIDUALS</u>	<u>% OF INDIVIDUALS</u>
<u>DOMESTIC SPECIES</u>				
Caprovines	13	22.03	4	16.00
Cattle (<u>Bos taurus</u>)	9	15.25	4	16.00
Total Domestic	22	37.29	8	32.00
<u>WILD SPECIES</u>				
Great bustard (<u>Otis tarda</u>)	3	5.08	1	4.00
Brown hare (<u>Lepus europaeus</u>)	3	5.08	3	12.00
Badger (<u>Meles taxus</u>)	1	1.69	1	4.00
Wild ass (<u>Asinus hydruntinus</u>)	11	18.64	3	12.00
Wild swine (<u>Sus scrofa fer.</u>)	3	5.08	2	8.00
Roe deer (<u>Capreolus capreolus</u>)	6	10.17	3	12.00
Red deer (<u>Cervus elaphus</u>)	4	6.78	2	8.00
Aurochs (<u>Bos primigenius</u>)	6	10.17	2	8.00
Total Wild	37	62.71	17	68.00

Note. Bökönyi does not provide scientific names.

TABLE XXX THE FAUNAL REMAINS FROM THE EARLY NEOLITHIC SITE OF LUDAS-BUDZSÁK,
JUGOSLAVIA

(Source: Bökönyi 1974)

	<u>NO. OF</u> <u>BONES</u>	<u>% OF</u> <u>BONES</u>	<u>NO. OF</u> <u>INDIVIDUALS</u>	<u>% OF</u> <u>INDIVIDUALS</u>
<u>DOMESTIC SPECIES</u>				
Cattle (<i>Bos taurus</i>)	284	10.38	25	9.58
Caprovines	1863	68.12	124	47.51
Pig (<i>Sus scrofa dom.</i>)	8	0.29	3	1.15
Dog (<i>Canis familiaris</i>)	8	0.29	3	1.15
Total Domestic	2163	79.08	155	59.39
<u>WILD SPECIES</u>				
Aurochs (<i>Bos primigenius</i>)	32	1.17	8	3.07
Red deer (<i>Cervus elaphus</i>)	28	0.95	8	3.07
Roe deer (<i>Capreolus capreolus</i>)	26	0.95	7	2.68
Wild swine (<i>Sus scrofa fer.</i>)	7	0.26	3	1.15
Wild ass (<i>Asinus hydruntinus</i>)	137	5.01	16	6.13
Wild cat (<i>Felis sylvestris</i>)	3	0.11	2	0.77
Badger (<i>Meles taxus</i>)	3	0.11	1	0.38
Wolf (<i>Canis lupus</i>)	1	0.04	1	0.38
Fox (<i>Canis vulpes</i>)	5	0.18	2	0.77
Beaver (<i>Caster fiber</i>)	1	0.04	1	0.38
Brown hare (<i>Lepus europaeus</i>)	44	1.61	8	3.07
Aves sp.	196	7.17	29	11.11
European pond tortoise (<i>Emys orbicularis</i>)	36	1.31	5	1.92
Pike (<i>Esox lucius</i>)	2	0.07	1	0.38
Carp (<i>Cyprinid sp.</i>)	1	0.04	1	0.38
Catfish (<i>Silurius glanis</i>)	3	0.11	1	0.38
Pisces sp.	47	1.72	6	2.30
Total Wild	572	20.92	106	40.61
TOTAL	2735		261	

Note. Bökönyi does not provide scientific names. These are the most likely.

TABLE XXXI THE FAUNAL REMAINS FROM MESOLITHIC AND EARLY NEOLITHIC LEVELS AT
LEPENSKI VIR, JUGOSLAVIA (Source: Bökönyi 1972)

	MESOLITHIC		NEOLITHIC	
	NO. OF BONES	% OF BONES	NO. OF BONES	% OF BONES
<u>WILD SPECIES</u>				
Aurochs (<i>Bos primigenius</i>)	21	3.33	174	7.34
Red deer (<i>Cervus elaphus</i>)	226	35.93	862	36.39
Roe deer (<i>Capreolus capreolus</i>)	5	0.74	36	1.52
Wild pig (<i>Sus scrofa fer.</i>)	16	2.54	211	8.91
Marten (<i>Mustala martes</i>)	9	1.43	3	0.12
Badger (<i>Meles taxus</i>)	3	0.48	7	0.30
Beaver (<i>Castor fiber</i>)	2	0.31	4	0.17
Aves sp.	7	1.11	10	0.42
Cyprinids (carp)	87	13.83	14	0.59
Catfish (<i>Silurius glanis</i>)	8	1.27	22	0.93
Pisces sp.	201	31.96	364	15.36
Chamois (<i>Rupicapra rupicapra</i>)			2	0.08
Wild ass (<i>Asinus hydruntinus</i>)			7	0.30
Wild cat (<i>Felis sylvestrus</i>)			1	0.04
Lynx (<i>Felix (Lynx) lynx</i>)			6	0.25
Brown bear (<i>Ursus arctis</i>)			27	1.14
Wolf (<i>Canis lupus</i>)			7	0.30
Fox (<i>Canis vulpes</i>)			1	0.04
Hare (<i>Lepus sp.</i>)			7	0.30
Total Wild	585	93.00	1765	74.50
<u>DOMESTIC SPECIES</u>				
Dog (<i>Canis familiaris</i>)	44	7.00	140	5.91
Cattle (<i>Bos taurus</i>)			375	15.91
Caprovines			81	3.42
Pig (<i>Sus scrofa dom.</i>)			8	0.34
Total Domestic	44	7.00	604	25.50
TOTAL	629		2369	

Note. Bökönyi does not provide scientific names, but these are the most likely.

TABLE XXXII NUMBER AND PER CENT OF ANIMAL BONES FROM EARLY, MIDDLE AND LATE NEOLITHIC LEVELS
AT ANZA, JUGOSLAVIA (source: Bökönyi, 1976)

DOMESTIC SPECIES	EARLY NEOLITHIC		MIDDLE NEOLITHIC		LATE NEOLITHIC	
	No. of Bones	% of Bones	No. of Bones	% of Bones	No. of Bones	% of Bones
Cattle (<i>Bos taurus</i>)	115	9.60	190	9.26	496	16.17
Ovicaprids	938	78.30	1538	74.95	2067	67.40
Pig (<i>Sus scrofa dom.</i>)	99	8.26	189	9.21	351	11.44
Dog (<i>Canis familiaris</i>)	5	0.42	38	1.85	36	1.17
Total Domestic	1157	96.58	1955	95.27	2950	96.18
WILD SPECIES						
Aurochs (<i>Bos primigenius</i>)	15	1.25	11	0.54	22	0.72
Red deer (<i>Cervus elaphus</i>)	4	0.33	8	0.39	21	0.68
Roe deer (<i>Capreolus capreolus</i>)			13	0.63		
Brown hare (<i>Lepus europaeus</i>)	2	0.17	11	0.54	5	0.16
Swine (<i>Sus scrofa fer.</i>)	7	0.58	6	0.29	5	0.16
Brown bear (<i>Ursus arctos</i>)			1	0.05		
Fox (<i>Canis vulpes</i>)			1	0.05	2	0.07
Beaver (<i>Castor fiber</i>)			1	0.05		
Badger (<i>Meles taxus</i>)					1	0.03
Wolf (<i>Canis lupus</i>)					1	0.03
Rodent					1	0.03
Birds	1	0.08	8	0.39		
Tortoise	12	1.00	37	1.80	60	1.96
Total Wild	41	3.42	97	4.73	118	3.82
TOTAL	1198		2052		3068	

Note. Bökönyi did not provide scientific names, but these are the most likely.

TABLE XXXLIII NUMBER AND PER CENT OF INDIVIDUAL ANIMALS FROM EARLY, MIDDLE AND LATE NEOLITHIC LEVELS
AT ANZA, JUGOSLAVIA (source: Bökönyi 1976)

DOMESTIC SPECIES	EARLY NEOLITHIC		MIDDLE NEOLITHIC		LATE NEOLITHIC	
	No. of Individuals	% of Individuals	No. of Individuals	% of Individuals	No. of Individuals	% of Individuals
Cattle (<i>Bos taurus</i>)	12	10.62	22	10.48	48	17.84
Ovicaprids	80	70.80	134	63.81	161	59.85
Pig (<i>Sus scrofa dom.</i>)	8	7.08	18	8.57	32	11.90
Dog (<i>Canis familiaris</i>)	2	1.77	8	3.81	7	2.60
Total Domestic	102	90.27	182	86.67	248	92.19
WILD SPECIES						
Aurochs (<i>Bos primigenius</i>)	3	2.65	4	1.90	5	1.85
Red deer (<i>Cervus elaphus</i>)	2	1.76	4	1.90	4	1.49
Roe deer (<i>Capreolus capreolus</i>)			4	1.90		
Brown hare (<i>Lepus europaeus</i>)	1	0.88	3	1.43	2	0.74
Swine (<i>Sus scrofa fer.</i>)	2	1.76	3	1.43	2	0.74
Brown bear (<i>Ursus arctos</i>)			1	0.48		
Fox (<i>Canis vulpes</i>)			1	0.48	1	0.37
Beaver (<i>Castor fiber</i>)			1	0.48		
Badger (<i>Meles taxus</i>)					1	0.37
Wolf (<i>Canis lupus</i>)					1	0.37
Rodent					1	0.37
Birds	1	0.88	3	1.43		
Tortoise	2	1.76	4	1.90	4	1.49
Total Wild	11	9.73	23	13.33	21	7.81
TOTAL	113		210		261	

Note. Bökönyi did not provide scientific names, but these are the most likely.

TABLE XXXIV FREQUENCY OF ANIMALS AND AMOUNT OF USABLE MEAT AT ANZA 1

	Kilograms of usable meat	Number of animals	Percentage of total number of animals	Total estimated weight	Percentage of estimated weight	Kilograms of usable meat from total estimated weight
Cattle (700)	350	12	10.9	8,400	60.0	4,200
Sheep/goat (25)	12.5	80	72.7	2,000	14.3	1,000
Pig (30)	15	8	7.2	240	1.7	120
Dog (10)	5	2	1.8	20	0.2	10
Aurochs (900)	450	3	2.7	2,700	19.3	1,350
Red deer (190)	95	2	2.7	380	2.7	190
Wild pig (107.5)	53.75	2	1.8	215	1.5	107.5
Hare (4.5)	2.25	1	0.9	4.5	---	2.25
Totals		110	99.8	13,979.5	99.7	6,989.75

Note. Numbers in parentheses indicate estimated adult weight in kilograms.
Weights except for dog are based on Clason 1973.
Kilograms of usable meat represent 50% of estimated weight.

(After Milisauskas 1978:61)

TABLE XXXV FAUNAL REMAINS FROM THE LATE NEOLITHIC SITE OF TRAIAN, ROUMANIA (PRE-CUCUTENI LEVEL) (Source: Murray 1970)				
	<u>No. Of Bones</u>	<u>% of Bones</u>	<u>No. of Individuals</u>	<u>% of Individuals</u>
<u>DOMESTIC SPECIES</u>				
Cattle (<u>Bos taurus</u>)	849	72.5	32	47.1
Ovicaprids	39	3.3	5	7.4
Pig (<u>Sus scrofa dom.</u>)	48	4.1	6	8.8
Dog (<u>Canis familiaris</u>)	4	0.3	3	4.4
Total domestic	940	80.2	46	67.7
<u>WILD SPECIES</u>				
Red deer (<u>Cervus elaphus</u>)	173	14.8	12	17.7
Roe deer (<u>Capreolus capreolus</u>)	4	0.3	2	2.9
Wild pig (<u>Sus scrofa fer.</u>)	36	3.1	4	5.9
? Wild pig	11	0.9	2	2.9
Beaver (<u>Castor fiber</u>)	8	0.7	2	2.9
Total wild	232	19.8	22	32.3
TOTAL	1172		68	

TABLE XXXVI FAUNAL REMAINS FROM THE LATE NEOLITHIC SITE OF TRAIAN, ROUMANIA (CUCUTENI A AND B LEVELS) (Source: Murray 1970)				
	<u>No. of Bones</u>	<u>% of Bones</u>	<u>No. of Individuals</u>	<u>% of Individuals</u>
<u>DOMESTIC SPECIES</u>				
Cattle (<u>Bos taurus</u>)	63	39.6	9	31.0
Ovicaprids	21	13.2	4	13.8
Pig (<u>Sus scrofa dom.</u>)	12	7.6	3	10.3
Total domestic	96	60.4	16	55.1
<u>WILD SPECIES</u>				
Red deer (<u>Cervus elaphus</u>)	49	30.8	7	24.1
Roe deer (<u>Capreolus capreolus</u>)	5	3.2	2	6.9
Wild pig (<u>Sus scrofa fer.</u>)	7	4.4	2	6.9
Horse	1	0.6	1	3.5
Bear	1	0.6	1	3.5
Total wild	63	39.6	13	44.9
TOTAL	159		29	

Note. Murray does not provide scientific names for either table.

