possible in part the publication of this monograph; I am thankful to Prof. W. W. Howells for making the Jarcho Fund available for this purpose. All these foundations and individuals have been very generous, and I am grateful for their support of my research on the Shanidar Neandertals.

There is one last individual who deserves more thanks than I can express here: my wife, Dr. Kathryn Maurer Trinkaus. It is she, more than anyone else, who has seen me through the long and, at times, seemingly interminable task of describing and analyzing the Shanidar sample. Her experience working in the Near East prepared me in invaluable ways for my trips to Iraq. Her general knowledge of anthropology, combined with abundant patience, provided me with feedback on my innumerable ramblings about the details of this bone or that aspect of morphology. Her assistance with a number of aspects of the work made the task much easier, and her encouragement through it all is in large part responsible for its completion.

The Shanidar Neandertals

CHAPTER 1

Introduction

The large cave that overlooks the Shanidar Valley in northeastern Iraq has provided shelter to human groups intermittently during the past 100,000 years. During that time, the various tenants of Shanidar Cave left behind considerable cultural debris and, among the various sediments on the cave floor, the remains of their dead. We can never know precisely who those people were, but through careful studies of what they left behind, including their own skeletal remains, we can attempt to reconstruct their physiques, adaptive patterns. and roles in human evolutionary history.

Through circumstances of preservation and discovery, the skeletal remains of nine individuals from the Mousterian levels of Shanidar Cave have become known to us. These are the Shanidar Neandertals. They consist of the partial skeletons of seven adults and two infants, which range in completeness from a few limb bones to a largely intact skeleton. As such, they comprise one of the largest samples of Neandertals. They are thus a major addition to the human paleontological record and a prime source of information concerning late Pleistocene human evolution in the Near East.

The Shanidar Neandertals are paleontologically important for several reasons. They greatly enlarge the quite small sample of Neandertal remains from the Near East. They are the only reasonably complete fossil human remains from the Near East outside the Levant. Perhaps most important, the Shanidar Neandertals retain portions of all anatomical regions. They thus provide data for a variety of paleontological studies of the Neandertals. Through the integration of the morphological data from the Shanidar fossils into studies of the Neandertals, our understanding of these extinct populations as part of late Pleistocene human evolution should be measurably enriched.

The field of human paleontology has advanced over most of the past century as each new discovery of fossil human remains has shed additional light

upon the morphological patterns of prehistoric humanity. For many years, the paucity of reasonably complete specimens meant that most new finds forced scholars to reevaluate previous conceptions and to adjust evolutionary schemes to accommodate the latest discovery. In this situation, many individual fossils acquired an exaggerated importance and evolutionary reconstructions were made to revolve around them. The course of human evolution was therefore seen as an ordering in space and time of individuals, fragments of which have been passed on to us, rather than a sequence of changing morphological patterns and associated adaptive patterns through time.

In recent years, paleontologists have increasingly moved away from this particularistic approach, trying to form samples from the collections of known fossils and to view human evolution more in terms of shifts in patterns of variation through time. This approach has been most successful for recent time periods, from which there are sufficiently large samples, and for which it is possible to assign specimens reliably to specific samples. As a result of this research, new insight has been gained into the morphological patterns of fossil hominids. Furthermore, it has been possible to reformulate the relevant questions whose answers should lead to the eventual elucidation of the evolutionary origins of living humans.

Despite this change in emphasis from the specimen to the sample, the individual fossil remains important in any study. Available samples are still small, extremely so for several anatomical regions, and known ranges of variation can be significantly altered by the addition or deletion of single specimens. What is needed is a populational approach in which carefully defined samples are systematically compared, never losing sight of the relative contributions of the individual pieces that make up the samples.

Two types of paleontological work follow from a populational approach to the hominid fossil record. One consists of detailed description of individual fossil specimens and discussion of the features that are unique to the specimens in question. This form of treatise provides the information necessary for careful evaluation of the relevance of each specimen to the greater scheme of human evolution. It also focuses on any aspects of a fossil that may be unique to that specimen. Furthermore, such descriptions make available detailed paleontological data to the profession and thus provide the basis for the second type of study. The last feature is especially important because most fossil human remains, including those from Shanidar, are national antiquities and seldom leave their countries of origin.

The other type of paleontological work consists of comparative and functional analyses of specific anatomical regions that attempt to delineate and [illegible] anatomical similarities and differences among samples. It is these [illegible]hat form the basis for the reconstruction of human evolutionary history.

This [illegible]cussion of the Shanidar Neandertal sample is primarily the first form of pa[illegible]ntological work. It is a detailed description of the fossil human

remains from the Mousterian levels of Shanidar Cave. As such, it is a discussion of those aspects of their morphology that place these remains within the greater Neandertal sample and those that make them unique.

Because all description is necessarily comparative, data are provided where appropriate to permit the adequate evaluation of the morphological patterns exhibited by the Shanidar fossils. In addition, because the data from the Shanidar sample and the comparisons of their morphologies to those of later Pleistocene and recent humans furnish insights into both the functional anatomy and phylogenetic affinities of these Upper Pleistocene humans, interpretations of their morphological patterns are included where relevant. Functional interpretations are provided in the chapters that describe and discuss the individual fossils and are summarized in Chapter 13. The phylogenetic implications of the Shanidar specimens are dealt with as well in Chapter 13. These discussions are followed in the final chapter with some thoughts on the evolution of the Neandertals.

The information presented here should enable the integration of the paleontological data from the Shanidar fossils into our knowledge of the Upper Pleistocene hominid fossil record. It should also provide some new insights into the evolution of the Neandertals and their role in the origin of anatomically modern humans.

CHAPTER 2

Shanidar Cave and the Discovery of the Shanidar Neandertals

The important archaeological and paleontological discoveries in Shanidar Cave ave received considerable publicity. This is due to the efforts of Dr. Ralph S. lecki and his associates, especially Dr. T. Dale Stewart, who have produced a nber of works since the site was first explored in the early 1950s (see References). These publications detail the history of work at Shanidar and the circumstances of the various discoveries that have been made there, of which the andertal finds have been the most spectacular. I will not attempt to summaze all the details of the exploration of Shanidar Cave and the discovery of the ine Neandertal partial skeletons; this has been done by Solecki and others (see specially Solecki 1963, 1971b; Stewart 1977). However, there are aspects of the history of the excavations in Shanidar Cave and the discoveries of the Neandertals that relate to our appreciation of the Neandertal remains.

THE SITE OF SHANIDAR CAVE

Shanidar Cave is located in the Zagros Mountains of northeastern Iraq, in the middle of Iraqi Kurdistan. As such, it is close to the point where Iraq meets Iran and Turkey (Figure 1). The region is one of high limestone bluffs and rolling

