Reports

Form of the Pubic Bone in Neanderthal Man

Abstract. Shanidar I and III from Iraq have the same peculiar form of pubis as Tabūn I from Palestine. These are the only such pubes known to exist. These facts suggest that Neanderthal man (Shanidar-Tabūn) and an early variety of modern man (Skhūl) coexisted during Mousterian times in this part of the world.

In 1939 Theodore D. McCown, now of the University of California, Berkeley, and the late Sir Arthur Keith of the Royal College of Surgeons, England, published an elaborate description (*1*) of a series of ancient human skeletons from two caves—es Skhūl and et Tabūn—at Mount Carmel, Palestine. In a preceding volume (*2*) the British archeologists, Dorothy Garrod and Dorothy Bate, had represented the stone industry associated with the skeletons as of the Levalloiso-Mousterian period of the Old Stone Age. This, together with the associated fauna, points to a late Pleistocene age, and specifically to the early Würm stage of the Last Pluvial (*3*).

Until the completion of the study by McCown and Keith it had been more or less expected that the Mount Carmel skeletons would show the rather uniform physical characteristics exhibited by the Mousterian or Neanderthal men known up to that time. On the contrary, only the Tabūn remains are like the classic Neanderthalers of Europe, the Skhūl remains being in many ways remarkably similar to modern or Neanthropic man.

Although these differences are best exemplified in the skulls, they extend to other skeletal parts, including the pelvis. In the latter connection, one statement by McCown and Keith (*1*, pp. 71–72) is not generally appreciated: ". . . the anatomical details [of all the specimens from the Skhūl cave] agree with those found in the pelvis of Neanthropic man, particularly the Cromagnon pelvis, rather than with those of the pelvis of Neanderthal man. Yet in total assemblage of characters we meet with a larger proportion of Neanderthal features than are met with in any modern race of Neanthropic man . . ., but the woman (Tabūn I) from the Tabūn cave presents an altogether peculiar pelvic picture. Her pelvis differs not only from those of the Skhūl people but presents features, particularly in the conformation of her pubic bones, which have not been met before, either in living or in fossil man . . . We cannot think that her pelvic features are merely a manifestation of individual variation; they seem too sharply defined for that. The pelvic features force upon us a need for hesitation in regarding this remarkable woman from the Tabūn cave as a mere variant of the Skhūl type."

These contrasting pelvic features, as illustrated by McCown and Keith, are shown in Figs. 1 and 2. Note in the Tabūn innominate the delicate, platelike form of the superior ramus of the pubis, and compare it with the stout, rounded form of the same part in the Skhūl innominates. Note also the much greater size of the obturator foramen in the Tabūn specimen. On the basis of these illustrations probably all students of the human skeleton will agree that the Skhūl pelves are essentially modern in character, and on the other hand that the forepart of the Tabūn specimen cannot be duplicated in modern man.

McCown and Keith wisely refrained from drawing conclusions from these pelvic features, because the more primitive Tabūn group was represented by a single pelvis and because the form of the pubic bone in Neanderthal man was unknown outside the Mount Carmel specimens. Obviously more specimens were needed to show whether such a fundamental difference existed beyond the Tabūn woman.

The picture is now clarified as a result of work on skeletons I and III recovered in 1957 in the upper part of the Mousterian layer at Shanidar, a cave site in northern Iraq about 600 miles in a direct line northeast of Mount Carmel (*4*). These skeletons have been shown by the carbon-14 dating method to have an age around 50,000 years, which places them in the final part of Würm I or more probably in the Würm I–II interstadial (*5*). This would make the Shanidar skeletons somewhat younger than the Mount Carmel skeletons. In a preliminary report on the skull of Shanidar I (*6*), I called attention to its many primitive features and related them to Tabūn rather than to Skhūl. Altogether surprising is the persistence of this kind of Neanderthal to such a late date.