TABLE XXXVII FAUNAL REMAINS FROM THE LATE NEOLITHIC
SITE OF GUMELNITA, ROUMANIA

	NO. OF BONES	% OF BONES	NO. OF INDIVI- DUALS	% OF INDIVI- DUALS
<u>DOMESTIC SPECIES</u>				
<u>Canis familiaris</u>	76	3.17	19	6.06
<u>Bos taurus</u>	1464	61.23	126	40.13
<u>Ovicaprinae</u>	269	11.25	42	13.38
<u>Sus scrofa domesticus</u>	225	9.42	43	13.70
Total Domestic	2034	85.07	230	73.21
<u>WILD SPECIES</u>				
<u>Sus scrofa ferus</u>	145	6.07	24	7.65
<u>Sus sp.</u>	29	1.21	9	2.87
<u>Cervus elaphus</u>	90	3.77	16	5.09
<u>Capreolus capreolus</u>	16	0.66	7	2.22
<u>Bos primigenius</u>	27	1.12	9	2.86
<u>Canis vulpes</u>	5	0.20	3	0.95
<u>Canis lupus</u>	4	0.16	3	0.95
<u>Ursus arctos</u>	2	0.08	2	0.64
<u>Castor fiber</u>	1	0.04	1	0.32
<u>Lepus europaeus</u>	1	0.04	1	0.32
<u>Equus caballus</u>	37	1.58	9	2.87
Total Wild	291	12.17	66	21.02
TOTAL	2391		314	

(Source: Necrasov and Haimovici 1966)

	NO. OF BONES	% OF BONES	NO. OF INDIVIDUALS	% OF INDIVIDUALS
<u>DOMESTIC SPECIES</u>				
Cattle	550	50.3	166	44.6
Ovicaprids	456	41.7	148	39.8
Pig	22	2.1	13	3.5
Dog	7	0.6	6	1.6
Total Domestic	1035	94.6	333	89.5
<u>WILD SPECIES</u>				
Roe deer	2	0.2	2	0.5
Pig	3	0.3	2	0.5
Donkey	13	1.2	8	2.2
Small equoid	9	0.8	8	2.2
Fox	14	1.2	7	1.9
Hare	10	0.9	7	1.9
Dolphin	8	0.7	5	1.3
Total Wild	59	5.39	39	10.48
TOTAL	1094		372	

(Source: Murray 1970)

SPECIES	TOTAL NUMBER OF BONES AND TEETH		
	E.N.	M.N.	L.N.
Cattle	10	17	15
Red deer	26	17	11
Roe deer	40	27	34
Sheep/goat	133	91	63
Pig	74	35	23
Dog	9	5	--
Fox	11	6	2
Cat	3	1	--
Hare	17	5	2
Bird	9	4	2
Hedgehog	2	3	1
Marten	3	--	2
Rodent	3	5	1
Tortoise	16	6	--
Fish	2	--	5
Badger	--	1	--
Weasel	--	1	--
Bear	--	--	3
TOTAL	457	224	164

(Source: Dennell 1978b)

TABLE XL FAUNAL REMAINS FROM LATE NEOLITHIC SITES IN BULGARIA

SPECIES	KODJADERMEN	DENEV	ROUSSE	HISSARLIK	OKOL GLAVA
<u>Canis familiaris</u> L. (dog)	x	x	x	x	x
<u>Canis vulpes</u> L. (fox)	x	x			
<u>Meles taxus</u> Pall. (badger)	x	x			
<u>Sus scrofa</u> L. (pig)	x		x	x	x
<u>Cervus elaphus</u> L. (red deer)	x	x	x	x	x
<u>Cervus capreolus</u> L. (roebeek) ^a	x	x	x	x	x
<u>Bos</u> sp. (cattle)	x	x	x		
<u>Ovis aries</u> L. (domestic sheep)	x	x	x		x
<u>Lepus timidus</u> L. (hare)	x	x			
<u>Mustela martes</u> L. (marten)		x			
<u>Felis (Lynx) lynx</u> L. (linx)		x			
<u>Sus scrofa ferus</u> Gm. (wild boar)		x			
<u>Castor fiber</u> L. (beaver)		x	x		
<u>Equus caballus</u> L. (horse)			x	x	
<u>Ursus arctos</u> L. (European brown bear)		x		x	x
<u>Bos primigenius</u> Boj. (aurochs)				x	x
<u>Mustella</u> sp. (weasel or stoat)					x
<u>Mustela putorius</u> L. (European polecat)					x
<u>Bos taurus brachyceros</u> Owen (wild? cattle)					x
<u>Aves</u> sp.	x		x	x	
<u>Siluris</u> (catfish)			x		
<u>Unio</u> (clam)			x		
<u>Umo</u> (mussel)	x		x		
<u>Helix pomatica</u> (snail)	x		x		
<u>Cardium</u>	rare				
<u>Canis lupus</u> (wolf)		x			
<u>Carpiodes carpio</u> (carp)				x	

^a Probably Capreolus capreolus L.

(Source: Gaul 1948)

TABLE XLI NUMBER AND PER CENT OF BONES FROM ACERAMIC, EARLY, MIDDLE, AND LATE NEOLITHIC LEVELS
AT ARGISSA, GREECE (source: Miljčić, Boessneck and Hopf 1962)

<u>DOMESTIC SPECIES</u>	<u>ACERAMIC</u>		<u>EARLY NEOLITHIC</u>		<u>MIDDLE NEOLITHIC</u>		<u>LATE NEOLITHIC</u>	
	No. of Bones	% of Bones	No. of Bones	% of Bones	No. of Bones	% of Bones	No. of Bones	% of Bones
Cattle (<u>Bos taurus</u>)	103	4.7	8	29.63	3		21	16.94
Ovicaprids	1820	83.5	7	25.93	5		74	59.68
Pig (<u>Sus scrofa dom.</u>)	216	9.9	11	40.74	5			
Dog (<u>Canis familiaris</u>)	4	0.2						
Total Domestic	2143	97.63	26	96.30	26		119	95.97
<u>WILD SPECIES</u>								
Red deer (<u>Cervus elaphus</u>)	2	0.09	1	3.70	1		2	1.61
Roe deer (<u>Capreolus capreolus</u>)	3	0.14						
Aurochs (<u>Bos primigenius</u>)	11?	0.50					2?	1.61
Swine (<u>Sus scrofa fer.</u>)	5?	0.23						
Hare (<u>Lepus sp.</u>)	8	0.36						
Fox (<u>Canis vulpes</u>)	1	0.05						
Birds	5	0.23						
Mussels	16	0.73					1	0.81
Total Wild	51	2.32	1	3.70	1		5	4.03
TOTAL	2194		27		14		124	

Note. Scientific names were not provided. These are the most likely.

TABLE XLII NUMBER AND PER CENT OF INDIVIDUAL ANIMALS FROM ACERAMIC, EARLY, MIDDLE AND LATE NEOLITHIC LEVELS AT ARGISSA, Greece (source: Milošević, Boessneck and Hopf 1962)

DOMESTIC SPECIES	ACERAMIC		EARLY NEOLITHIC		MIDDLE NEOLITHIC		LATE NEOLITHIC	
	No. of Individuals	% of Individuals	No. of Individuals	% of Individuals	No. of Individuals	No. of Individuals	% of Individuals	
Cattle (<i>Bos taurus</i>)	8	7.08	2	25.0	2	3	15.0	
Ovicaprids	54	47.79	2	25.0	2	8	40.0	
Pig (<i>Sus scrofa dom.</i>)	19	16.81	3	37.5	1	6	30.0	
Dog (<i>Canis familiaris</i>)	2	1.77						
Total Domestic	83	73.45	7	37.5	5	17	85.0	
WILD SPECIES								
Red deer (<i>Cervus elaphus</i>)	1	0.88	1	12.5	1	1	5.0	
Roe deer (<i>Capreolus capreolus</i>)	2	1.77						
Aurochs (<i>Bos primigenius</i>)	5	4.42				1	5.0	
Swine (<i>Sus scrofa fer.</i>)	1	0.88						
Hare (<i>Lepus sp.</i>)	4	3.54						
Fox (<i>Canis lupus</i>)	1	0.88						
Birds	4	3.54						
Mussels	12	10.62				1	5.0	
Total Wild	30	26.55	1	12.5		3	15.0	
TOTAL	113		8		6	20		

Note. Scientific names were not provided. These are the most likely.

TABLE XLIII FAUNAL REMAINS FROM MESOLITHIC, EARLY,
MIDDLE AND LATE NEOLITHIC LEVELS AT
FRANCHTHI CAVE, GREECE

	TIME PERIOD				
	Meso.	E.N.	M.N.	L.N.	F.N.
<u>DOMESTIC SPECIES</u>					
Sheep/goat		x	x ^a	x ^b	x ^c
Pig		x	x	x	x
Cattle		?	x	?	x
Dog	x				
<u>WILD SPECIES</u>					
Wild goat	x				
Red deer	x ^d	x	?	?	x
Wild cattle/bison	x	?	?	?	?
Swine	x	?	?	?	?
Fox	x				
Hare	x				
Land snails	x	x	x	x	x
Marine molluscs	x	x	x	x	x
Small fishes	x	x	x	x	x
Large fishes (tuna and others)	x	x	x	x	x

Note. x represents presence of a species
F.N. refers to Final Neolithic

- ^a Sheep/goat make up 70-75% of the middle Neolithic sample.
^b Sheep/goat make up about 90% of the late Neolithic sample.
^c Sheep/goat make up about 70% of the final Neolithic sample.
^d 78-85% of the bones found in Mesolithic levels are of red deer.

(Source: Jacobsen 1973 and 1976)

TABLE XLIV FAUNAL REMAINS FROM THE EARLY NEOLITHIC SITE
OF NEA NIKOMEDEIA, GREECE

Large bovine	(50% immature)
Sheep/goat	(47% immature)
Pig	(90% immature)
Deer	(a few fragments)
Hare	(common)
Tortoise	1
Canid	1
Fish and bird	(not uncommon at all levels)
Molluscs	(<i>Cardium edule</i> - large number of broken shells)
Shellfish	of saltwater and brackish water varieties

(Source: Higgs 1962)

TABLE XLV FAUNAL REMAINS FROM THE EARLY, MIDDLE AND
LATE NEOLITHIC LEVELS AT LERNA, GREECE

SPECIES	NUMBER OF FRAGMENTS		
	E.N.	M.N.	L.N.
<u>Canis familiaris</u>	1	6	8
<u>Vulpes vulpes</u> (red fox)	2	3	1
<u>Lepus europ.</u> (hare)	3	1	2
<u>Sus scrofa</u>	4	1	1
Transitional and <u>Sus domesticus</u>	34	157	115
<u>Cerphus elaphus</u>	2	11	11
<u>Ovis et/sive Capra</u>	87	250	165
<u>Ovis sp.</u>	3	11	3
<u>Capra sp.</u>		35	14
<u>Bos primigenius</u>	8	3	
<u>Bos taurus domesticus</u>	17	104	97
<u>Aves</u>	4	6	2
<u>Reptilia</u>	1	3	3
<u>Pisces</u>		3	1
Invertebrates (mostly molluscs)	147	1613	1570
Groups of splinters	9	40	52
TOTAL	322	2247	2045

(Source: Gejvall 1969)

TABLE XLVI FAUNAL REMAINS FROM THE MIDDLE NEOLITHIC
AT SITAGROI, GREECE

DOMESTIC SPECIES

Cattle (Bos taurus)
Caprovines
Pig (Sus scrofa dom.)
Dog (Canis familiaris)

WILD SPECIES

Red deer (Cervus elaphus)
Wild swine (Sus scrofa fer.)
Fallow deer (Dama dama)
Roe deer (Capreolus capreolus)
Wild cat (Felis sp.)
Marten (Mustela martes)
Badger (Meles taxus)
Brown bear (Ursus arctis)
Fox (Canis vulpes)
Wolf (Canis lupus)
Beaver (Castor fiber)
Hare (Lepus sp.)
Small carnivore
Tortoise
Aves sp.

(Sources: C. Renfrew 1972b and Schwartz 1976)

Note. Neither source provided scientific names. These are the most likely.

TABLE XLVII FAUNAL REMAINS FROM THE MIDDLE NEOLITHIC LEVELS AT OTZAKI, GREECE
(PROTO SESKLO, VOR SESKLO, EARLY SESKLO, LATE SESKLO LEVELS)

	NUMBER AND % OF BONES								NUMBER AND % OF INDIVIDUALS																
	NO.	PS	%	NO.	VS	%	NO.	ES	%	NO.	LS	%	NO.	PS	%	NO.	VS	%	NO.	ES	%	NO.	LS	%	
<u>DOMESTIC SPECIES</u>																									
Cattle	27	34		65	30		21	19		12	25		5	31		15	28		5	21		3	21.5		
Ovicaprids	46	57		108	50		41	37		9	19		9	56		25	46		7	29		3	21.5		
Pig	7	9		44	20		48	44		27	56		2	13		14	26		12	50		8	57		
Dog	1			2			1						1			2			1						
<u>WILD SPECIES</u>																									
Deer				3												2									
Pig	1												1												
Hare				1												1									
TOTAL	82			223			111			48			18			60			25			13			

(Source: Boessneck 1955)

TABLE XLVIII RELATIVE IMPORTANCE ON THE BASIS OF MEAT WEIGHT OF THE FAUNAL SPECIES FOUND IN CLIFF 17, PIT A AND IN SQUARE N3 AT THE LATE NEOLITHIC SITE OF SALIAGOS, GREECE (after J.D. Evans and C. Renfrew 1968)

SPECIES	CLIFF 17, PIT A				SQUARE N3	
	NO. OF FRAGMENTS	MIN. NO. OF ANIMALS	MEAT WT. PER ANIMAL	TOTAL MEAT WEIGHT(kg)	MIN. NO. ANIMALS	TOTAL MEAT WEIGHT(kg)
sheep/goat	2595	17	29kg	490	22	640
bovine	32	1	210kg	210	6	1260
pig	96	4	45kg	180	10	450
tunny	1930	48	135kg	6500	7	940
other fish	358
<u>Patella</u>	1900	1900	3.5g	6.50	1970	6.90
<u>Monodonta</u>	340	340	1.0g	0.35	650	0.65
<u>Murex</u>	140	140	5.0g	0.70	216	1.80
<u>Cerastoderma</u>	90	45	1.0g	0.05	53	0.05

Note. Minimum numbers calculated for livestock are based on the number of humeri found, and for tunny on the number of vertebrae, at 39 vertebrae per fish.

Meat weight for livestock is taken as half modern liveweight.

Meat weight for tunny is taken as 135 kg., a rough average for fish of a length of 0.6 to 1.8 metres.

APPENDIX 6

FLORAL DATA FOR NEOLITHIC SITES IN SOUTH EASTERN-EUROPE

The following series of tables provides all the floral data that are presently available from French, German and English sources. This includes both carbonized seed remains and impressions in clay daub and pottery.

The choice of plants for the tables is based on the relative frequency of their appearance in plant lists and is in no way an exhaustive list of plants known from Neolithic sites in this region. More complete plant lists from some sites will be found in Appendix 7.

Although in most instances my sources have used common rather than scientific names the latter are used here. The following list provides a key to the abbreviations used in the tables as well as the scientific and common names of each species.