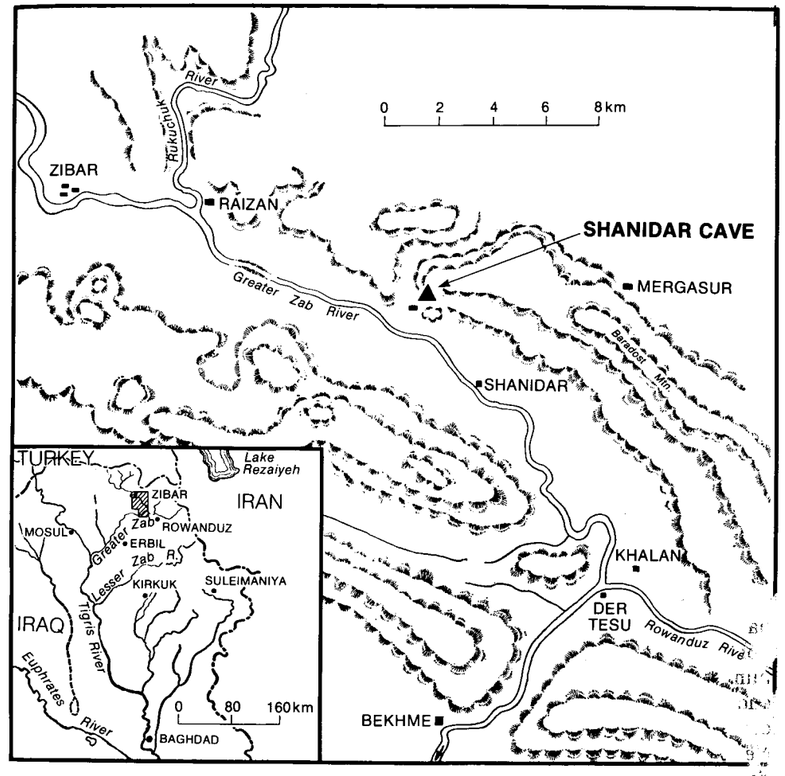

Figure 1 Northeastern Iraq with the location of Shanidar Cave. Redrawn with permission from Solecki (1963). (Copyright 1963 by the American Association for the Advancement of Science.)

terrain. The limestone contains numerous caves, of which Shanidar Cave appears to be one of the largest.

The site itself is in the Shanidar Valley, which leads off to the north from the larger valley formed by the Greater Zab River, not far from the village of Shanidar (36° 50′ N, 44° 13′ E). It is about 13.5 km northwest of the junction of the Greater Zab River with the Rowanduz River, about 400 km north of Baghdad. The cave is 765 m above sea level, about two-thirds of the way up the side of the Shanidar Valley, close to where the lower, more level part of the slope meets the nearly vertical upper portion of the limestone bluff (Figure 2). The cave thus has a commanding view of the Shanidar Valley and is not far

Figure 2 View across the Shanidar Valley, with Shanidar Cave (lower right). Photo courtesy R. S. Solecki.

from the Greater Zab Valley. In prehistoric times, under cooler and wetter conditions, it must have been a welcome retreat.

Inside the broad triangular entrance to the cave is a large space, approximately 50 m wide and almost 45 m deep (Figure 3). At the time of excavation, the cave was occupied by several families of Barzani Kurds, and the excavation showed that the cave was well used by peoples in both the recent and prehistoric past (Solecki 1971b, 1979).

The excavated portion of Shanidar Cave contains archaeological deposits that are nearly 14 m deep (Figure 4). The majority of the remains are from the Middle Paleolithic, but the sequence extends, with some breaks, to the present. Although the site contains a large number of discernible stratigraphic levels, it was not possible to identify clearly every one during excavation because many grade into each other, are discontinuous within the excavated area, and/or were disturbed by a number of rockfalls within the cave that left large limestone

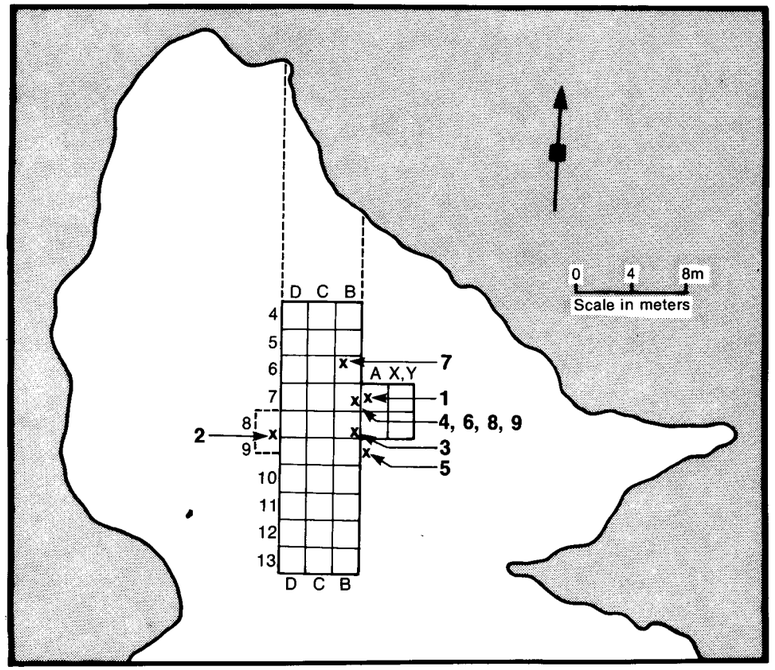

Figure 3 Schematic floorplan of Shanidar Cave, indicating the area excavated, the excavation grid, and the horizontal locations of the Neandertal partial skeletons. Redrawn with permission from Stewart (1977).

blocks in the deposits. The Shanidar deposits were therefore divided into five strata, or *Layers*, which were identified on the basis of both natural stratigraphy and inclusive cultural material. The different layers are, as far as can be determined, separated from each other by chronological breaks.

The uppermost stratum, Layer A, includes material from the Neolithic to the present, including innumerable hearths, artifacts, and organic material. Below Layer A is a Proto-Neolithic level, Layer B1, that has yielded considerable amounts of cultural material and 28 human burials. Layer B2, which was originally thought to be continuous with B1 and was later shown to be distinct stratigraphically and culturally, is typically Mesolithic, with numerous microliths and lacking the grinding tools of the overlying Neolithic and Proto-Neolithic. These three upper levels are relatively shallow, but they nonetheless have yielded considerable cultural material (Solecki 1952–1953, 1963).

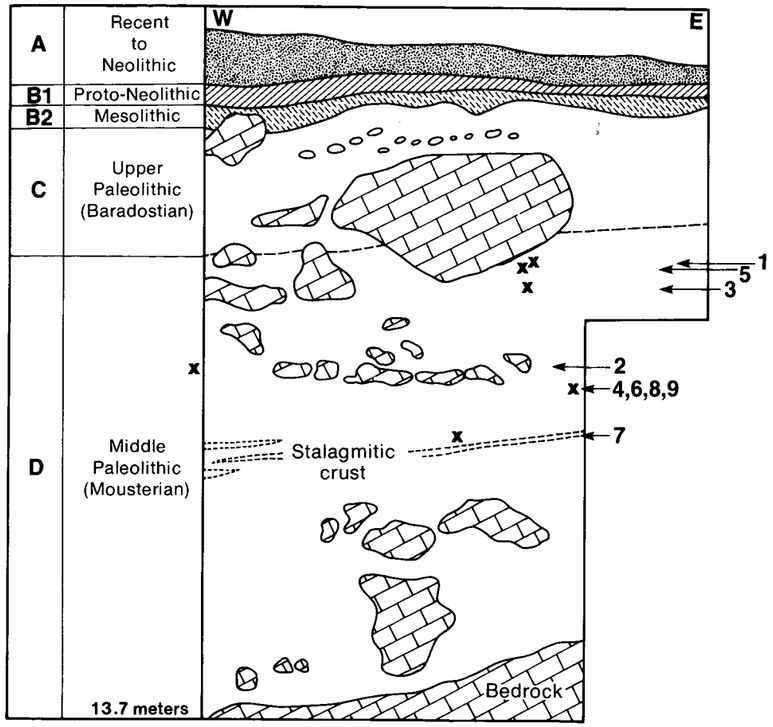

Figure 4 Schematic stratigraphic section of the excavation trench in Shanidar Cave. Approximate vertical positions of the Neandertal partial skeletons are indicated. Redrawn with permission from Stewart (1977).