Among the restorable parts of the skeleton of Shanidar I is a pair of pubic bones. The left bone, shown in Fig. 2, obviously has the same peculiar features as that of Tabūn I. Since Shanidar I appears to be a male, these pelvic features are not sex-induced changes.

Shanidar III, which was brought to Washington for study, is represented by a few fragments, including part of the right pubis (Fig. 3). This pubic fragment includes only the median portion of the superior ramus, but enough to show much the same flat structure as the corresponding part of Tabūn I and Shanidar I. Judging from size, Shanidar III is probably male.

By putting together the facts set forth here, it is now possible to say that the Tabūn and Shanidar specimens combine a virtually classic Neanderthal skull morphology with a

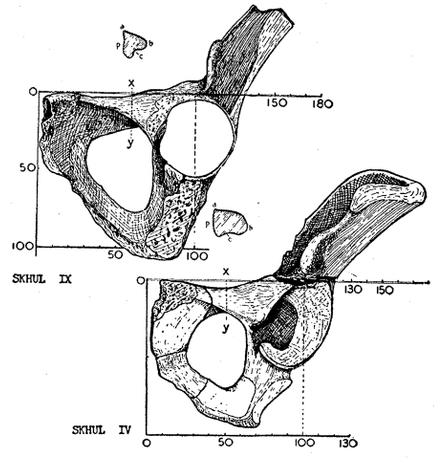

Fig. 1. Two Skhūl innominate bones (left) with cross sections of the superior pubic rami along the lines *x-y*: *a*, linea arcuata; *b*, ventral margin; *p*, pelvic aspect; *c*, groove for the obturator nerve. [Modified from McCown and Keith (*1*, Figs. 49c, 49f, 50, and 52)]

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Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to *one* 2-column figure (that is, a figure whose width equals two columns of text) or to *one* 2-column table or to *two* 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [*Science* **125**, 16 (1957)].

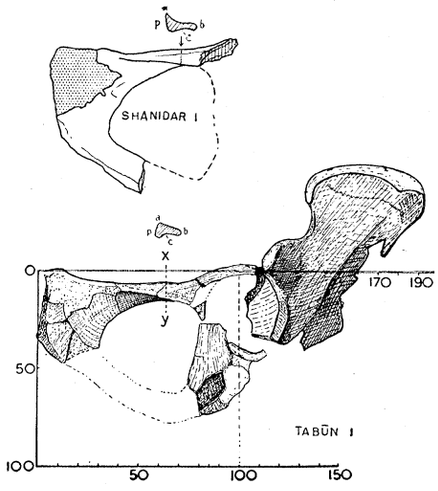

Fig. 2. Left pubic bone of Shanidar I and left innominate bone of Tabūn I, each with a cross section of the superior pubic ramus along the line *x*-*y*. Explanation of abbreviations in Fig. 1. [Lower figure modified from McCown and Keith (*1*, Figs. 49g and 53)]

unique shape of pelvis, whereas the Skhūl specimens combine a nearly modern skull morphology with an essentially modern shape of pelvis. The pelvic differences impress me as having as much significance as the skull differences. Together they amount to a fundamental difference.

So long as the skulls from Mount Carmel were mainly the subject of discussion, interpretations of their variations took two courses: (i) "the Mount Carmel people were in the throes of evolutionary change" (*1*, p. 14), or (ii) "the Mount Carmel population arose . . . as a result of hybridization of a Neanderthaloid and a modern type, these types having been formed earlier in different geographical regions" (*7*, p. 258). In view of the new evidence, neither of these explanations seems completely logical. To my way of thinking it is simpler and more reasonable to strip the Mount Carmel remains of the role of a "population," and especially a hybrid population, and to recognize their two components as fundamentally distinct. There is no reason now to regard the Skhūl specimens as anything other than representatives of an early variety of modern man. The Tabūn-Shanidar specimens then become representatives of the local Neanderthal variety, which probably went on to extinction. All this does away with the need for setting up hypothetical types and for assuming that the whole lot of the Mount Carmel skeletons represents a single breeding population.