ABBREVI- ATION	SCIENTIFIC NAME	COMMON NAME
Tm	<u>Triticum monoccocum</u> L.	Einkorn wheat
Td	<u>Triticum diccocum</u> Schubl.	Emmer wheat
Ta, Tc	<u>Triticum compactum</u> Host.	Club wheat
	<u>Triticum aestivum</u> (vulgare) Host. (Vill)	Bread wheat
Tsp.	<u>Triticum</u> species	Wheat
Hd.	<u>Hordeum distichon</u> L.	Hulled 2-row barley
Hvn	<u>Hordeum vulgare</u> L. var <u>nudum</u>	Naked 6-row barley
Hh	<u>Hordeum hexasticum</u> L.	Hulled 6-row barley
Hsp.	<u>Hordeum</u> species	Barley
Le	<u>Lens esculenta</u>	Lentil
Vsp.	<u>Vicia</u> species	Vetch
Psp.	<u>Pisum</u> species	Pea

ABBREVI- ATION	SCIENTIFIC NAME	COMMON NAME
L		Legumes
Qsp.	<u>Quercus</u> species	Acorn
Cm	<u>Cornus mas</u> L.	Cornelian cherry
Pm	<u>Panicum miliaceum</u> L.	Broomcorn millet
O		Other

The following abbreviations have been used in column O

Vsp.	<u>Vitis</u> species	Grape
Asp.	<u>Avena</u> species	Oats
Osp.	<u>Olea</u> species	Wild olive
Pad	<u>Pistacia atlantica</u> Desf.	Pistachio
Ca	<u>Corylus avellana</u> L.	Hazelnut
Psp.	<u>Prunus</u> species	
Pi	<u>Prunus institis</u> L.	Wild plum
Ps	<u>Prunus spinosa</u> L.	Sloe
Pal	<u>Prunus avium</u> L.	Cherry
Fs	<u>Fagus sylvatica</u> L.	Beech nut
Pm	<u>Pyrus malus</u> L.	Apple
Cs	<u>Cannabis sativa</u> L.	Hemp
Ls	<u>Lathyrus sativus</u>	Grass pea
Fsp.	<u>Ficus</u> species	Fig
Lo	<u>Lithospermum officianale</u> L.	Corn cromwell
Jr	<u>Juglans regia</u> L.	Walnut
Ag	<u>Agrostemma Githaga</u> L.	Corncockle
Lsp.	<u>Lolium</u> species	Rye grass
Gr		Grass
Ar	<u>Agropyron repens</u> Beauv.	Couch grass
Cav	<u>Chenopodium album</u> V.	Lamb's quarters

TABLE XLIX

PLANTS FOUND IN EARLY NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Hh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>HUNGARY</u>																
Tiszajenő- Száraserpart								x								
Röszke-Ludvár	x	x		x												x
Gyalaret	x	x		x												x
Szarvas- Szappanosí Szölok				x				x								
Hódmezővásárhely- Gorsza- Kovács Tanya Mehtelek				x												Ca
<u>JUGOSLAVIA</u>																
Vršnik	x	x														
Obre 1	x	x	x		6-row barley				x		xx					
Nosza Gyöngypart													x		x	Fs
Ludaš Budzsák													x		x	Fs
Starčevo	x	x			6-row barley						x			x		Pm
Anza	x	xx	x		6-row barley				x		x					Grass
<u>BULGARIA</u>																
Tell Azmak	x	xxx	xx			x			x		x					Ls
Kazanluk	xxx	xx	x			x			x	x	x					x ¹

TABLE XLIX

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Fh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>BULGARIA (cont'd)</u>																
✓ Cavdar	x	x	x			x			x		x		x	x		x ²
Karanovo	x	x				x		x	x	x			x			Nuts
<u>GREECE</u>																
Knossos		x	xxx	x	x	x		x	xx							x
Nea Nikomedia	x	x				x			x	x	x		x	x		Psp
Argissa	x	x		x		x	x 6-row			x					x	
Achilleion	x	x	x			6-row barley							x		x	Asp
Sesklo		x			x						x		x			x ³
Soufli	x	xx		x	x				x		x					Osp
Franchthi Cave	x	x			x				x							x ⁴
Ghediki	x	x			x				x	x	x					Pad
Lerna													x?			Psp?

x - present

xx - abundant

xxx - Very abundant

1 Kazanluk - see more complete listing in Appendix 7

2 Cavdar - see more complete listing in Appendix 7

3 Sesklo - Pistacia atlantica Desf. is very abundant, Vitis silvestris

4 Franchthi - Pistacia atlantica Desf., Prunus species (Almond)

TABLE L

PLANTS FOUND IN MIDDLE NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Hh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>JUGOLSAVIA</u>																
Vršnik	x	x	x					x								
Medvednjak	x	x	x													
Anza	x	xx		x	6-row barley				x	x	x					Cav
<u>BULGARIA</u>																
Tell Azmak		x	x			xxx				xxx	x					x
Karanovo	x	x				x				x	x					
Kazanluk	x	x	x			x			x	x						x
Jasa Tepe					x				x	x						x
<u>GREECE</u>																
Tsani								x								
Sitagroi	xxx	x			6-row barley				x	x			x			
Franchthi Cave	x	x			x				x							
Haliakman				x					x	x						
Lerna					x				x	x	x					Fsp

x - present

xx - abundant

xxx - very abundant

TABLE LI

PLANTS FOUND IN LATE NEOLITHIC SITES OF SOUTH-EASTERN EUROPE

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Hh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>JUGOSLAVIA</u>																
Gornja Tuzla	x	x														
Vinča		x												x		Asp x ¹
Butmir	x		x				x		x		x					
Lug	x	x		x			x6-row barley									
Obre 11	xx		x				6-row barley		x		x					
Ripač									x	x					x	Vsp
Donja Dolina																Vsp
Anza	x	x		x				x	x		x					x
<u>ROUMANIA</u>																
Habașești				x						x						
Vădaștra				x				x								
Sălcuța				x				x							x	
Gumelnița				x												
Căscioarele				x?												
Vidra				x											x	
Aldeni				x												
Frumusica				x												Cs
Izvoare				x												
Bontesti				x												

TABLE LI

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Hh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>BULGARIA</u>																
Tell Azmak	x	x				x	xxx		xx	xxx	x					x
Karanovo	x	x				x		x	x	x	x				x	
Kapitan Dimitriev	x	xxx					x		x	xx						x
Kazanluk	x	x	x			x		x	x							x ²
Jasa Tepe	x	x							x							
Hotnica	x	x														
Sava																
Kodjadermen				x												Lo
Goljama Deltschevo	x	x	x			x			x				x			x ³
Rašev				x												
Metchkur				x												Jr
Donchovo Mogila	x	x	x			x	x	xxx		x	x					x
Imamovka Dupka																
Unatcite	x					x	x									Ar,Ag
Rousse	x	x														
Koubrat				x												
Sveti Kirilovo			x													Ag
Kostievo				x												
Karnobat			x													
Zagortsky									x							
Krivodol	x	x														6-row barley
Sadovec	x	x														6-row barley
Ezero		x														6-row (xxx)
Chotnica	x	x						xxx								

TABLE LI

SITE	Tm	Td	Ta Tc	Tsp	Hd	Hvn	Hh	Hsp	Le	Vsp	Psp	L	Qsp	Cm	Pm	O
<u>GREECE</u>																
Rakmani				x					x		x					Fsp (xxx)
Sitagroi	x	x					x		x	x				x		
Dikili Tash	x						xxx		x	x	x					x ⁴
Pyrasos	x	x					xxx				x					
Dhimini				x				x			x					x ⁵
Kephala						x										Lsp (xxx)
Servia			x						x	x						
Olynthus				x		x									x	Fsp
Sesklo		xxx	x			x	x				x	x	x			x ⁶
Franchthi Cave	x	x			x				x							
Sallagos				x	x		?									Lsp
Lerna					x				x	x	x					x ⁷
Magoule Visviki	x	x				x										
Marmoriani				x				x								

x - present

xx - abundant

xxx - very abundant

1 Butmir - Pyrus malus L., Pyrus species (pear), Corylus avellana L.

2 Kazanluk - see Appendix 7, Table LV

3 Goljamo Deltschevo - Sambucus, Polygonum

4 Dikili Tash - Pyrus species (pear), Vitis species

5 Dhimini - Ficus species, Pyrus species (pear), Prunus species (almond)

6 Sesklo - Ficus species, Prunus species (almond), Pistacia atlantica Desf.

7 Lerna - Ficus species, Arbutus unedo L.

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 Kosse 1979
 Méhtelek, Tiszajenő-Szárázérpart

2. For sites in Jugoslavia.

Gimbutas 1970
 Obre II
 J. Renfrew 1973b
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4. For sites in Bulgaria.

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 Chevdar (Čavdar), Karanovo (LN)

5. For sites in Greece

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 J. Renfrew 1968
 Saliagos
 J. Renfrew 1969
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 Catling 1978
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 Van Zeist and Bottema 1971
 Nea Nikomedeia

APPENDIX 7

TABLES OF FLORAL REMAINS FROM SEVERAL NEOLITHIC SITES IN
SOUTH-EASTERN EUROPE

In Appendix 6 tables were produced comparing seed remains and seed impressions found in all the Neolithic sites of south-eastern Europe for which such data were available. In this appendix more complete data are produced for some of these sites. These tables show either a quantitative breakdown of the floral remains or the extensive variety of the plant remains found in these sites. The latter tables illustrate the wide gamut of plants which one might expect to have been used or to have been found as weeds in crops at most sites in the region. The former tables serve to show that there was probably wide variation in the relative importance of various crop species in different regions and at different times within a region.

TABLE LII FLORAL REMAINS FROM THE EARLY NEOLITHIC SITE OF GYALARET, HUNGARY

	<u>Number of Seeds</u>
<u>Triticum monococcum</u> L.	24
<u>Triticum dicoccon</u> Schrank.	8
<u>Triticum</u> sp.	6
<u>Gramineae cultae-palea</u>	23
<u>Lathyrus</u> sp. (?)	1
<u>Bromus</u> sp. (?)	1
TOTAL	<hr/> 63

(Source: Hartyányi and Nováki 1975)

TABLE LIII COMPARISON OF FLORAL REMAINS FROM EARLY, MIDDLE, AND LATE NEOLITHIC LEVELS AT ANZA, JUGOSLAVIA

SPECIES	NUMBER OF SEEDS OR SPIKELETS		
	E.N.	M.N.	L.N.
<u>Triticum monococcum</u> L.	5	5	23
<u>Triticum dicoccon</u>	48	32	20
<u>Triticum</u> spikelet forks		27	19
<u>Hordeum vulgare</u>	13	6	2
<u>Triticum compactum</u>	15		
<u>Pisum sativum</u> var. <u>arvense</u>	3	3	2
<u>Lens esculenta</u>	2	5	7
Grass	1		
<u>Corylus avellana</u> L.		1	
Weeds (<u>Rumex</u> and <u>Chenopodium album</u>)			11
TOTAL	<hr/> 87	79	74

(Source: J. Renfrew 1976)

TABLE LIV COMPARISON OF FLORAL REMAINS FROM EARLY,
MIDDLE, AND LATE NEOLITHIC LEVELS AT TELL
AZMAK, BULGARIA

SPECIES	NUMBER OF SEEDS		
	E.N.	M.N.	L.N.
<u>Triticum monococcum</u>	47		500
<u>Triticum dicoccum</u>	614	4	69
<u>Triticum aestivum</u>	527		
<u>Hordeum vulgare L.</u> var nudum	2	2177	
<u>Lathyrus sativus</u>	162		
<u>Pisum sp.</u>	39	9	49
<u>Vicia sp.</u>		2485	9447
<u>Lens esculenta</u>			2825
<u>Galium aparine</u>			12
<u>Polygonum aviculare</u>			14
<u>Pyrus amygdaliformis</u>		1	
<u>Sambucus sp.</u>		1	
TOTAL	1391	4677	12916

(Source: Dennell 1978b)

TABLE LV FLORAL REMAINS FROM EARLY NEOLITHIC LEVELS
AT KAZANLUK, BULGARIA (Source: Dennell 1978b)

STAPLE RESOURCES: Vicia cf sativa
Triticum dicoccum
Hordeum hexastichum

INCIDENTAL RESOURCES: Triticum monococcum
Triticum aestivum
Rubus idaeus
Malus sp.
Juglans regia
Cornus mas
Vitis cf sylvestris
Lens sp.
Pisum sp.

CASUAL RESOURCES: Chenopodium sp.
Linum cf bienne
Rumex crispus
Polygonum aviculare
Arenaria sp.
Galium aparine
Galium mollugo
Solanum sp.
Potentilla sp.
Verbascum sp.
Atriplex sp.

WEEDS: Rumex acetosella
Verbascum sp.
Labiatae
Polygonum sp.
Chenopodium album
Caryophyllaceae
Astragalus sp.
Medicago sp.
Brassica sp.
Sambucus ebulus
Cruciferae
Graminae
Galium mollugo

Note. The ranking of the above plant remains, other than weed seeds is based on their archaeological representation and not on their probable importance to the diet.

TABLE LVI COMPARISON OF FLORAL REMAINS FROM MIDDLE
AND LATE NEOLITHIC LEVELS AT KAZANLUK,
BULGARIA

SPECIES	NUMBER OF SEEDS	
	M.N.	L.N.
<u>Triticum aestivum</u>	1	1
<u>Triticum monococcum</u>	4	1
<u>Triticum dicoccum</u>	66	83
<u>Hordeum hexastichum</u>	33	24
<u>Vicia sp.</u>	23	53
<u>Lens sp.</u>	52	73
<u>Cornus mas</u>	2	1
<u>Rubus sp.</u>	1	6
<u>Rumex (acetosella)</u>	2	8
<u>Rumex (crispus)</u>	2	7
<u>Juglans sp.</u>		1
<u>Vitis sp.</u>		1
Unknown	26	14
TOTAL	212	274

(Source: Dennell 1978b)

TABLE LVII FLORAL REMAINS FROM THE EARLY NEOLITHIC SITE
OF CHEVDAR, BULGARIA

STAPLE RESOURCES: Vicia cf. sativa
Triticum dicoccum
Hordeum hexastichum

INCIDENTAL RESOURCES: Lens sp.
Rubus idaeus
Malus sp.
Cornus mas
Rumex (crispus)
Triticum monococcum
Triticum aestivum

CASUAL RESOURCES: Chenopodium sp.
Malva sp.
Linum, cf. bienne
Potentilla sp.
Polygonum sp.
Verbascum sp.
Galium (aparine)
Galium (mollugo)
Sambucus ebulus
Avena sp.