Layer C contains a lithic assemblage that bears many resemblances to the Levantine Aurignacian, especially its earlier phases. It contains high frequencies of burins, end scrapers, *rabots* (utilized blade cores), and notched pieces (Garrod 1957; Solecki 1952–1953; 1958a). These characteristics have led Solecki (1958a) to refer to it as a new industry, the Baradostian, which is known only from the Zagros Mountains. The typological characteristics of the industry may, however, be due in part to the scarcity of large flint nodules in the Zagros and the need to reutilize many tools and cores (Jelinek 1975).

Layer C is as much as 4 m deep in places and appears to have spanned a considerable period of time. Not surprisingly, there are noticeable frequency changes in tool types within Layer C; several type classes, such as side scrapers and burins, decrease through time, whereas end scrapers and denticulates–notched pieces increase through the deposits (Edens 1980; Solecki 1958a). However, the general characteristics of the assemblage are consistent with the interpretation that it represents an early Upper Paleolithic phase within the Zagros Mountains.

These typological inferences are supported by a series of radiocarbon determinations from different depths within Layer C (Table 1). These radiocarbon dates place the beginning of Layer C around 34,000 years B.P. and its end about 28,000 years B.P. No human remains were discovered in Layer C.

The Middle Paleolithic levels, Layer D, make up the majority of the Shanidar deposits, being approximately 8.5 m deep. Hearths, animal remains, and stone tools are distributed continuously throughout Layer D, but there appear to be two concentrations of occupational debris. The upper concentration is near the top of Layer D, immediately below the depositional disconformity between Layers C and D. It is within this material that three Neandertals—Shanidar 1, 3, and 5—were discovered. The lower concentration of debris is near the middle of Layer D, between 9.8 and 8.5 m below datum. It contains a distinct stalagmitic lens, indicating a brief period of high humidity. Six of the Neandertals—Shanidar 2, 4, 6, 7, 8, and 9—were found slightly above this lower occupational concentration.

The Mousterian assemblage from Shanidar Cave has been described by Solecki (1963) as relatively homogeneous throughout Layer D, and all the descriptions of the industry treat the tools as though they derive from a single lithic industry (Akazawa 1975; Skinner 1965; Solecki 1952–1953). Any trends through time within the Shanidar Layer D Mousterian are therefore obscured, if such existed.

Quantitative data on the Shanidar Layer D assemblage have been published by Skinner (1965) and Akazawa (1975). Skinner's sample included a sample of all the excavated implements and cores ($N = 618$) in the Iraq Museum, the Smithsonian Institution, and Solecki's laboratory at Columbia University. Akazawa only studied the material in the Iraq Museum, yet he obtained a sample size similar to that of Skinner (714 implements, 672 of which can be fitted into Bordes's Mousterian typology). It is evident from the published data that a number of pieces included in his sample by Akazawa, especially in the miscellaneous types (Bordes's types 38–62), were not considered to be implements by Skinner. Yet despite some marked differences in type frequencies, which are undoubtedly due to both their different samples and personal variation in type identification, the frequency distributions of Skinner and Akazawa are generally similar, especially for types 1–37. The type frequencies of Skinner and Akazawa are provided in Table 2.

The Shanidar Layer D assemblage contains predominantly Mousterian elements, with a preponderance of Mousterian points and side-scrapers, especially single edge side-scrapers. It is possible that many of the implements that have been classified as Mousterian points are in fact side-scrapers that

TABLE 1
Radiocarbon Determinations from Layers C and D of Shanidar Cave

	Depth below datum (m)	Years before present (B.P.)	Laboratory number	Comments	References
Upper Layer C	2.35	28,700 ± 700	W-651		Rubin and Alexander (1960)
	3.05	26,500 ± 1,500	L-335H	portions of the same sample	Broecker and Kulp (1957)
	3.05	29,500 ± 1,500	W-178		Rubin and Suess (1955)
Middle Layer C	—	33,900 ± 900	GrN-1830	"bone" fraction	Vogel and Waterbolk (1963)
		34,000 ± 420	GrN-1494	"rest" fraction	
Lower Layer C	3.30	33,300 ± 1,000	W-650		Rubin and Alexander (1960)
	4.57	32,300 ± 3,000	L-335I	portions of the same sample	Broecker and Kulp (1957)
	4.57	>34,000	W-180		Rubin and Suess (1955)
	—	35,440 ± 600	GrN-2016	"bone" fraction	Vogel and Waterbolk (1963)
		34,590 ± 500	GrN-2015	"rest" fraction	
Upper Layer D	5.10	46,900 ± 1,500	GrN-2527		Vogel and Waterbolk (1963)
	—	50,600 ± 3,000	GrN-1495		Vogel and Waterbolk (1963)

TABLE 2
Typological Characteristics of the Shanidar Mousterian Assemblage[a]

Bordes's type number	Type	Skinner (1965) $N = 571$ Count	Skinner (1965) $N = 571$ %	Akazawa (1975) $N = 672$ Count	Akazawa (1975) $N = 672$ %
Levallois					
1, 2	Levallois flake	5	0.88	5	0.74
3	Levallois point	1	0.18	0	0.00
4	Retouched Levallois point	4	0.70	0	0.00
Mousterian					
6	Mousterian point	68	11.91	41	6.10
7	Elongate Mousterian point	43	7.53	49	7.29
8	Limace	3	0.53	5	0.74
Side-scraper					
9	Single straight	77	13.49	24	3.57
10	Single convex	88	15.41	62	9.23
11	Single concave	6	1.05	6	0.89
12	Double straight	39	6.83	1	0.15
13	Double convex	27	4.73	0	0.00
14	Double concave	3	0.53	0	0.00
15	Double biconvex	5	0.88	14	2.08
16	Double biconcave	0	0.00	4	0.60
17	Double concave–convex	6	1.05	5	0.74
18	Straight convergent	22	3.85	3	0.45
19	Convex convergent	14	2.45	21	3.13
21	Déjété	16	2.80	9	1.34
22	Transverse straight	4	0.70	0	0.00
23	Transverse convex	1	0.18	5	0.74
25	Bulbarly retouched	2	0.35	5	0.74
26	Abrupt retouched	21	3.68	0	0.00
28	Bifacially retouched	3	0.53	0	0.00
29	Alterniate retouched	5	0.88	8	1.19
Upper Paleolithic					
30, 31	End-scraper	21	3.68	11	1.64
32, 33	Burin	11	1.93	32	4.76
34, 35	Perforator	16	2.80	43	6.40
36, 37	Backed blade	1	0.18	18	2.68
Miscellaneous					
38	Naturally backed blade	17	2.98	35	5.21
40	Truncated piece	0	0.00	26	3.87
42	Notched piece	16	2.80	46	6.85
43	Denticulate	16	2.80	42	6.25
44	Burinate	0	0.00	3	0.45
45	Retouched flake: bulbar surface	0	0.00	10	1.49
46, 47	Retouched flake: thick	4	0.70	50	7.44
48, 49	Retouched flake: thin	4	0.70	87	12.95

(continued)

TABLE 2 *Continued*

Bordes's type number	Type	Skinner (1965) N = 571 Count	Skinner (1965) N = 571 %	Akazawa (1975) N = 672 Count	Akazawa (1975) N = 672 %
51	Tayac point	1	0.18	0	0.00
54	End-notched flake	0	0.00	2	0.30
62	Miscellaneous	1	0.18	0	0.00
ILty	Levallois types index		1.75		0.74
IR	Side-scraper types index		59.37		24.85
IAn	Backed blades index		0.18		2.68
	Mousterian type tools index		79.33		38.99
	Upper Paleolithic type tools index		8.58		15.48
	Denticulate tools index		2.80		6.25
IL	Levallois débitage index		3.0		
IF	Faceting index		43.2		
ILam	Blades index		12.7		
	Discoidal cores	27	57.45		
	Prismatic cores	10	21.28		
	Informe cores	10	21.28		

[a]Data from Skinner (1965:105) and Akazawa (1975:5–7). The type names are preceded by Bordes's (1954–1955) type numbers. Typical and atypical types have been pooled.

were retouched so as to resemble points. Although the Levallois technique was employed, it was relatively rarely used in manufacturing the Shanidar implements. These characteristics of the assemblage are reflected in the typological and technological indices that can be computed from the available data (Table 2).

