Chronological Framework for the Study of the Palaeolithic in Japan

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IN THIS paper I attempt to organize available information into a chronological framework that would facilitate our understanding of anthropological remains recovered from Pleistocene formations in Japan. For the Late Pleistocene, K. Kobayashi (1965) and Kotani (1969) have presented excellent summaries in English in journals easily accessible to North American archaeologists, and Morlan (1967*a*) assembled chronometric data then available and supplied useful comments. While the detailed synthesis by Minato and his associates (1965) still remains a valuable source of information, a number of paleomagnetic and radiometric data which became available since the late 1960s now allow us to discuss the Lower and Middle Pleistocene formations on firmer ground than before. Recent tephrochronological and chronometric studies, on the other hand, compel us to revise some of our former views on the Upper Pleistocene stratigraphy.

A fourfold division of the Pleistocene into the Basal, Lower, Middle, and Upper will be used, as this division is most convenient in dealing with original source materials, especially those concerning faunal assemblages. With reference to the Alpine sequence, the Basal Pleistocene here refers to the Pre-Günz portion of the Pleistocene; the Lower Pleistocene covers the period from the Günz Glacial through the end of the Mindel Glacial stage; the Middle Pleistocene refers to the Mindel/Riss Interglacial and the Riss Glacial stages; and the Upper Pleistocene to the Riss/Würm Interglacial and the Würm Glaciation. The radiometric ages for the Alpine stages, shown in columns 1 through 3 of Figure 1, are based on Cooke's synthesis of Pleistocene climatic events with the paleomagnetic time scale (Cooke 1973).

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Figure 1 presents stratigraphic sequences from the vicinities of two of the best-known areas of Japan: Tokyo Bay and Osaka Bay. The Tokyo Bay sequence here is a composite of two local sequences. The Upper and Middle Pleistocene sequence is the standard South Kanto sequence with type localities in the north and west of the present Tokyo Bay. The Lower and Basal Pleistocene sequence is from Boso Peninsula to the east and south of Tokyo Bay, where paleontological and paleomagnetic data are more numerous.

1. Basal Pleistocene

Stratigraphic Units

In the Osaka Bay area (Fig. 1, column 5), the Basal Pleistocene as defined here is represented by the lower portion of the Osaka Group, up to the Azuki Tuff (Ishida et al. 1969; Itihara et al. 1973; Kamei and Setoguchi 1970; Susumu Nishimura and Sasajima 1970). The boundary between the Matuyama Reversed and Gauss Normal Magnetic epochs lies in the basal part of the Osaka Group, while the base of the Osaka Group does not exceed 3 million radiometric years. The chronometric age of the reversely magnetized Azuki Tuff was given as 0.87 $\pm$ 0.07 million years by the fission track method and as 1.42 million years by the potassium/argon method. The fission track age of ca. 0.87 million years appears to be more consistent with the paleomagnetic time scale.

In southern Kanto (Fig. 1, column 6), the base of the Umegase Formation is older than the Matuyama/Gauss boundary, and the Olduvai (or Gilsa) polarity event is represented at the middle horizon of the Umegase Formation (Nakagawa, Niitsuma, and Hayasaka 1969). The Matuyama/Bruhunes boundary and the Jaramillo polarity event are located within the Kokumoto Formation. Thus, the lower part of the Kokumoto Formation should also be included in the Basal Pleistocene as defined here.

Climate

The temperature curve shown in Figure 1, column 5, is a composite from Ishida et al. (1969) and Itihara et al. (1973) that I have adjusted to the paleomagnetic time scale. The climate during the Basal Pleistocene apparently remained quite warm, with the *Metasequoia* flora continuing from the Pliocene. Occurrences of several cool phases in the latter half, after about 2 million years ago, are suggested by the appearance of cool-temperature species such as pollen and macrofloral remains. These include *Picea maximowiczii, Pinus koraiensis,* and *Menanthes trifoliata.*

Mammalian Fauna

Faunal assemblages from the Basal Pleistocene formations are characterized by the following species: *Stegodon sugiyamai; Stegodon shodoensis; Stegodon shodoensis akashiensis; Stegodon aurorae; Elephas shigensis; Elephas proximus; Cervus (Deperetia) kanusensis; Elaphurus akashiensis; Rusa.* These are obtained from the Umegase Formation and the basal part of the Kokumoto Formation on the Boso Peninsula and from the lower part of the Osaka Group and correlative formations (such as the Akashi Formation) in the Osaka Bay area (Kamei 1962; Kamei and Setoguchi 1970; Ikebe et al. 1966; Itihara et al. 1973). Kamei (1962, 1965) suggested