WEEDS: Rumex acetosella
Polygonum aviculare
Labiatae

Note. The ranking of the above plant remains, other than weed seeds, is based on their archaeological representation and not on their probable importance to the diet.

(after Dennell 1978b)

TABLE LVIII FLORAL REMAINS FROM LATE NEOLITHIC LEVELS
OF GOLJAMO DELTSHEVO, BULGARIA

SPECIES	NUMBER OF SEEDS
<u>Triticum monococcum</u>	3
<u>Hordeum vulgare var nudum</u>	1470
<u>Sambucus sp.</u>	113
TOTAL	5600

NUMBER OF GRAIN AND SEED
IMPRESSIONS

<u>Triticum monococcum</u>	97
<u>Triticum dicoccum</u>	8
<u>Triticum sp.</u>	230
<u>Hordeum (6-row)</u>	48
<u>Vicia sp.</u>	2
<u>Sambucus sp.</u>	7
<u>Quercus sp.</u>	2
<u>Polygonum sp.</u>	3
TOTAL	397

Note; The contents of three seed samples have been combined to give the quantities in the first part of this table.

(Source: Dennell 1978b)

TABLE LIX FLORAL REMAINS FROM THE LATE NEOLITHIC SITE
OF DONCOVO MOGILA, BULGARIA

SPECIES	NUMBER OF SEEDS
<u>Triticum monococcum</u>	29
<u>Triticum dicoccum</u>	22
<u>Triticum compactum</u>	53
<u>Hordeum vulgare var nudum</u>	325
<u>Hordeum (6-row)</u>	5210
<u>Galium aparine</u>	1
TOTAL	<hr/> 5640

Note.

The contents of three seed samples have been combined combined to give the quantities in this table.

(Source: Dennell 1978b)

TABLE LX FLORAL REMAINS FROM THE EARLY NEOLITHIC SITE
OF NEA NIKOMEDEIA, GREECE

SPECIES	NUMBER OF SEEDS
<u>Triticum monococcum</u>	275
<u>Triticum dicoccum</u>	2858
<u>Hordeum vulgare var nudum</u>	2167
<u>Gramineae indet.</u>	1
<u>Lens culinaris</u>	5431
<u>Pisum sativum</u>	48
<u>Vicia ervilia</u>	54
<u>Leguminosae indet.</u>	3
<u>Quercus</u>	9
<u>Cornus mas</u>	3
TOTAL	<hr/> 10849

(Source: Van Zeist and Bottema 1971)

TABLE LXI FLORAL REMAINS FROM EARLY (ACERAMIC) NEOLITHIC LEVELS AT SESKLO, GREECE

SPECIES	NUMBER OF SEEDS
<u>Triticum dicoccum</u> Schubl.	6
<u>Hordeum distichum</u> L.	1
<u>Pisum</u> sp.	5
<u>Pistachia atlantica</u> Desf.	74
<u>Quercus</u> sp.	1
TOTAL	81

(Source: J. Renfrew 1973b)

TABLE LXII FLORAL REMAINS FROM THE EARLY (ACERAMIC) NEOLITHIC SITE OF GHEDIKI, GREECE

SPECIES	NUMBER OF SEEDS
<u>Triticum dicoccum</u> Schubl.	44
<u>Triticum monococcum</u> L.	2
<u>Hordeum distichum</u> L.	9
<u>Hordeum distichum</u> var. nudum	1
<u>Pisum</u> sp.	5
<u>Vicia</u> sp.	4
<u>Lens esculenta</u> Moench.	4
<u>Pistacia atlantica</u> Desf.	2
TOTAL	71

(Source: J. Renfrew 1966)

TABLE LXIII COMPARISON OF FLORAL REMAINS FOUND AT
FRANCHTHI CAVE, GREECE FROM PALAEOOLITHIC
LEVELS TO LATE NEOLITHIC LEVELS
(after Hansen and J. Renfrew 1978)

SPECIES	TIME PERIOD				
	P	M	E.N.	M.N.	L.N.
<u>Lithospermum arvense</u> L.	x	x	x	x	x
<u>Alkanna cf. arientalis</u>	x	x	x	x	x
<u>Anchusa</u> sp.	x	x	x	x	x
<u>Vicia</u> sp.	x	x	x	x	x
<u>Pistacia</u> sp.	x	x	x	x	x
<u>Prunus amygdalus</u> Batsch.	x	x	x	x	x
<u>Hordeum spontaneum</u> C.Koch	x	x			
<u>Avena</u> sp.	x	x			
<u>Lens</u> sp.	x	x			
<u>Pisum</u> sp.		x			
<u>Pyrus amygdaliformis</u> Vill.		x			
<u>Triticum dicoccum</u> Schubl.			x	x	x
<u>Hordeum distichum</u> L.			x	x	x
<u>Lens cf. culinaris</u> Medik.			x	x	x
<u>Triticum monococcum</u> L.				x	x
<u>Vitis sylvestris</u> L.					x

Note. x - indicates presence of a species
P = Palaeolithic
M = Mesolithic

APPENDIX 8

MARINE MOLLUSCS FROM THE NEOLITHIC SITES OF
KNOSSOS, SALIAGOS AND KEPHALA

The following tables serve to illustrate the wide variety of marine molluscs found in Neolithic sites of the Aegean islands and coastal Greece. Many, though by no means all, were gathered as sources of food.

TABLE LXIV

MARINE MOLLUSCA FROM NEOLITHIC LEVELS OF KNOSSOS, GREECE
(source: Shackleton, N. 1968a)

	<u>Number of Specimens</u>
BIVALVIA	
<u>Arca barbata</u> L.	8
<u>Arca diluvii</u> Lamarck	1
<u>Glycimeris</u> sp.*	16 whole + many fragments
<u>Ostrea edulis</u> L.	1
<u>Pinna nobilis</u> L.	7 fragments
<u>Spondylus gaederopus</u> L.	3
<u>Cerastoderma</u> sp.	637
<u>Mactra corallina</u> L.	2
<u>Donax trunculus</u> L.	2
<u>Vernerupis aureus</u> (Gmelin)	1
GASTEROPODA	
<u>Patella</u> sp.	46
<u>Monodonta turbinata</u> (Born)	49
<u>Cymatium parthenopium</u> (Von Salis)	7
<u>Tonna galea</u> (Linne)	5 fragments
<u>Murex trunculus</u> L.	1
<u>Charonia lampas</u> (Linne) and <u>Charonia variegata</u> (Phil.)	9 fragments
<u>Cassis undulata</u> (Gmelin)	3 fragments
<u>Luria lurida</u> (Linne)*	5
<u>Conus mediterraneus</u> Bruguieres	3
SCAPHOPODA	
<u>Dentalium dentale</u> L.*	18
CRUSTACEA	
Crab	2 claws, species unidentified

Note. Not all of the above species are considered to be food sources. Those marked with an asterisk are unlikely to represent food remains. Shackleton does not specify from which levels his sample is taken.

TABLE LXV

MARINE MOLLUSCA FROM THE LATE NEOLITHIC SITE OF SALIAGOS,
GREECE (source: Shackleton 1968b)

	<u>Number of Specimens</u>
BIVALVIA	
<u>Arca noae</u>	81
<u>Arca barbata</u>	8
<u>Glycimeris pilosus</u>	7
<u>Lima lima</u>	2
<u>Ostrea edulis</u>	28
<u>Ostrea stentina</u>	1
<u>Loripes lacteus</u>	3
<u>Mytilus galloprovincialis</u>	144
<u>Pinna nobilis</u>	462
<u>Chlamys per-felis</u>	1
<u>Spondylus gaederopus</u>	178
<u>Cerastoderma edule</u> (<u>Cardium edule</u>)	?
<u>Callista chione</u>	1
<u>Venus verrucosa</u>	31
<u>Venerupis aurea</u>	10% of all shells
<u>Pharus legumen</u>	1
<u>Solen marginatus</u>	9
<u>Barnea candida</u>	1
GASTEROPODA	
<u>Haliotis lamellosa</u>	2
<u>Diodora graeca</u>	1
<u>Patella coerulea</u> and <u>Patella</u> <u>lusitanica</u>	together > ½ of all shells
<u>Monodonta turbinata</u> (<u>Trochus</u> <u>turbinatus</u>)	2nd most common shell
<u>Lemintina aremaria</u>	
<u>Bivonia triquetra</u>	
<u>Cymatium parthenopium</u>	27
<u>Tonna galea</u>	1
<u>Murex trunculus</u>	5% of all shells
<u>Murex brandaris</u>	43
<u>Thais haemastoma</u>	17
<u>Charonia lampas</u>	
<u>Charonia variegata</u>	
<u>Natica dillwynii</u>	1
<u>Luria luida</u>	1
<u>Cypraea achatidea</u>	2

	<u>Number of Specimens</u>
<u>Columbella rustica</u>	12
<u>Columbella decollata</u>	5
<u>Fasciolaria lignaria</u>	1
<u>Cerithium vulgatum</u>	2% of all shells
<u>Conus mediterraneus</u>	10
 CEPHALOPODA	
<u>Sepia officinalis</u>	1
 CRUSTACEA	
crab	24 claws - species unknown
 ECHINODERMATA	
sea urchin	c. 12 fragments

Note. Not all of the above species are considered to be food sources.

TABLE LXVI

MARINE MOLLUSCA FROM THE LATE NEOLITHIC SITE OF KEPHALA,
GREECE (source: Coy 1977)

	<u>Number of Specimens</u>
Limpets (3 species)	154
Murex (s species)	14
Triton	31
Topshell	10
Hornshell	3
Cowrie	1
Abalone (2 species)	10
Pen shell	3
Ark shell (2 species)	3
Cockles (2 named species plus others)	4
Oyster	1
Other bivalves	16
TOTAL	<hr/> 250

Note. Coy does not provide scientific names.

APPENDIX 9

CLIMATIC DATA FOR SOUTH-EASTERN EUROPE

Data for the tables in the appendix have been taken from the following sources:

Turrill 1929

Dennell 1978b

Mellor 1975

Pécsi and Sárfavi 1964

Kosse 1979

Great Britain Naval Intelligence 1944

TABLE LXVII AVERAGE MONTHLY TEMPERATURES FOR CITIES IN SOUTH-EASTERN HUNGARY
(in Degrees Celsius)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Szeged	-1.0	0.8	6.5	11.7	17.2	20.4	22.7	21.7	17.7	12.1	6.1	1.6	11.5
Kecskemet	-1.8	0.1	5.5	11.0	16.6	19.7	21.9	20.9	16.5	10.8	4.8	0.4	10.5

TABLE LXVIII AVERAGE MONTHLY TEMPERATURES FOR CITIES IN JUGOSLAVIA
(in Degrees Celsius)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Osijek	-1.6	1.1	6.1	11.1	16.6	20.0	22.2	21.1	16.6	11.6	5.5	1.6	11.0
Belgrade	-1.6	1.0	6.1	11.1	16.4	19.5	22.0	21.4	17.4	12.9	5.9	1.2	11.1
Kragujevac	-1.8	0.7	5.6	10.6	15.8	18.8	21.2	20.4	16.5	12.1	5.5	0.9	10.5
Vranje	-2.2	0.6	5.8	10.8	15.9	18.7	21.4	21.1	17.4	12.7	5.5	0.7	10.7
Uzice	-2.2	-2.2	3.3	8.8	13.3	16.6	18.8	16.6	13.8	11.6	3.3	-1.1	8.3
Bjelasnica	-7.7	-7.7	-5.0	-2.2	2.7	6.6	9.9	9.4	6.6	2.2	-2.2	-5.5	0.6
Pljevlja	-3.8	-1.6	1.6	9.4	11.1	15.0	17.2	16.6	12.7	9.4	2.2	-1.6	7.4
Prijepolje	-1.6	-0.5	2.7	11.6	13.3	17.2	20.0	19.4	15.5	11.1	5.0	0.0	9.5
Niš	-1.1	1.1	5.5	11.1	16.6	19.4	22.2	21.6	17.7	12.7	5.5	1.1	11.1
Novi Pazar	-2.7	0.0	3.3	11.1	12.7	17.7	20.5	20.0	16.6	12.2	5.0	0.5	9.7
Skoplje	-1.6	1.1	7.2	11.6	16.6	20.5	22.7	22.2	18.8	12.7	6.1	1.1	11.6
Zvornik	-1.1	2.2	6.6	10.5	15.5	18.8	20.5	20.0	16.1	12.2	5.5	2.2	10.8
Sarajevo	-2.6	-0.5	4.0	9.5	13.9	17.2	19.4	19.0	15.4	10.6	4.2	-1.1	9.1
Banja Luka	-0.7	1.4	6.0	11.4	15.8	19.3	21.3	20.5	16.5	11.8	5.7	0.8	10.8
Bitolje	-1.1	2.7	6.6	11.1	16.6	20.0	22.2	21.6	18.3	13.3	6.1	2.2	11.6

TABLE LXIX AVERAGE MONTHLY TEMPERATURES FOR SULINA, ROUMANIA
(in Degrees Celsius)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Sulina	-1.7	0.0	4.1	9.5	15.8	20.1	22.5	21.9	17.9	13.2	6.5	1.7	11.0