In addition to the 672 tools that Akazawa classified according to Bordes's technique, he identified 42 "retouched rods" (as defined by Hole and Flannery [1967]). These implements are usually associated with Baradostian or Zarzian assemblages, but they appear to come from the lower Mousterian levels at Shanidar and are therefore clearly associated with the Mousterian.

These characteristics of the Shanidar Layer D assemblage are similar to those of other Zagros Mousterian assemblages, such as those from Bisitun E+ to F− (Coon 1951; Skinner 1965), Hazar Merd C (Garrod 1930; Skinner 1965) and Kunji (Hole and Flannery 1967; Skinner 1965). They all contain high frequencies of Mousterian points and side-scrapers, the tools tend to be extensively retouched, and the flake production strategy resulted in disc cores, whereas the Levallois technique was rarely employed (Skinner 1965). Indices of Levallois débitage (IL) are 4.8, 7.0, and 4.5 for Bisitun E+ to F−, Hazar Merd C, and Kunji, respectively (Skinner 1965).

These typological characteristics of the Shanidar Mousterian and the other

Zagros Middle Paleolithic industries have suggested to Skinner (1965:197) that there was a "cultural area" within the Zagros during Middle Paleolithic times and that the typological differences between these industries and the contemporaneous Levantine industries can be considered to be the products of stylistic traditions. On the other hand, it may be that the differences between the Zagros and Levantine Mousterian assemblages are due to the nature of available raw material (Jelinek 1975; Solecki 1963). Most of the raw material available in the Zagros is in the form of stream pebbles rather than large nodules or tabular layers and, as a result, tools at Shanidar and the other Zagros sites tend to be small and were extensively retouched before they were discarded (Jelinek 1975). Because the Levallois technique is rather wasteful of raw material, it was probably seldom used so as to get the maximum use out of the available siliceous rock.

The faunal remains from Layer D were analyzed preliminarily by Reed (Reed and Braidwood 1960) and Perkins (1964) and have been studied in detail by Evins (1981). All the species represented are currently extant, although some of them have become extinct locally in historical times. The dominant species in the sample are wild goat (*Capra aegagrus*), tortoise (*Testudo graeca*) and, to a lesser extent, wild boar (*Sus scrofa*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and red fox (*Vulpes vulpes*). It is not known to what extent the faunal sample reflects solely human predation or a combination of human and nonhuman carnivore predation. There appears to be relatively little variation in either the species represented or their relative proportions through the levels of Layer D (Evins 1981), even though there was considerable climatic fluctuation in the region during the Upper Pleistocene (Wright 1962). The faunal profile probably reflects primarily the rugged topography of the area around Shanidar because more open-country animals, such as sheep, are rare until they are introduced through domestication in the post-Pleistocene (Evins 1981; Perkins 1964).

Solecki and his colleagues have used several techniques to date the deposits in Layer D. Two samples of charcoal from the top of Layer D have yielded radiocarbon dates that suggest an age of at least 45,000 years B.P. for the end of the Shanidar Mousterian (Table 1). On the basis of palynological analyses of nine samples and trace-element analyses of five samples distributed through the uppermost 8.5 m of the Shanidar deposits, Solecki (1963) reconstructed a climatic sequence for the deposits. The climatic sequence, with the aid of the radiocarbon determinations, was correlated with estimated climatic sequences from elsewhere in the Near East and the eastern Mediterranean. In addition, a constant rate of deposition in the cave was assumed to assist in the dating of the earlier levels of the site. Using all these estimates in concert, an age of about 60,000–70,000 years B.P. was suggested for the middle of Layer D, and the bottom of Layer D was placed at about 100,000 years B.P.

These age estimations are extremely tenuous and need to be substantiated by independent means. They are all dependent upon the two radiocarbon

determinations from the top of Layer D. These dates are beyond the range within which standard radiocarbon dating techniques produce reliable finite dates (Henry and Servello 1974) and they therefore may be only minimum ages. Furthermore, the Upper Pleistocene Near Eastern climatic sequence is considerably more complex than was previously believed (Farrand 1971, 1979), and it is difficult to accept a constant rate of sedimentation within Shanidar Cave.

These age determinations for the different portions of Layer D nonetheless provide a general chronological framework for the Shanidar Mousterian deposits. They show, most importantly, that the Shanidar Mousterian deposits and the Neandertals they contained span considerable geological time. The Shanidar fossils were probably roughly contemporary with the other Near Eastern Neandertals from Amud and Tabūn (Jelinek 1982; Chapter 13) and with many of the European early last glacial Neandertals (Vandermeersch, 1965; Wolpoff, 1980b).

HISTORY OF EXCAVATIONS

The site of Shanidar Cave was first explored by R. S. Solecki in 1951 while he was engaged in an archaeological survey of northeastern Iraq. The large cave was occupied then, and during much of the time that the cave was being excavated, by a group of Barzani Kurds; this limited the area that Solecki could excavate to a portion of the middle of the cave. During the 1951 reconnaissance, Solecki dug a test pit and recovered sufficient material to encourage him to return later in 1951 for more extensive excavations (Solecki 1952). In his sounding late in 1951, Solecki established the basic four-part stratigraphic sequence, Layers D–A, that has remained, with refinements, the stratigraphic scheme for Shanidar Cave (Solecki, 1952–1953).

Solecki returned for 10 weeks of excavation in 1953. He completed the sounding begun in 1951 and enlarged the area of excavation. It was during this season that he was able to outline in considerable detail the stratigraphic sequence within the cave (Solecki 1955a, 1955b). It was also in 1953 that the first Neandertal remains to be discovered in Iraq were found. On 22 June, deep within the Mousterian levels, the fragmentary skeleton of an infant (Shanidar 7) was unearthed (Solecki 1953, 1954, 1955c). The remains were turned over to the late Dr. Muzaffer Şenyürek for study.

During 1956 and 1957, Solecki returned to Shanidar for excavations within the cave and elsewhere in the valley. The little work that was done in the cave during the fall of 1956 was concentrated in Layer A (Solecki 1957a). But during the spring of 1957, significant work was done in Shanidar Cave, much of it in Layer D (Solecki 1957d, 1958b). During the months of April and May, three adult Neandertal skeletons (Shanidar 1, 2, and 3) were discovered (Solecki 1957b, 1960). Shanidar 3 was the first of these to be discovered, on 16 April 1957, but due to its fragmentary nature it was not recognized as hominid until after the excavations. Shanidar 1 was discovered shortly afterward, on 27 April, close to the top of Layer D. It was the discovery of the Shanidar 1 skeleton (Figure 5) that firmly established the presence at Shanidar Cave of humans morphologically similar to the other Near Eastern and European Neandertals. Almost a month later, on 23 May, human remains, which became Shanidar 2, were encountered slightly above the level at which the child was found in 1953, near the middle of Layer D. These and subsequently discovered Neandertal remains were turned over to Dr. T. Dale Stewart for study.