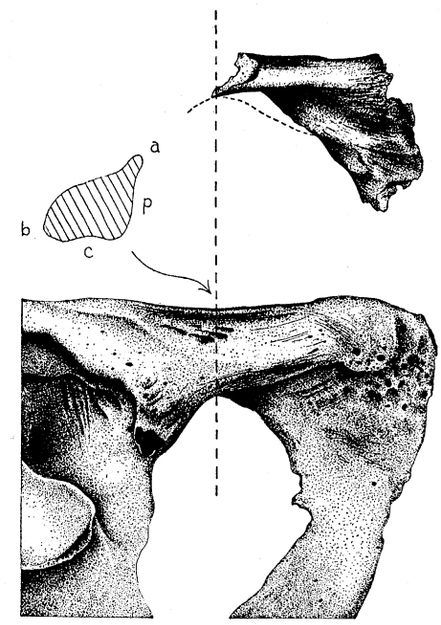

Fig. 3. Fragment of right pubic bone of Shanidar III shown in comparison with the corresponding part of a modern specimen (male). Explanation of abbreviations in Fig. 1.

It may be objected that spatial separation is required to maintain the distinctiveness of human varieties and that the Mount Carmel caves did not afford such separation. In general this is a valid objection, but as yet there is no proof that the recovery of two different varieties of man from a cultural layer which accumulated over thousands of years in the Mount Carmel caves necessarily means actual physical contact between these varieties. I have stated elsewhere (*8*) my reasons for doubting that the Skhūl and Tabūn remains represent a breeding population. The fact that these remains were separated stratigraphically most likely means that the distinct varieties which they represent were separated in space; in other words, separate occupation of the caves at different times by these distinct human varieties could have taken place while they were living in the surrounding area as breeding isolates. The concept of contemporary breeding isolates is well established, but the nature of the isolates in this instance cannot be clearly discerned. Incidentally, such an explanation often has been precluded in the past by the dubious assumption that all remains of ancient man have to be fitted into a straight evolutionary line.

To recapitulate, then; the evidence here presented forces consideration of the possibility that an early variety of modern man lived side by side, so to speak, with a Neanderthal variety during Mousterian times in the area now designated as the Near East.

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References and Notes

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Fusion of Complex Flicker II

Abstract. Flicker waveform has been found to have a slight but specific effect upon fusion threshold. A depression of threshold amplitude of about 30 percent occurs if a second harmonic of near-threshold amplitude is added to the fundamental. The magnitude of the depression depends critically on the relative phase of the two components of the waveform.

The frequency at which a flickering light appears to fuse into steady light has appeared to depend mainly on the average luminance and the amplitude of the fundamental Fourier component of the flicker waveform, and very little on its other components (*1*). However, recent results with a waveform whose second harmonic was much stronger than its fundamental (*2*) seemed to yield flicker fusion which depended on the amplitude of either the fundamental or the second harmonic, whichever was above threshold (*3*). This experiment was designed to check whether the threshold for flicker fusion is indeed not depressed when two components are summed, both components being near threshold.

The subject was seated with his head held fixed by a chin rest. A Sylvania R-1131/c glow modulator transluminated a ground glass screen placed 10 inches from his eyes. The luminance could be varied without change of color by special circuitry provided by H. S. McDonald of Bell Telephone Laboratories. Only one average luminance was used in the experiments, namely 200 ft-lam. The screen subtended about 1° at the subject's eyes and was seen in a white surround of 40 ft-lam, subtending about 10°. The average d-c lamp luminance could be modulated in one of three modes selected by the subject by switch. These modes were: a sinusoid of frequency f, a sinusoid of frequency $2f$, and the two components summed. The experimenter set the frequencies and the relative phase of the components (see Fig. 1). The subject could vary the amplitude of modula-