TABLE LXX AVERAGE MONTHLY TEMPERATURES FOR CITIES IN BULGARIA
(in Degrees Celsius)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Petrohan	-4.9	-4.0	-1.6	3.0	8.8	11.6	13.6	13.8	10.2	6.0	-0.1	-3.0	4.4
Sofia	-3.0	-1.4	4.0	10.0	14.8	18.4	20.7	19.7	15.9	11.0	4.8	1.8	9.5
Kazanluk	-0.6	2.2	5.6	10.6	16.1	19.4	21.7	21.7	16.7	12.1	5.6	2.2	11.1
Gabrovo	-1.3	0.6	5.5	10.1	14.8	17.9	19.9	19.5	15.7	10.9	4.9	1.1	10.0
Plovdiv	-0.5	1.2	6.4	12.2	17.2	21.1	23.5	22.5	18.4	13.4	6.9	1.8	12.1
Kyustendil	-2.4	1.4	5.2	10.4	16.1	18.8	21.0	20.9	16.6	11.6	4.8	1.8	10.5
Rilski Monastir	-2.6	-1.2	1.3	5.9	11.5	13.8	16.0	16.0	12.1	8.2	3.2	0.0	7.0
Petritsch	2.4	3.8	8.2	12.8	18.1	22.2	24.2	24.0	19.3	14.1	7.7	3.9	13.4
Varna	1.4	2.6	6.0	10.3	15.4	19.7	22.1	22.1	18.3	13.7	7.8	4.7	12.0
Burgas	0.8	1.3	5.3	10.8	15.9	20.2	23.0	22.3	18.8	14.4	8.4	3.5	12.6

TABLE LXXI AVERAGE MONTHLY TEMPERATURES FOR CITIES IN GREECE
 (in Degrees Celsius)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Chania	10.8	10.8	13.1	15.7	19.3	23.1	25.7	25.3	23.2	20.3	15.6	12.3	17.9
Herakleion	10.6	11.1	12.8	16.1	20.0	23.9	25.6	26.1	23.9	19.4	16.1	12.8	18.2
Nauplia	10.0	11.1	12.5	15.3	19.0	23.3	26.7	26.7	24.0	20.4	15.0	11.8	18.0
Sparta	9.4	10.7	12.3	15.4	19.7	23.9	25.6	26.1	23.9	19.4	16.1	12.8	17.7
Athens	9.3	10.3	11.9	15.0	19.3	23.6	27.0	26.9	23.7	20.1	14.2	11.0	17.7
Naxos	12.6	12.8	14.1	16.4	19.7	23.2	24.9	24.8	22.7	21.1	16.7	13.9	18.6
Volo	7.4	9.4	11.7	14.8	19.4	23.7	26.0	25.7	22.1	19.2	12.9	9.7	16.8
Larissa	5.5	7.6	10.6	14.6	19.2	24.0	26.5	25.7	22.1	18.0	10.3	7.0	15.9
Salonica	5.6	7.2	10.0	13.9	19.4	23.2	26.7	25.6	22.2	17.8	11.1	7.8	15.9
Kavalla	5.6	6.7	9.4	13.9	20.0	23.6	25.6	26.1	21.7	16.7	11.7	8.9	15.8

TABLE LXXII AVERAGE MONTHLY PRECIPITATION FOR CITIES IN SOUTH-EASTERN HUNGARY
(in Millimetres)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
Szeged	32	34	38	49	<u>61</u>	<u>68</u>	51	48	47	<u>52</u>	<u>52</u>	41	573
Kecskemet	26	29	32	44	<u>55</u>	<u>54</u>	48	44	46	<u>48</u>	<u>50</u>	37	513

TABLE LXXIII AVERAGE MONTHLY PRECIPITATION FOR CITIES IN JUGOSLAVIA
(in Millimetres)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
Osijek	33	30	41	61	<u>76</u>	<u>79</u>	61	58	56	<u>64</u>	51	43	653
Belgrade	29	33	45	57	<u>72</u>	<u>80</u>	<u>70</u>	45	44	<u>60</u>	43	41	619
Kragujevac	41	58	36	51	<u>69</u>	<u>86</u>	51	48	38	48	<u>61</u>	46	633
Uzice	51	51	61	66	<u>99</u>	<u>124</u>	<u>91</u>	48	53	64	74	56	838
Bjelasnica	183	<u>193</u>	<u>198</u>	185	168	<u>163</u>	107	102	135	183	183	<u>201</u>	2001
Pljevlja	66	<u>66</u>	<u>79</u>	81	<u>91</u>	<u>119</u>	81	64	81	<u>119</u>	84	<u>84</u>	1015
Prijepolje	48	43	56	61	<u>89</u>	<u>109</u>	<u>84</u>	46	46	58	66	51	757
Niš	33	46	38	56	48	<u>69</u>	43	46	43	<u>64</u>	<u>61</u>	36	583
Novi Pazar	56	56	69	71	<u>79</u>	<u>104</u>	71	53	71	<u>102</u>	<u>71</u>	71	874
Skoplje	36	30	18	43	<u>56</u>	<u>56</u>	36	36	30	<u>51</u>	38	48	473
Zvornik	43	56	56	74	<u>99</u>	<u>122</u>	94	69	71	<u>102</u>	46	66	898
Banja Luka	48	58	74	91	<u>124</u>	<u>119</u>	84	76	84	<u>117</u>	61	61	997
Sarajevo	59	56	<u>77</u>	59	69	78	59	63	72	<u>102</u>	<u>77</u>	71	842
Travnik	71	64	<u>79</u>	70	78	<u>79</u>	75	56	66	<u>91</u>	<u>66</u>	71	866
Bitolje	48	<u>71</u>	<u>46</u>	66	69	<u>61</u>	38	36	36	<u>74</u>	<u>71</u>	61	677

Note. The precipitation figures for the three wettest months at each settlement have been underlined in the above tables.

TABLE LXXIV AVERAGE MONTHLY PRECIPITATION FOR SULINA, ROUMANIA
(in Millimetres)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
Sulina	28	21	30	33	34	<u>56</u>	34	26	<u>43</u>	<u>41</u>	40	28	414

TABLE LXXV AVERAGE MONTHLY PRECIPITATION FOR CITIES IN BULGARIA
(in Millimetres)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
Petrohan	58	80	89	101	<u>119</u>	<u>141</u>	<u>111</u>	80	105	92	96	61	1150
Sofia	38	36	37	52	<u>86</u>	<u>82</u>	<u>69</u>	54	49	62	49	36	650
Kazanluk	44	46	37	44	<u>70</u>	<u>95</u>	<u>57</u>	38	45	53	<u>63</u>	43	635
Gabrovo	47	43	60	73	<u>109</u>	<u>132</u>	<u>102</u>	77	67	60	<u>69</u>	45	899
Plovdiv	<u>48</u>	46	41	<u>47</u>	<u>43</u>	<u>67</u>	<u>42</u>	31	34	32	45	34	510
Kyustendil	<u>49</u>	48	31	<u>45</u>	<u>72</u>	<u>60</u>	<u>60</u>	<u>60</u>	38	55	<u>64</u>	43	625
Rilski Monastir	48	62	55	<u>79</u>	<u>79</u>	<u>85</u>	61	54	41	78	<u>87</u>	48	777
Petritsch	60	<u>77</u>	60	<u>65</u>	44	35	31	19	20	<u>76</u>	<u>90</u>	45	628
Varna	30	27	28	33	<u>49</u>	<u>74</u>	<u>47</u>	42	34	45	46	39	501
Burgas	47	<u>57</u>	41	45	51	<u>86</u>	40	30	22	51	<u>64</u>	52	586

Note. The precipitation figures for the three wettest months at each settlement have been underlined in the above tables.

TABLE LXXVI AVERAGE MONTHLY PRECIPITATION FOR CITIES IN GREECE
(in Millimetres)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
Chania	<u>105</u>	100	45	20	10	6	0	2	8	24	<u>171</u>	<u>143</u>	634
Herakleion	<u>86</u>	82	50	16	12	2	3	9	20	46	<u>91</u>	<u>101</u>	518
Athens	<u>52</u>	37	34	21	<u>20</u>	17	7	9	14	44	<u>73</u>	<u>62</u>	390
Volo	<u>43</u>	45	<u>46</u>	33	36	26	13	17	30	43	<u>67</u>	<u>55</u>	454
Larissa	45	46	<u>42</u>	40	<u>48</u>	33	31	19	27	48	<u>69</u>	<u>59</u>	507
Salonika	37	36	41	48	<u>60</u>	44	25	31	40	53	<u>69</u>	<u>61</u>	545
Kavalla	<u>71</u>	<u>87</u>	69	49	<u>52</u>	42	18	55	34	22	69	<u>82</u>	650

Note. The precipitation figures for the three wettest months at each settlement have been underlined in the above table.