Given the successes of the 1956–1957 season at Shanidar, there was every reason to believe that Shanidar Cave would yield more archaeological and paleontological material. So in 1960, with an expanded crew, Solecki returned to Shanidar. Archaeologically, the 1960 season served to expand greatly the cultural remains from Shanidar Cave; paleontologically, it added five more Neandertal partial skeletons to the Shanidar sample (Solecki 1961, 1971b).

Initially, portions of Shanidar 2 and 3, which could not be recovered in 1957 due to large overburdens, were recovered. Then on 3 August 1960, the largely complete, although damaged, skeleton of a large individual, Shanidar 4, was revealed slightly above the level of the Shanidar 2 remains. Soil samples from around this skeleton yielded surprisingly high concentrations of wildflower pollen, suggesting that offerings of flowers were placed around the grave (Leroi-Gourhan 1968, 1975; Solecki 1971b, 1975, 1977); this is the well-known "flower burial" from Shanidar Cave. Shortly after the discovery of Shanidar 4, on 7 August, another skeleton was uncovered near the top of Layer D at the same level as Shanidar 1. This became Shanidar 5. Then, as Shanidar 4 was being excavated and prepared for removal, bones of a second individual were found mixed with those of Shanidar 4. These bones duplicated ones already identified for Shanidar 4 and were considerably smaller; this Neandertal became Shanidar 6. To add further to the confusion, several bones of an infant were noticed among the loose bones collected when Shanidar 4 and 6 were removed in a block from Shanidar Cave, and while Stewart was cleaning and restoring Shanidar 4 and 6 in the Iraq Museum in Baghdad he realized that there were portions of a third adult preserved with Shanidar 4 and 6. This totaled seven adults and two infants from the Mousterian levels of Shanidar Cave, the largest sample of Neandertal partial skeletons known from a single site.

Numbering of the Fossils

The history of excavation of the Shanidar Neandertals has led to confusion over the numbering of the individuals. The first child to be discovered, in 1953, was referred to only as the *Shanidar child* (Solecki 1953). When, in 1957, three adults were unearthed, they were referred to as Shanidar I, II, and III, in the order of recognition of their hominid status (Solecki 1957d, 1960). The same procedure was followed for the discoveries in 1960 of Shanidar IV, V, and VI.

TABLE 3
Numbering of the Shanidar Individuals

Original designation	*Catalogue of Fossil Hominids* number	Current number
I or 1	1	1
II or 2	2	2
III or 3	3	3
IV	4	4
V	5	5
VI	6	6
"child"	7	7
VII	—	8
VIII	—	9

When Stewart realized that there was another adult with Shanidar IV and VI, he tentatively called it Shanidar VII (1963), pending further determination of which pieces belonged to this individual and which belonged to Shanidar IV and VI. Subsequently, Solecki (1971b, 1977), accepting the identification of a seventh adult and calling it Shanidar VII, referred to the second Shanidar child, the one discovered with Shanidar IV and VI, as Shanidar VIII.

This system of numbering, Shanidar I–VIII plus the Shanidar child, was confused by the publication of the *Catalogue of Fossil Hominids: Part III* (Stewart and Solecki 1975). In the *Catalogue of Fossil Hominids*, the editors labeled Shanidar I–VI as Shanidar 1–6, referred to the Shanidar child as Shanidar 7, and omitted Shanidar VII and VIII. Although it may lead to some confusion initially, I believe that the *Catalogue of Fossil Hominids* should be followed as a standard reference. In this, every specimen is given a number; there is only one numbering system for each site (rather than, for example, the two systems used by McCown and Keith [1939], one for partial skeletons and one for isolated bones, for the hominids from Mugharet es-Skhūl and Mugharet et-Tabūn), and only arabic numerals are used. For the Shanidar Neandertals, therefore, Shanidar I–VI become Shanidar 1–6, the "Shanidar child" (the first child) becomes Shanidar 7, Shanidar VII of Stewart and Solecki (the seventh adult) becomes Shanidar 8, and Shanidar VIII of Solecki (the second child) becomes Shanidar 9 (Table 3). This is the numbering system I have used previously (Trinkaus 1977b) and I employ it in this monograph.

THE NEANDERTAL PARTIAL SKELETONS

The Shanidar 1, 2, 3, 5, and 7 partial skeletons were discovered as isolated burials, and therefore the attribution of their remains by individual has been

clear. The Shanidar 4, 6, 8, and 9 remains, however, have been considerably more difficult to sort by individual.

Shanidar 4, 6, 8, and 9 were discovered superimposed on each other. They represent either a single multiple burial or a series of single burials closely spaced in time. The order of burial seems to have been Shanidar 9 first and then Shanidar 8, 6, and 4, in that order (Solecki 1977). Most of their remains were removed in a block, to be sorted later in the Iraq Museum. Loose bones that became separated during removal of the block from the cave were collected and placed with the other remains in Baghdad. In 1962, Stewart unpacked the remains, restored many of the pieces, and sorted the bones by individual (Stewart 1963). Subsequently, in 1976 (Trinkaus 1977b), 1978, and 1980, I continued the sorting and restoration to achieve the present arrangement.

During burial and the subsequent excavation, many of the Shanidar 4, 6, 8, and 9 remains became mixed. The Shanidar 9 infant remains are readily separable from the others. The adult remains have been sorted primarily on the basis of size and, in the case of Shanidar 4, with the aid of the *in situ* photographs. The Shanidar 4 remains are significantly larger than those of Shanidar 6, and larger than most of those of Shanidar 8. The Shanidar 8 remains, however, are only slightly larger than those of Shanidar 6, and for many of the bones it is simply impossible to determine whether they belong to Shanidar 6 or 8. Because Shanidar 6 was discovered first, and appears to have been more complete, many of the bones that could belong to either Shanidar 6 or 8 have been assigned to Shanidar 6. This probably accounts, in part, for the paucity of remains from Shanidar 8. Most of the Shanidar 4 pieces are probably accurately assigned.

The circumstances of discovery and excavation of the individual Shanidar Neandertals have been dealt with in detail by Solecki and Stewart in a number of publications (e.g., Solecki 1953, 1960, 1971b; Stewart 1963, 1977). It is not necessary to repeat all the details here, but summaries of this information may provide additional insight into the Shanidar remains.

Shanidar 1

During excavations along the east wall of the trench in square B7 on 27 April 1957, workmen encountered bone at 4.34 m below datum (the depth figures indicate the position of the first bone encountered). This level is slightly below the boundary between Layers C and D. The bone turned out to be the top of the cranium of an individual presenting clear Neandertal features (Figure 5). Further excavation around the cranial vault revealed the facial skeleton, slightly displaced anteriorly, and the mandible and cervical vertebrae, considerably removed to the left and front of the cranium. The postcranial skeleton extended to the east from the cranium, into the side of the excavation beneath about 4 m of sediment containing a number of limestone blocks, some of them

large enough to require blasting before removal. The skull and vertebrae were removed as a unit encased in plaster. Then the deposits above the postcranial skeleton were excavated to expose the skeleton fully. The postcranial skeleton was removed in two sections: a larger one containing the trunk, arms, and upper legs, and a smaller one containing the lower legs and feet.

Shanidar 1 had been lying on his back, turned slightly onto his right side, with his arms across his chest and his legs fully extended. The head had been displaced from the trunk. The remainder of the bones, except for the tibiae that had been disturbed after interment, were close to their original anatomical positions. Based on the arrangement of the bones and the position of the body between large limestone blocks and under a layer of small rocks, Solecki suggested that Shanidar 1 died in a rockfall and was subsequently covered with a layer of small pieces of limestone by the other members of his social group.