APPENDIX 10

TEMPERATURE AND PRECIPITATION GRAPHS FOR SOUTH-EASTERN
EUROPE

FIGURE 7
Average Monthly Temperatures for Osijek Jugoslavia

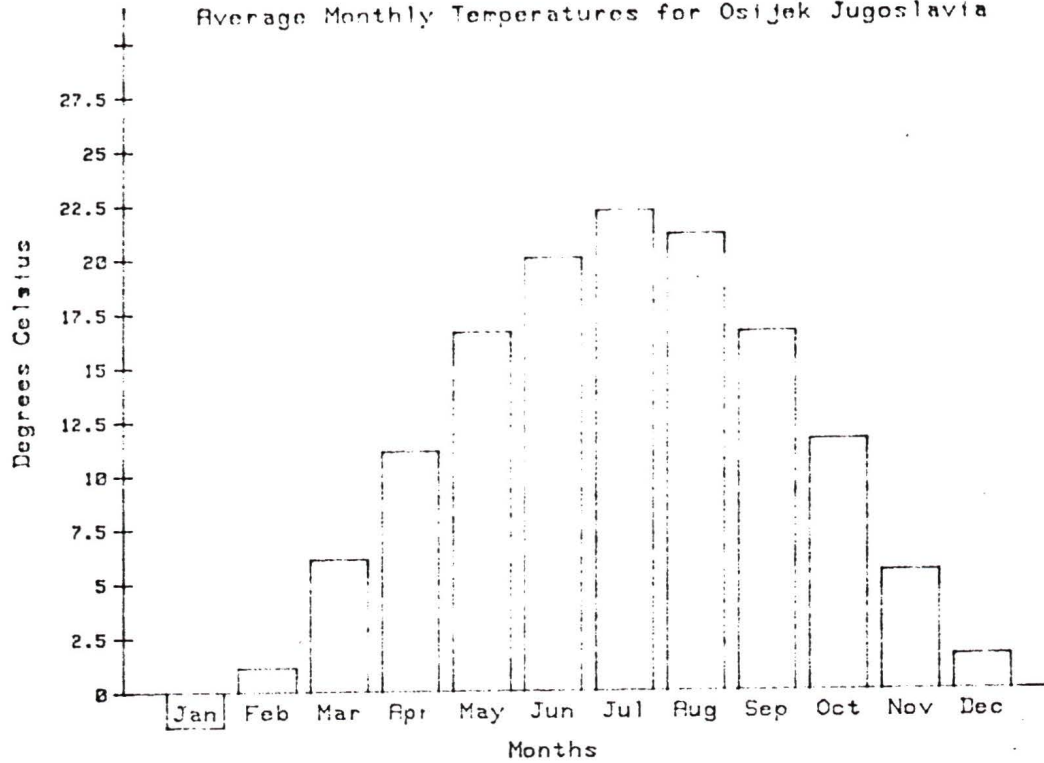


FIGURE 8
Average Monthly Precipitation for Osijek Jugoslavia

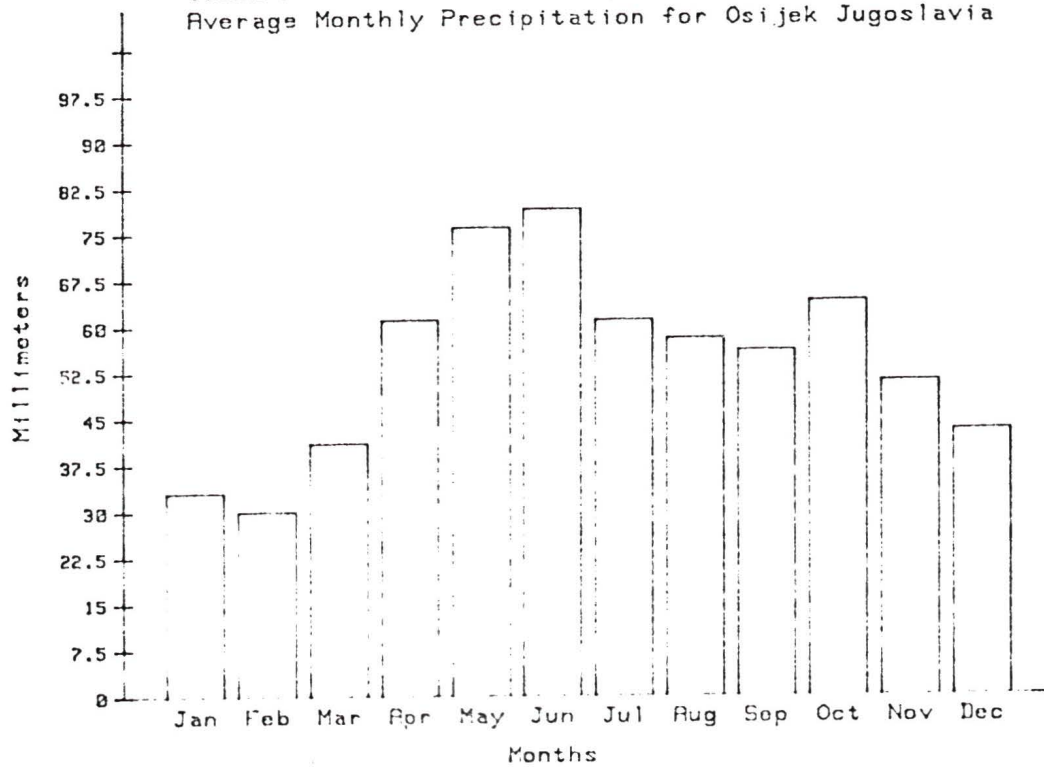


FIGURE 9

Average Monthly Temperatures for Kragujevac Jugoslavia

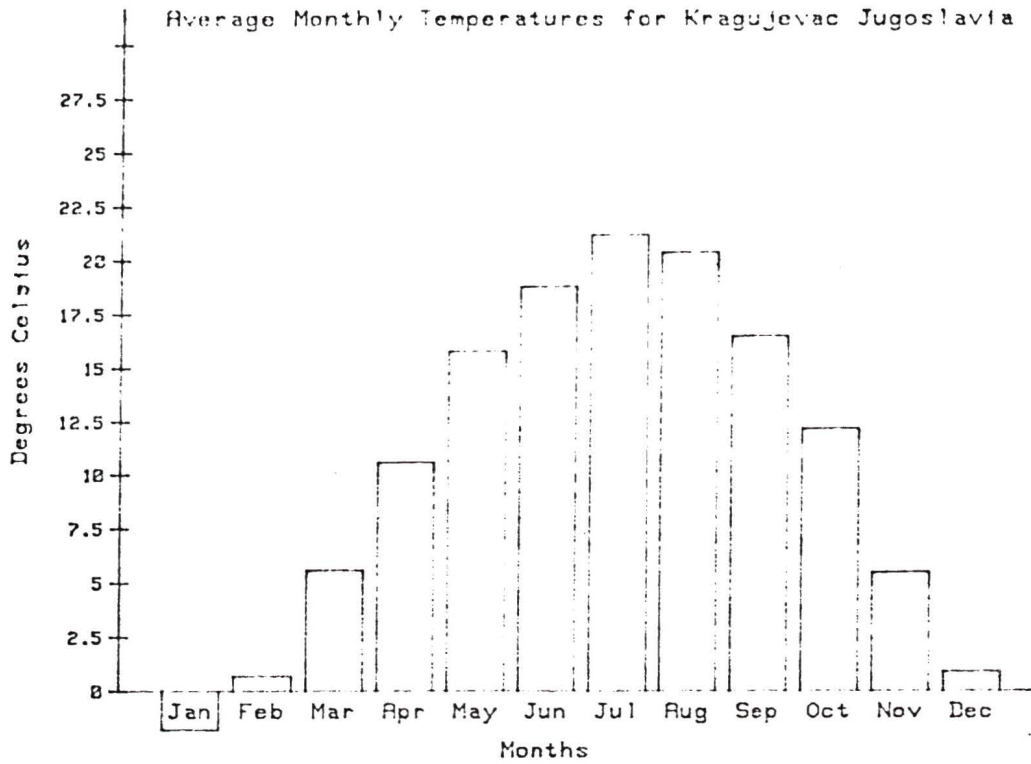


FIGURE 10

Average Monthly Precipitation for Kragujevac Jugoslavia

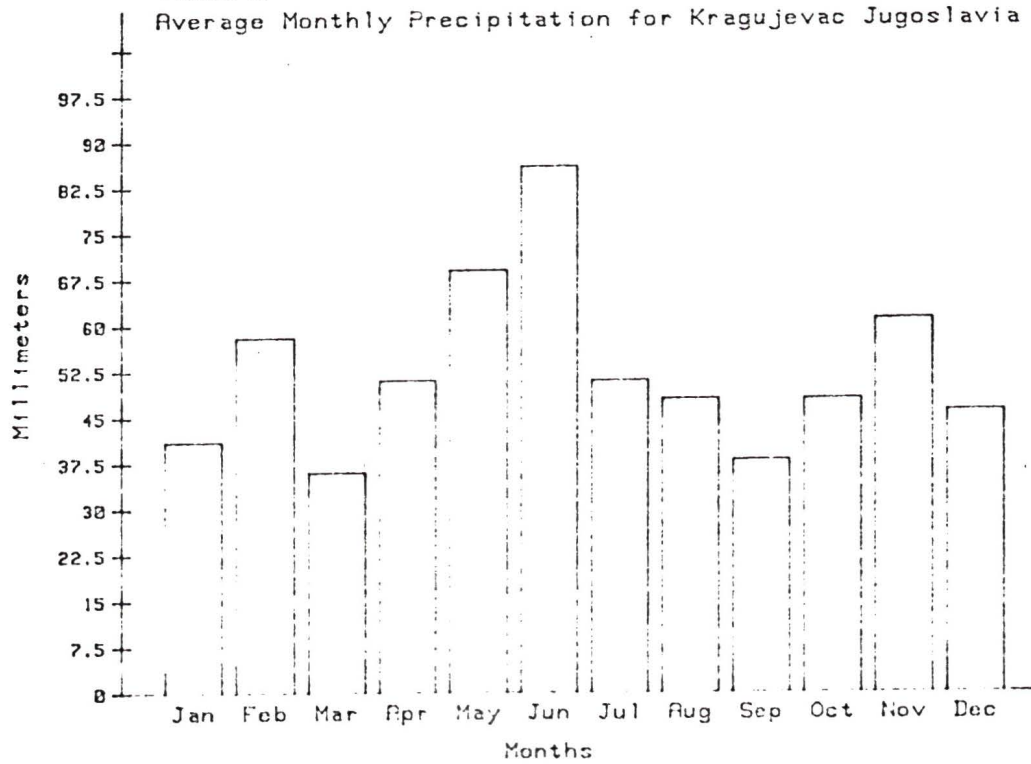


FIGURE 11

Average Monthly Temperatures for Bitolje Jugoslavia

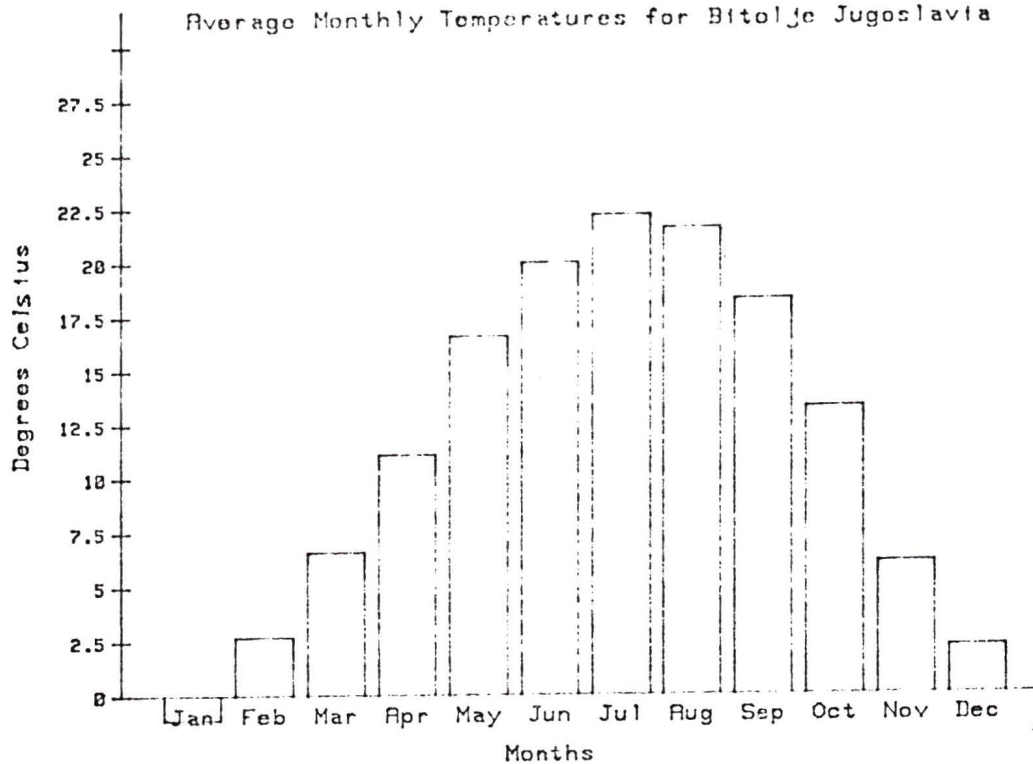


FIGURE 12

Average Monthly Precipitation for Bitolje Jugoslavia

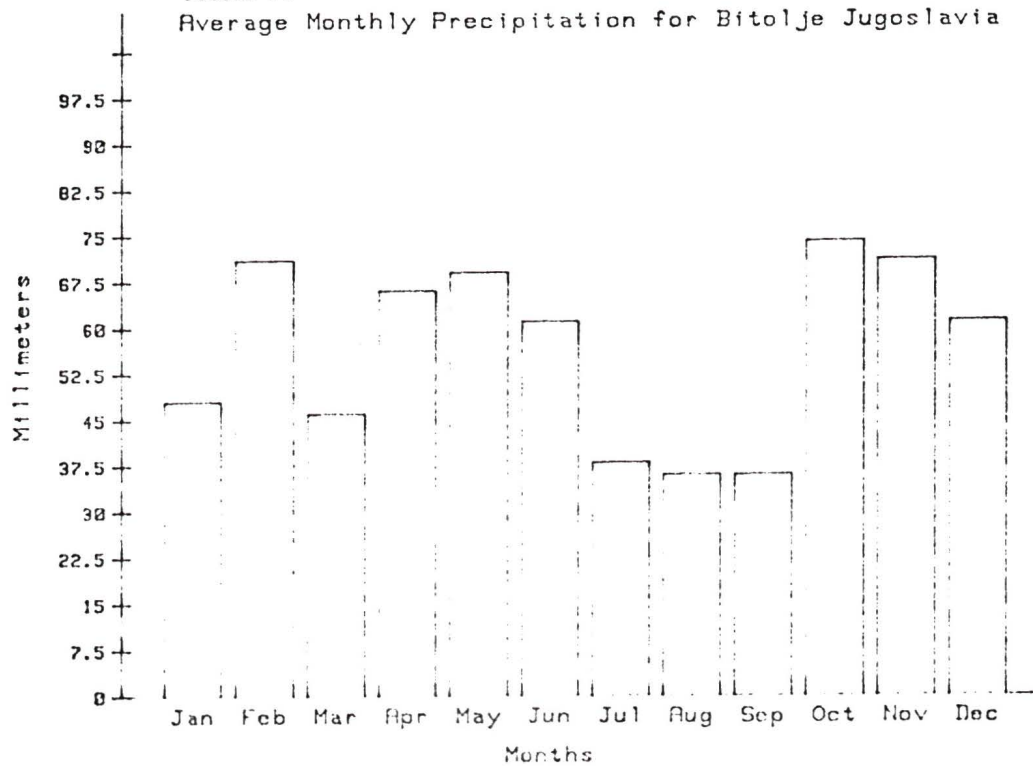


FIGURE 13

Average Monthly Temperatures for Sulina Roumania

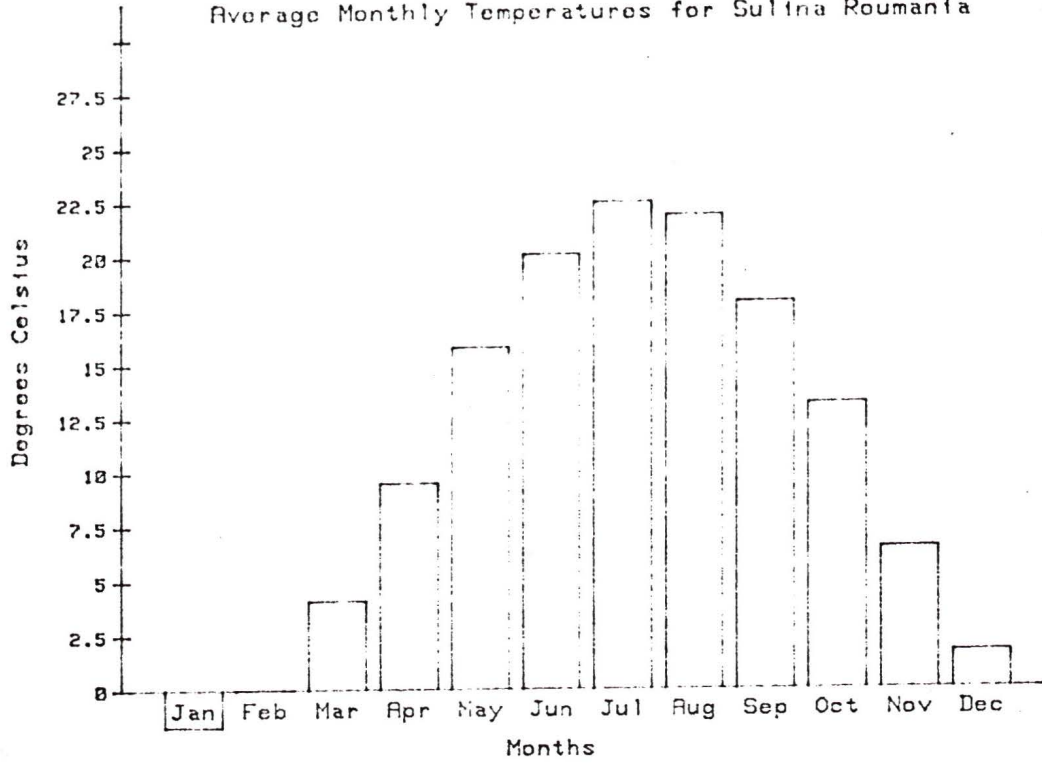


FIGURE 14

Average Monthly Precipitation for Sulina Roumania

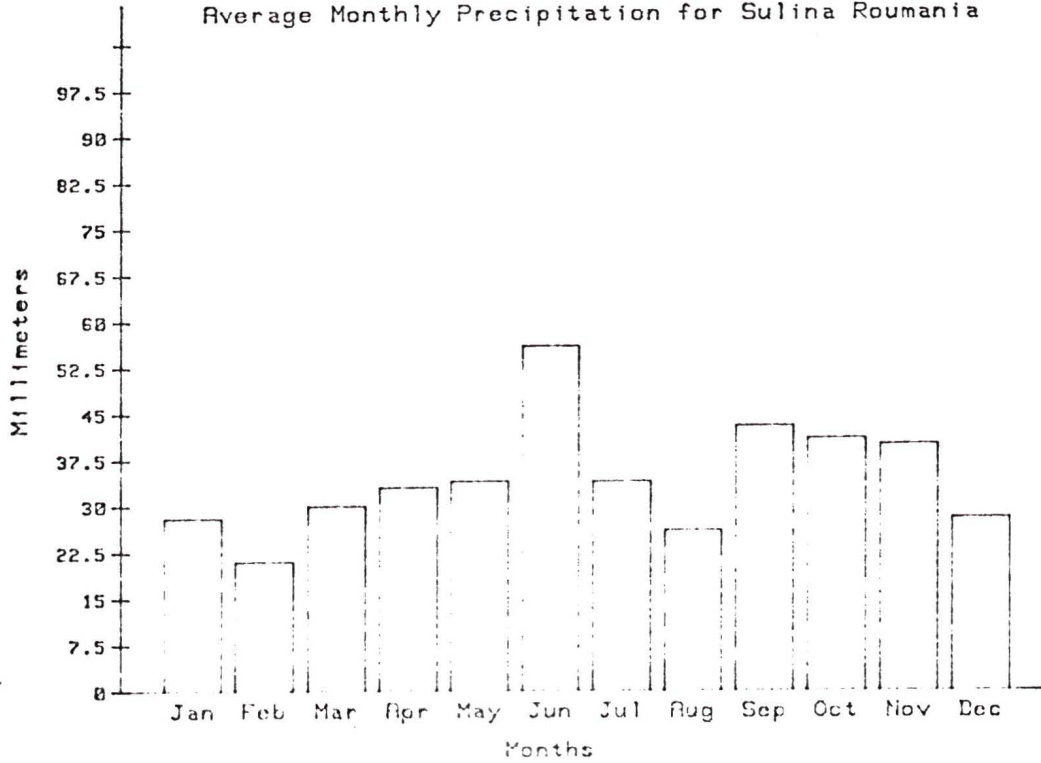


FIGURE 15
Average Monthly Temperatures for Sofia Bulgaria

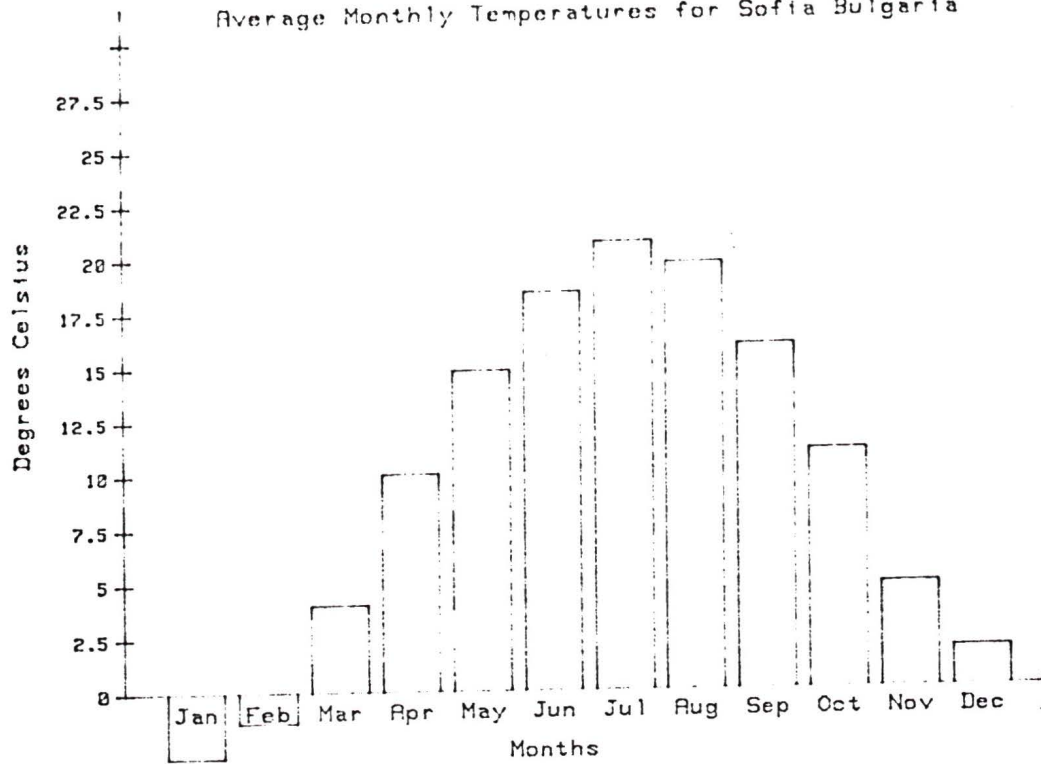


FIGURE 16
Average Monthly Precipitation for Sofia Bulgaria

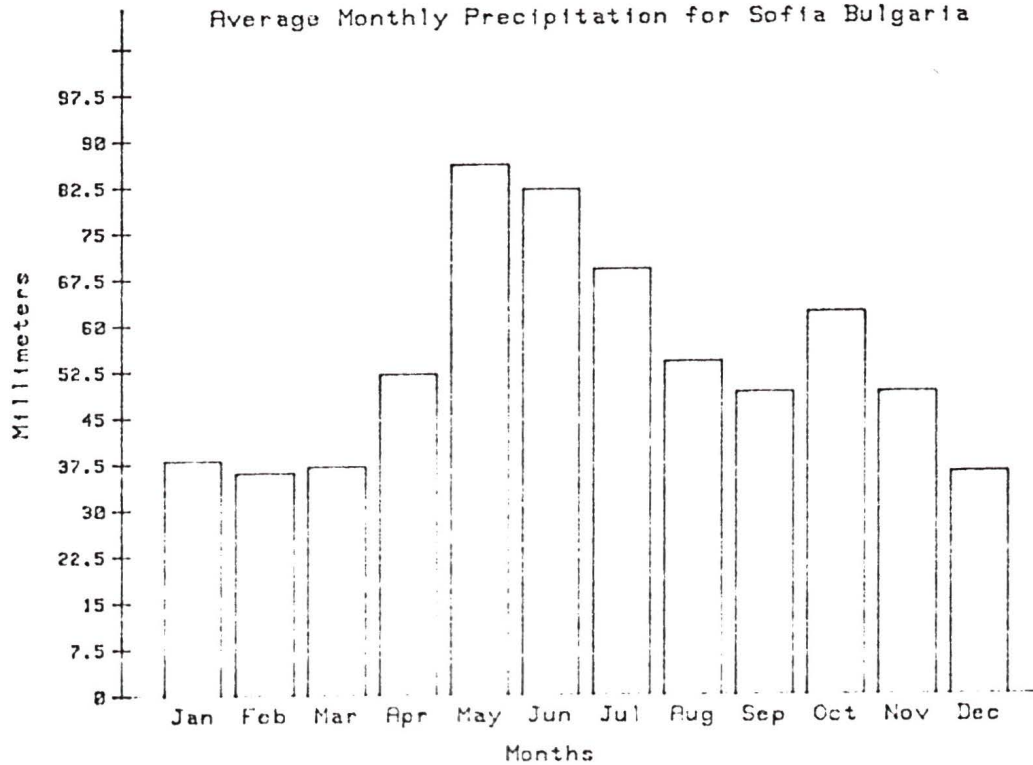


FIGURE 17
Average Monthly Temperatures for Kazanluk Bulgaria

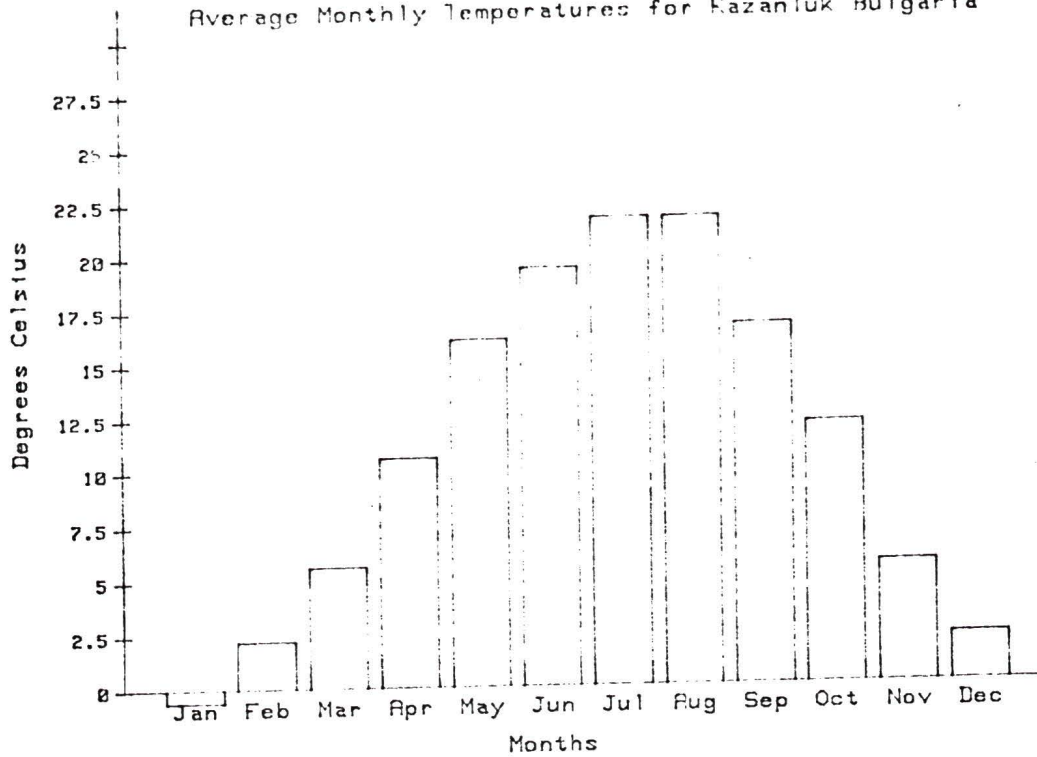


FIGURE 18
Average Monthly Precipitation for Kazanluk Bulgaria

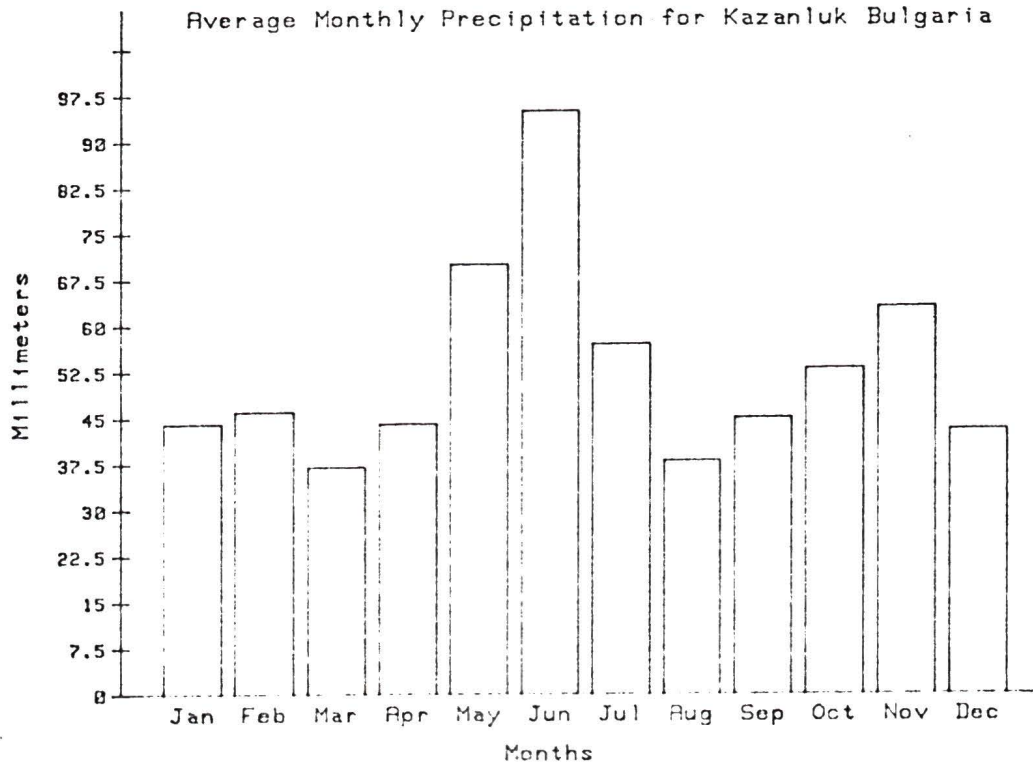


FIGURE 19
Average Monthly Temperatures for Varna Bulgaria

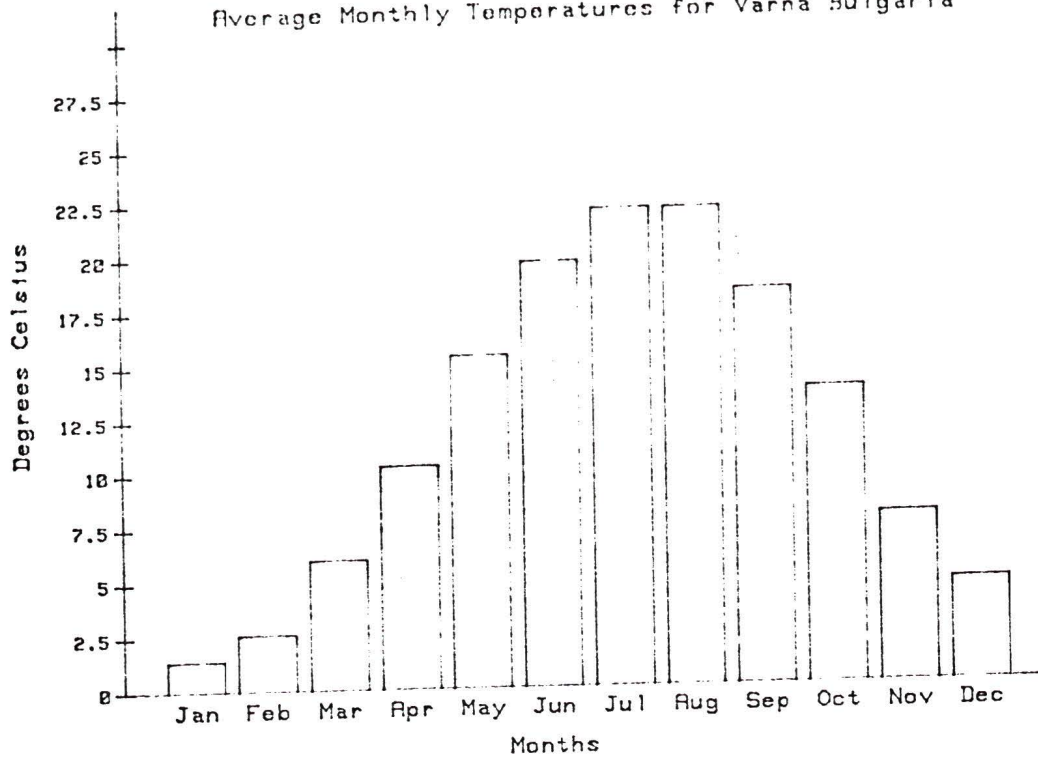


FIGURE 20
Average Monthly Precipitation for Varna Bulgaria