The Shanidar 1 remains, like all the Shanidar Neandertal specimens, were not mineralized, usually quite fragmentary, and always fragile to the touch. This applies mainly to the larger bones and especially to the bones with thin cortical surface bone and underlying trabeculae. Therefore, many of the smaller bones, long bones with narrow shafts, and areas of solid cortical bone, such as much of the facial skeleton, survived well, whereas the femoral and tibial shafts, the cranial vault, and much of the axial skeleton were quite fragmentary.

Shanidar 1 was reconstructed by Stewart (1958, 1959) during 1957 and 1958. He concentrated his efforts on the skull and selected portions of the postcranial skeleton (Stewart 1977). The reconstruction of the facial skeleton, both cranial and mandibular, was straightforward and provided an accurate restoration. Much of the cranial vault bone had lost its internal table and portions were missing. Also, there is no solid contact between the left temporal and the rest of the cranial vault. Therefore, it was necessary for Stewart to approximate the positions of the left temporal and portions of the parietals and occipital. Although there is some warping of the posterior cranium in the final reconstruction, it is minor and can easily be corrected in measurements of the cranium. Despite Stewart's original reservations about his restoration (Stewart 1958), it is probably as accurate a restoration as is possible, given the condition of the fossil; it is undoubtedly close to the original shape of the cranium.

The cleaning and restoration of most of the postcranial skeleton presented few difficulties. A number of the bones, such as the ilia, ischia, sacrum, and right femoral shaft, were crushed *in situ* and could not be disassembled and restored to their original conditions without loss of information. On these bones and parts of others, the fracture lines contained variable quantities of bone meal that would be lost in disassembly and cleaning of the pieces, so that gaps would remain between the fragments when they were reassembled. There-

Figure 5 The Shanidar 1 cranium as it was discovered *in situ*. Photo courtesy R. S. Solecki.

fore, a number of pieces were left in their original state after surface cleaning and chemical impregnation to provide some solidity.

Sometime prior to his death, Shanidar 1 sustained injuries to his right frontal and left orbit and a massive injury to his right side that resulted in arthritic degenerations of the right knee, ankle, and first tarsometatarsal joint, a fracture of the right fifth metatarsal, and extreme atrophy and/or hypotrophy of the right clavicle, scapula, and humerus with fractures and a possible amputation of the distal humerus. These abnormalities are discussed in detail in Chapter 12. However, reference is made to them where they bear upon the morphological interpretations of the Shanidar 1 remains. It is not clear to what extent these lesions may have affected the morphology of anatomical regions that are not clearly abnormal. It will be assumed that the influence was minimal, unless there is evidence to suggest otherwise.

SHANIDAR 1

Cranium	Clavicles	Ossa coxae
Mandible	Scapulae	Femur (right)
Maxillary dentition: 16	Humeri	Patellae
Mandibular dentition: 14	Radius (left)	Tibiae
Cervical vertebrae: 4	Ulna (left)	Fibulae
Thoracic vertebrae: 10–11	Metacarpals: 3	Tali
Lumbar vertebrae: 5		Calcanei
Sacrum		Anterior tarsals: 8
Ribs: ≥ 14		Metatarsals: 8
		Proximal phalanx: 1

Shanidar 2

Toward the end of the 1957 season, one of the workmen cleaning the west wall on 23 May encountered teeth along the western boundary of square D8. On further examination, the teeth were recognized to be those of an adult human, Shanidar 2. The teeth were found at 7.25 m below datum, close to the middle of the Shanidar deposits and well within the Mousterian levels. The rest of the skull, when exposed, revealed the cranium and mandible of an adult Neandertal that had been flattened from side to side so that its breadth was only 5–6 cm. Apparently it had been buried between two rocks that, with the weight of the overlying sediment, had crushed the soft bone. Because Shanidar 2 was discovered late in the season, it was decided to remove the skull with the attached postcranial bones (two scapulae and the cervical vertebrae) in two blocks, each jacketed in plaster. The rest of the postcranial skeleton, several thoracic and lumbar vertebrae, and a tibia and fibula were left deep in the west wall of the excavation under more than 7 m of deposits; they were excavated early in the 1960 season.

The cervical vertebrae and scapulae of Shanidar 2 were pressed up against the occipital, suggesting that the head had been forced strongly backwards at the time of death. Because little of the postcranial skeleton survived, the burial position of Shanidar 2 is unknown. Yet a rockfall either at time of death or shortly thereafter undoubtedly influenced the final resting position of the individual.

The Shanidar 2 skull was considerably more damaged than that of Shanidar 1, but its poor condition was exacerbated by its treatment in the Iraq Museum. By the time Stewart began his restoration of the fossil in 1960, it had been soaked, in its *in situ* position, in preservative (Figure 6). Stewart was able to disassemble the skull and to reassemble some portions of it, but it was not possible to provide a full restoration of the cranium (Stewart 1961b). More recently (1978), I added slightly to Stewart's restoration, primarily using the teeth and the preserved fragments of alveoli to reconstruct the dental arcade. Stewart completely restored the mandible, replacing the missing portions with filler. His reconstruction is reasonable. However, if the reconstruction of the maxillary dental arcade is accurate, the mandibular reconstruction is too wide posteriorly. Yet since the symphyseal region of the mandible is absent and the central portions of the maxillae are fragmentary, it is not possible to determine conclusively which reconstruction is closer to the original condition.

The restoration of the postcrania presented no difficulties. Although portions are missing from the preserved bones, none of them appears to have been significantly distorted.

SHANIDAR 2

Cranium	Cervical vertebrae: 7	Scapulae
Mandible	Thoracic vertebrae: 8	Tibia (left)
Maxillary dentition: 16	Lumbar vertebrae: 4	Fibula (left)
Mandibular dentition: 15		

Shanidar 3

The first fragments of Shanidar 3 were uncovered on 16 April 1957 during cleaning of the east wall of the main excavation trench. They were found in the northeast corner of square B9 at approximately 5.40 m below datum. Hence, Shanidar 3 was not far from Shanidar 1 but was probably slightly older, being a meter deeper in the deposits. The remains were between rocks in the wall of the trench, and only vertebrae and ribs were still in anatomical position. The individual appears to have been lying on his right side between the rocks.

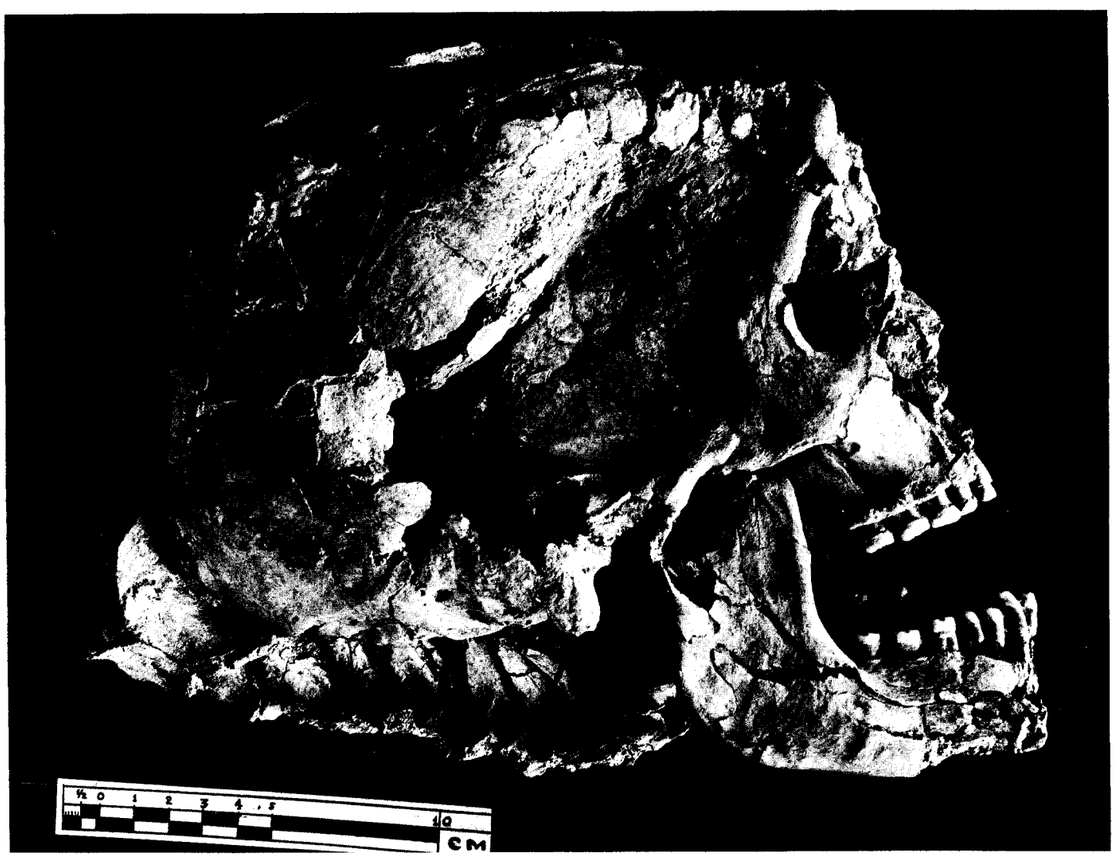

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Figure 6 Two views of the Shanidar 2 skull and cervical vertebrae in their crushed *in situ* position. This was the condition of the specimen after initial cleaning and impregnation in the Iraq Museum and prior to the reconstruction by Stewart. Photos courtesy the Iraq Museum.

During the 1957 season, portions of the ribs, thoracic and lumbar vertebrae, sacrum, innominate bones, a clavicle, hand bones, and foot bones were recovered, along with four isolated teeth. In 1960, further excavation was undertaken in the vicinity of the discovery, and portions of thoracic vertebrae, ribs, clavicles, scapulae, humeri, ulnae, radius, and hand bones were retrieved. These remains have been combined to provide our current knowledge of the anatomy of Shanidar 3.

The analysis of Shanidar 3 was begun by Stewart after the 1957 season, but circumstances prevented him from completing it and integrating the 1960 discoveries. In 1976, I resumed the reconstruction of the fragmentary pieces and, with Stewart, completed the preliminary analysis of the partial skeleton (Trinkaus 1982f; Trinkaus and Stewart 1980). Almost all the Shanidar 3 bones, with the exception of some of the smaller hand and foot bones, are damaged, some considerably. However, there has been little or no warping of the bones, and it has been possible to reassemble most of the preserved pieces.

SHANIDAR 3

Maxillary dentition: 2	Clavicles	Ossa coxae
Mandibular dentition: 2	Scapulae	Femur (side indet.)
Thoracic vertebrae: 12	Humeri	Tibiae
Lumbar vertebrae: 5	Ulnae	Fibulae
Sacrum	Radius (left)	Tali
Ribs: ≥ 20	Carpals: 6	Calcanei
	Metacarpals: 4	Anterior tarsals: 9
	Proximal phalanges: 3	Metatarsals: 6–7
	Middle phalanges: 4	Sesamoids: 2
	Distal phalanges: 3	Proximal phalanges: 2

Shanidar 4

On 3 August 1960, Solecki decided to remove a number of large limestone blocks near the middle of the Mousterian deposits that were protruding from the east wall of the trench to square B7. During this process, bone was encountered between the rocks, at 7.49 m below datum. The bone turned out to be human tibia and fibula. Excavation continued between the rocks, and most of the skeleton of a large individual was revealed lying on his left side with the right arm across the body and the legs partially flexed (Figure 7). This individual became Shanidar 4, the Shanidar "flower burial" (Solecki 1971b, 1975, 1977). Although most of the bones could be identified and appeared relatively intact *in situ*, it was soon realized that all of them were extremely fragile, contained numerous breaks, and tended to fall apart if removed. After considerable effort (see Solecki 1971b; Stewart 1963), the skeleton was removed in a block to be unpacked in the Iraq Museum.

As mentioned earlier, during the preparation of Shanidar 4 for removal from Shanidar Cave and subsequently in the Iraq Museum, the remains of two adults

Figure 7 The Shanidar 4 partial skeleton *in situ* in Shanidar Cave. The right scapula, humerus, radius, ulna, ribs, innominate bone, femur, and proximal tibia are evident, as are the left radius and ulna above the right forearm bones. The cranium and mandible had been removed prior to the taking of this photograph. The remains of Shanidar 6, 8, and 9 were underneath the semiflexed remains of Shanidar 4. Photo courtesy R. S. Solecki.

(Shanidar 6 and 8) and an infant (Shanidar 9) were found associated with the Shanidar 4 partial skeleton. Their particular circumstances are discussed later. There may be some mixing of the Shanidar 4 bones with those of Shanidar 6 and 8. If any exists, it is probably minimal and should not adversely affect the morphological consideration of the Shanidar Neandertals as a sample.

The Shanidar 4 skeleton was unpacked in 1962 by Stewart and the more complete pieces were restored and studied by him at that time (Stewart 1963). In 1976 (Trinkaus 1977b), 1978, and 1980, I continued this work, which appeared at times to be interminable. Not only were the Shanidar 4 bones more fragmented than those of Shanidar 1 or 2, but they were mixed with those of two other adults and few of the breaks presented clean edges for reassembly. For example, of the 184 pieces of cranial vault preserved for Shanidar 4, none has all of its edges unworn and many lack portions of the internal or external tables. Also, Shanidar 4 is the only one of the Shanidar Neandertals to have significant calcareous encrustations, which are many times harder than the friable bones and cannot be removed in many cases without damage to the bone. Although it appears at the moment as though the reassembly of the Shanidar 4 (and Shanidar 6 and 8) remains has proceeded as far as is possible, a considerable number of unidentified fragments remain and it may be possible to add pieces on to some of the existing bones. However, I doubt significant new morphological data will be obtained through additional reconstruction.

Some of the Shanidar 4 bones are in extremely poor condition. However, there is relatively little distortion in the pieces because in most cases bone fragments without reliable joins have been left apart.

SHANIDAR 4

Cranium	Scapulae	Ossa coxae
Mandible	Humeri	Femora
Maxillary dentition: 3	Ulnae	Patella (left)
Mandibular dentition: 9	Radii	Tibiae
Cervical vertebrae: ≥ 4	Carpals: 10	Fibulae
Thoracic vertebrae: ≥ 7	Metacarpals: 10	Tali
Lumbar vertebrae: 4	Proximal phalanges: 8	Calcanei
Sacrum	Middle phalanges: 6	Anterior tarsals: 5
Coccygeal vertebra: 1	Distal phalanges: 5	Metatarsals: 6–7
Ribs: ≥ 20		Sesamoid: 1
		Proximal phalanges: 9
		Middle phalanges: 5
		Distal phalanges: 5

Shanidar 5

Four days after the discovery of Shanidar 4, on 7 August 1960, Solecki began exploring along the east wall of the Shanidar excavation near where

Shanidar 1 and 3 had been found, largely with the hope of finding more pieces of Shanidar 3. Instead, he found another Neandertal skeleton about 4.48 m below datum. This became Shanidar 5 (Solecki 1961). As with the other Shanidar adults, Shanidar 5 was wedged between rocks and appears to have been killed by a rockfall. In fact, the Shanidar 5 remains were quite disturbed, yet close enough to an original articulated position to establish firmly that he was crushed and bent by a rockfall. The legs were in a semiflexed position with the anterior surface facing down. The pelvis, or what little remains of it, was beneath a medium-sized rock, the other side of which supported the cranium. The upper limb and trunk bones that have survived were found out of context. It therefore appears that the trunk of Shanidar 5 was bent backward so that the head was next to the pelvis, and then the body was buried in this position.