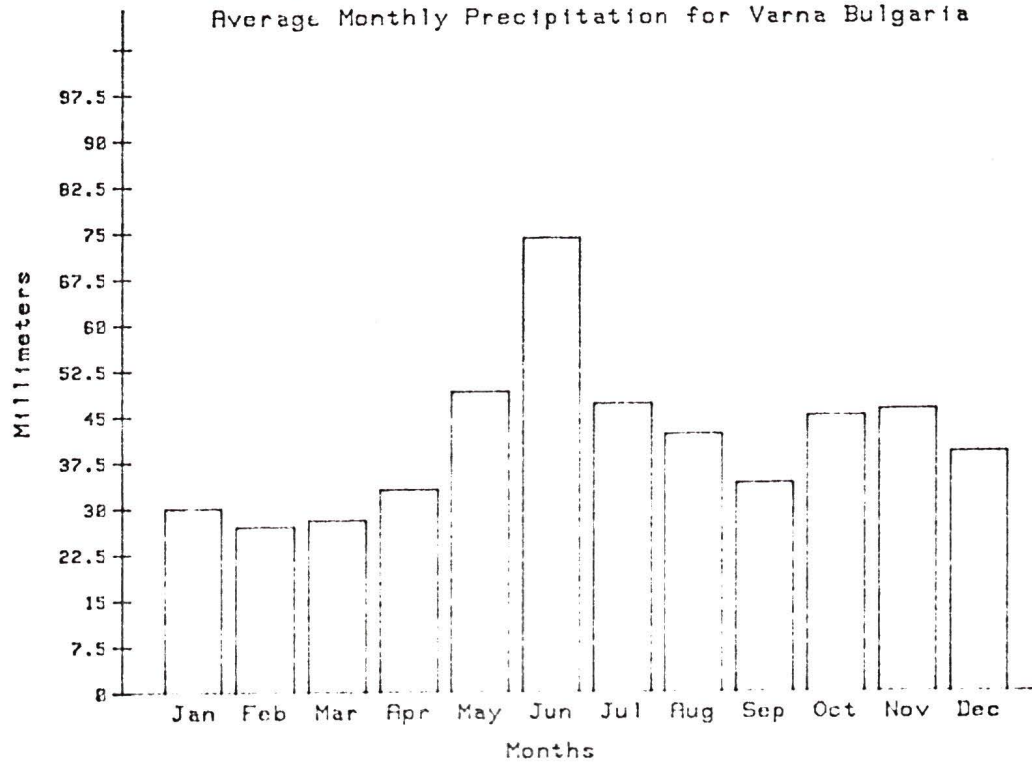


FIGURE 21
Average Monthly Temperatures for Larissa Greece

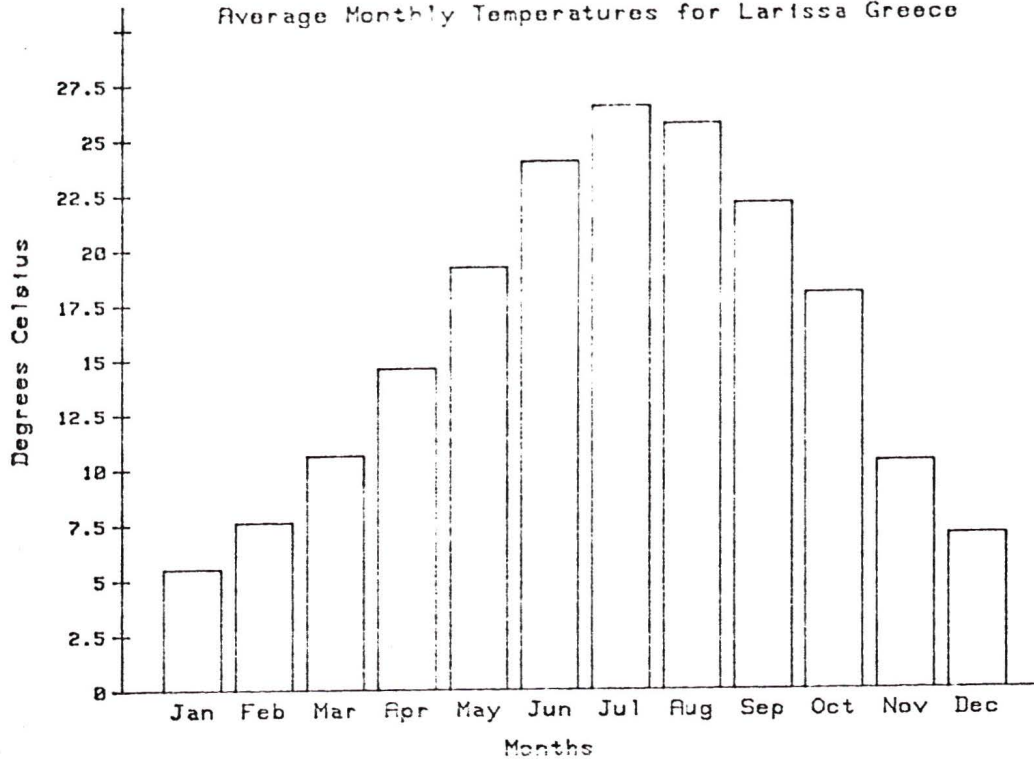


FIGURE 22
Average Monthly Precipitation for Larissa Greece

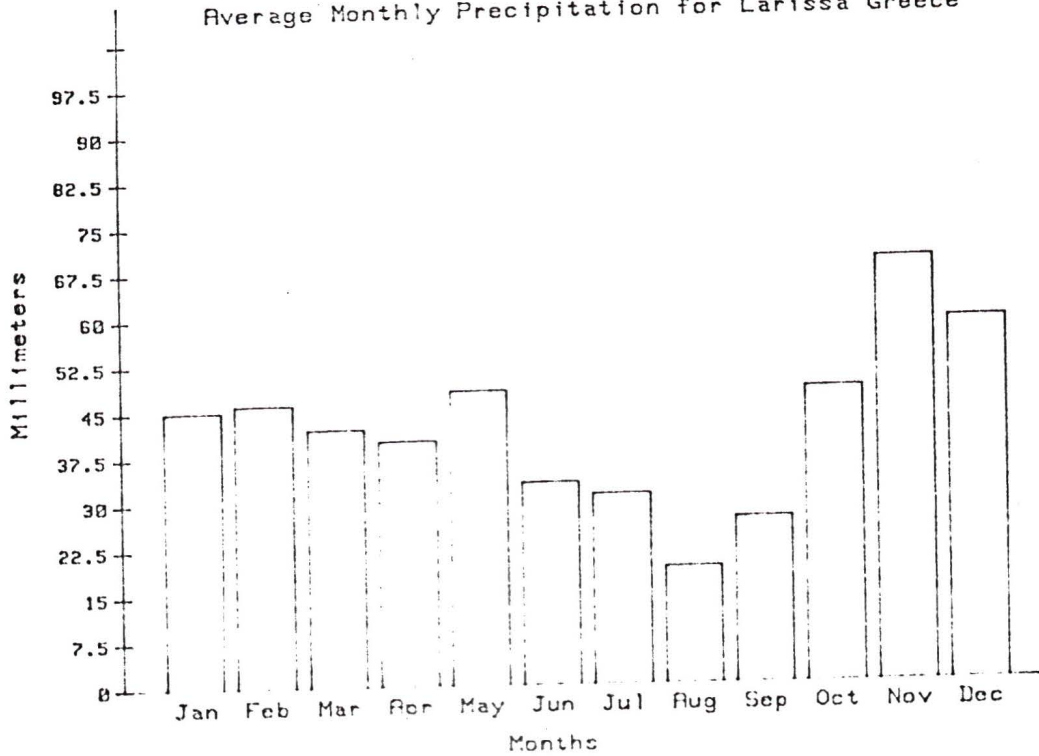


FIGURE 23
Average Monthly Temperatures for Athens Greece

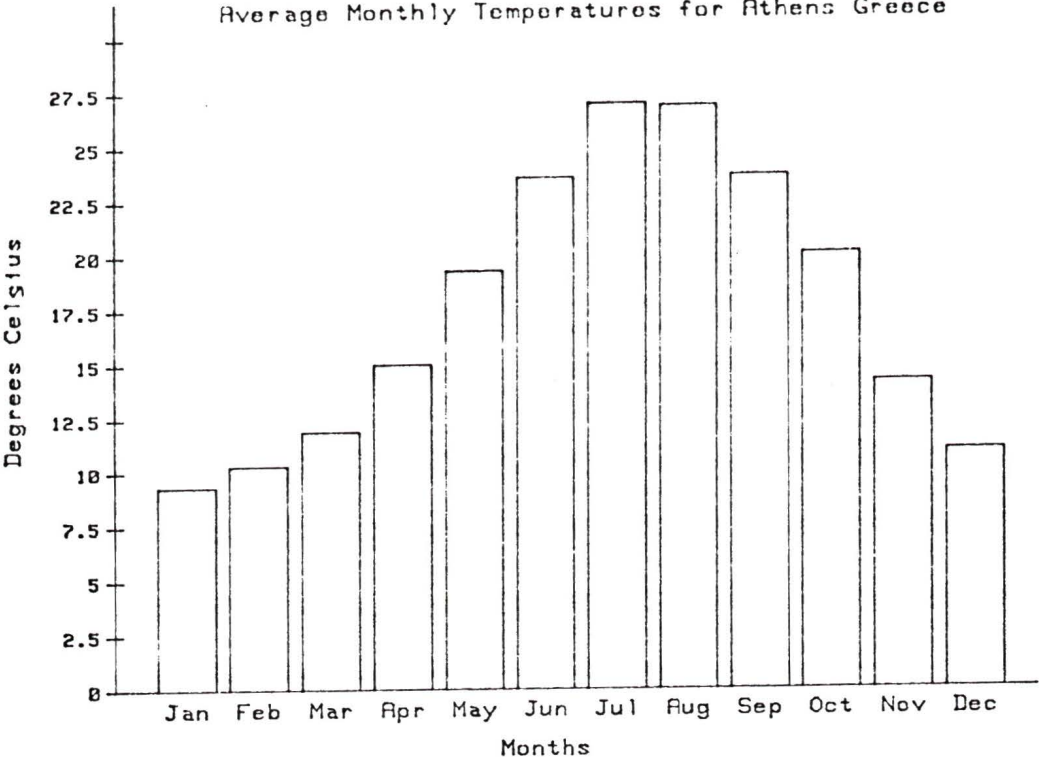
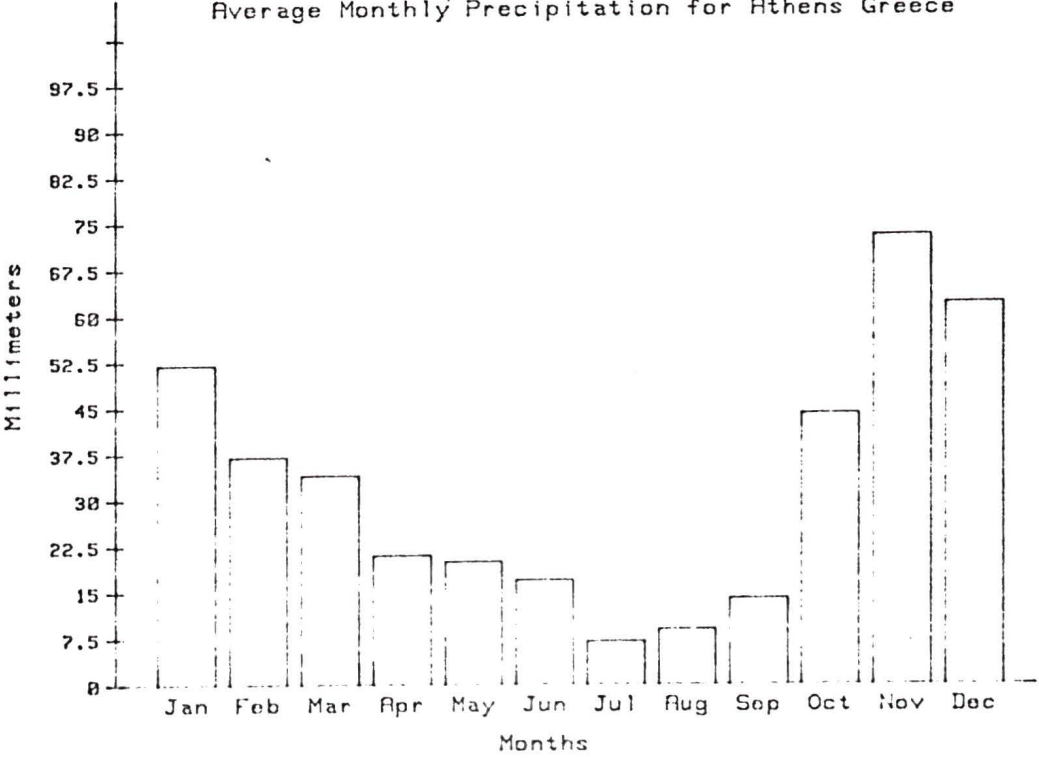


FIGURE 24
Average Monthly Precipitation for Athens Greece



VITA

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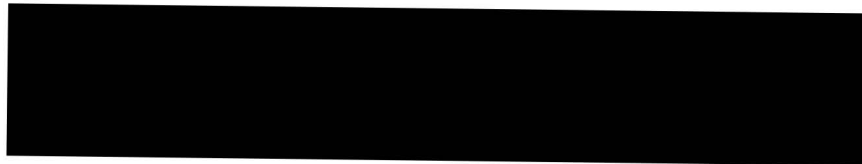
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Title of Thesis

ECONOMIC AND SETTLEMENT PATTERNS IN SOUTH-EASTERN EUROPE
DURING THE NEOLITHIC

Author



Gwyneth Elaine Kingham

June 30, 1980

Date