The cranium of Shanidar 5 was pressed up against the rock between it and the pelvis, so that the cranium, rock, and pelvis were removed as a unit. The limb bones were removed in pieces to be reassembled later. Although it was found in 1960, Shanidar 5 was not unpacked until 1976, when I cleaned and restored the specimen (Trinkaus 1977d, 1978f).

The Shanidar 5 cranium had been greatly compressed *in situ*, so that the face, left temporal, and left parietal were folded underneath the frontal. Most of the breaks were clean, so that it has been possible to reassemble the maxillae, zygomatic bones, frontal bone, left parietal bone, and left temporal bone with minimal difficulty.

The upper limb bones from Shanidar 5, although incomplete, are in excellent condition. The femora and tibiae, however, lost considerable portions of their shafts where the bone turned to bone meal *in situ*. However, the joins between the fragments are, for the most part, reliable.

SHANIDAR 5

Cranium	Scapula	Os coxae (side indet.)
Maxillary dentition: 3	Ulnae	Femora
Cervical vertebra: 1	Radius (right)	Patellae
Ribs: ≥ 8	Carpals: 3	Tibia (left)
	Metacarpals: 3	Fibula (left)
	Proximal phalanges: 2	
	Middle phalanges: 2	
	Distal phalanges: 3	

Shanidar 6

The circumstances of discovery of Shanidar 6 were discussed previously with respect to Shanidar 4. Suffice it to say that on 9 August 1960, Stewart realized that another, smaller individual was present below Shanidar 4. Because Shanidar 5 had been discovered in the meantime, this new individual

was given the number of Shanidar 6. The Shanidar 6 remains were already mixed with those of Shanidar 4 *in situ*, and became more so during the process of excavation and unpacking of the block containing the bones in Baghdad. Based on the position of the arm bones, Shanidar 6 appears to have been buried in a position similar to that of Shanidar 4, semiflexed on the left side, slightly to the southwest and below Shanidar 4.

Most of the remains of this individual are in good condition, frequently better than those of Shanidar 4. Although few of the bones are complete and many of the long bones lack significant portions, almost all of the joins are clean and leave no doubt as to the reconstruction. A few of the Shanidar 6 remains, in particular the dentition and femora, were originally assigned to Shanidar 4 (Stewart 1963). However, size differences and duplication of parts have made it possible to assign correctly most of the pieces.

SHANIDAR 6

Cranium	Humeri	Os coxae (side indet.)
Maxillary dentition: 11	Ulnae	Femora
Mandibular dentition: 5	Radii	Patella (right)
Sternum	Carpals: 2	Tibiae
Lumbar vertebrae: 4	Metacarpals: 5	Fibulae
	Proximal phalanges: 3	Talus (right)
	Middle phalanges: 4	Anterior tarsals: 2
	Distal phalanges: 2	Metatarsals: 4
		Proximal phalanx: 1
		Distal phalanx: 1

Shanidar 7

The first discovery of Neandertal remains in Shanidar Cave occurred on 22 June 1953. During excavation, first the skull and then the whole body of an infant was found at a depth of 7.87 m below datum in square B6. It was therefore slightly above the stalagmitic level in the middle of Layer D and below the Shanidar 4, 6, 8, and 9 multiple burial. This makes it the most ancient of the Shanidar individuals.

The infant was lying on its right side in a tightly flexed position. All of the bones were crushed, so that the maximum vertical thickness of the skeleton was about 4.5 cm. Yet it appears as though most of the skeleton was preserved, despite its extreme fragmentation.

The remains were cleaned and studied by Şenyürek in 1956 and 1957. But he concerned himself almost exclusively with the largely complete deciduous dentition and only mentioned briefly the other pieces (Şenyürek 1957a, 1957b, 1959). Although the cranial and postcranial pieces are incomplete, they

provide information on the growth and development of Neandertal morphology.

SHANIDAR 7

Cranium	Ulna (right)	Femur (right?)
Maxillary dentition: 8	Metacarpals: 9?	Tibia (side indet.)
Mandibular dentition: 8	Proximal phalanges: 3	Metatarsals: 10?
Cervical vertebra: 1?	Middle phalanges: 4	Proximal phalanges: 3
Lumbar vertebrae: 3	Distal phalanx: 1	
Ribs: 2		

Shanidar 8

During the packaging and removal in a block of Shanidar 4 and 6 between 4 and 15 August 1960, a number of bones and fragments were dislodged. They were collected and placed with the other remains in the Iraq Museum. In 1962, when he began his study of the Shanidar 4 and 6 remains, Stewart soon realized that a second adult of small size was represented, mostly by the loose bones (Stewart 1963). The new adult became Shanidar VII (now Shanidar 8).

It is hard to describe Shanidar 8 as a partial skeleton because it is primarily a collection of extras from Shanidar 4 and 6. However, the bones appear to go together, on the basis of size and morphology, and they should therefore properly be considered as part of an individual. Except for the isolated scaphoid bone and the foot bones, most of the Shanidar 8 bones are extremely incomplete.

SHANIDAR 8

Cranium	Fibula (right)
Humeri	Anterior tarsal: 1
Radius (right)	Metatarsals: 6
Carpal: 1	Sesamoid: 1
	Proximal phalanges: 4
	Middle phalanx: 1

Shanidar 9

The infant discovered in association with Shanidar 4, 6, and 8 was first noticed in August 1960, when the multiple burial was being removed from Shanidar Cave. The remains, which consist of parts of nine vertebrae, became separated from the adult skeletons, and their exact *in situ* location was lost.

The Shanidar 9 vertebrae were found articulated and encased in semibrecci-

ated sediment in two sections. One section contained C-5–C-7 plus T-1; the other contained five thoracic vertebrae. It is assumed that the two pieces fit together, which would make the five thoracic vertebrae T-2–T-6. This assumption cannot be substantiated.

SHANIDAR 9

Cervical vertebrae: 3
Thoracic vertebrae: 6

CHAPTER 3

Morphometric Considerations

A substantial portion of the paleontological data from the Shanidar Neandertal sample consists of linear and angular measurements of the fossils. Although the measurements alone would give a very incomplete description of the sample, morphometrics permit the systematic comparison of the Shanidar Neandertals to each other, a consideration of the ranges of variation in size and proportions within the Shanidar sample, and an evaluation of the position of the Shanidar specimens within ranges of variation of the Neandertals and other Pleistocene hominid samples. For this reason, an effort has been made to provide as complete a set of measurements as possible for the Shanidar remains.

Most of the morphometrics provided were determined personally on the original fossil remains. A few of the measurements have been taken from the work of T. D. Stewart. These consist of *in situ* measurements of several long bones, particularly those of Shanidar 4, and several determinations that were not repeated. There are differences in a number of measurements between the determinations previously published by Stewart and those presented here. These differences are due either to personal differences in measuring techniques or to reconstructions of the specimens done subsequent to the work of Stewart that have altered the dimensions of the fossils.

A number of the morphometrics provided are estimates of the original dimensions of the fossils (indicated by enclosing the measurements in parentheses in the tables). In a sample as fragmentary as the Shanidar one, it is necessary to approximate measurements that would otherwise be unobtainable. If this were not done, the available morphometric data would be a fraction of what it is. The various estimates consist of four general types.

The most frequent approximation is the reconstruction of damaged margins