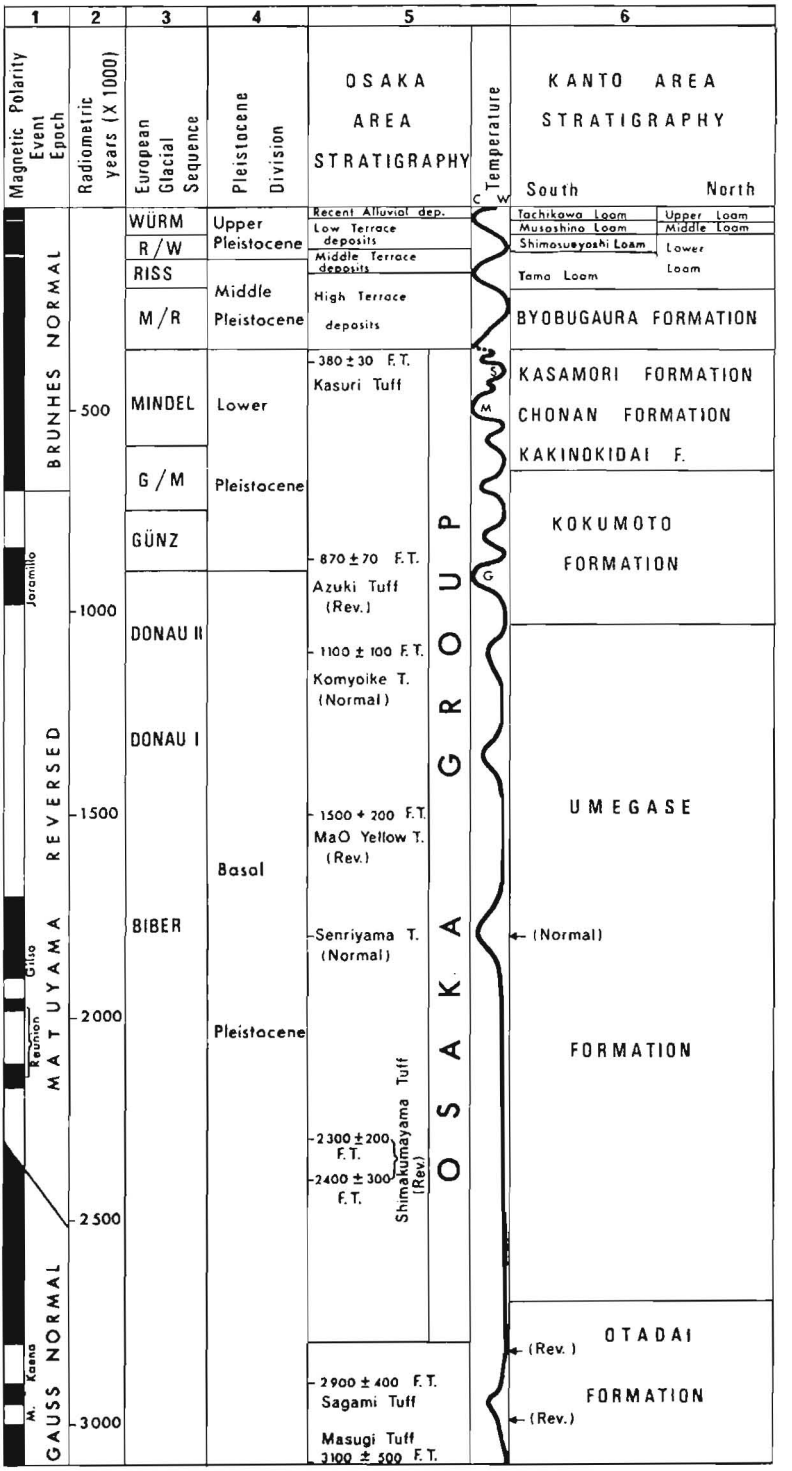

Fig. 1 Pleistocene stratigraphy of Japan.

that the *Stegodon* species probably represented the remnants of the Indo-Malayan elements which were widespread throughout East Asia during late Tertiary times, while the *Elephas* species and the deer indicated arrivals of forms related to the Nihowan Fauna.

Human Remains

Appearances of new mammalian forms suggest the existence of a dry-land passage to the Japanese archipelago from continental Asia during the Basal Pleistocene. The recovery of a stone artifact from the Nihowan Formation (Gai and Wei 1974) raises a possibility that a toolmaking hominid may already have been present in North China. However, no reliable evidence of human occupation of the Japanese archipelago, either as skeletal or as archaeological remains, could be assigned to Basal Pleistocene formations.

A cranial fragment was reportedly recovered by a local collector at Nishiyagi (Fig. 2), near Akashi, from Naora's *Parastegodon* Bed (Naora 1954: 149; Watanabe 1970). This horizon is an equivalent of the Marine clay 0-Yellow Tuff horizon dated by the fission-track method at 1.5 $\pm$ 0.2 million years and by the potassium/argon method at 2.99 million years (Itihara et al. 1973). The specimen itself has since been lost, and the specimen-bearing deposits had apparently been eroded away by the time of the 1948 reinvestigation of the locality. As to the innominate bone, or Hasebe's *Nipponanthropus akashiensis* (Hasebe 1948), I accept Naora's observation that it was originally contained in the Nishiyagi Formation (or his *Paleoloxodon* Bed). If so, it should date to the Upper Pleistocene, even though Lower and Middle Pleistocene ages have been attributed to this specimen by various authors.

A claim of "Villafranchian" artifacts was made by Matsumoto et al. (1959) on bone and stone specimens obtained from the fossiliferous formation at Hanaizumi in northern Honshu. Some of these specimens could very well be man-made (S. Kato 1975; T. Kobayashi 1975), but the associated fauna, in fact, are of Late Pleistocene age, as will be discussed in a later section of this paper.

2. Lower Pleistocene

Stratigraphic Units

The Lower Pleistocene is represented in the Osaka Bay area (Fig. 1, column 5) by the upper part of the Osaka Group down to the Azuki Tuff. The fission-track ages of 0.87 $\pm$ 0.07 million years for the Azuki Tuff and of 0.38 $\pm$ 0.03 million years for the Kasuri Tuff in the uppermost part of the Osaka Group (Susumu Nishimura and Sasajima 1970) are consistent with this assignment. In the Tokyo Bay area of southern Kanto (Fig. 1, column 6), the upper half of the Umegase Formation and the Kokumoto, Kakinokidai, Chonan, and Kasamori formations appear to correlate with this portion of the Osaka Group.

Climate

Evidence of marked climatic oscillations is reported for the upper part of Osaka Group (Itihara et al. 1973: 30). Ishida et al. (1969) distinguish two "cold ages" and one "warm age" within this time span. They were named the "Gokenya cold age"

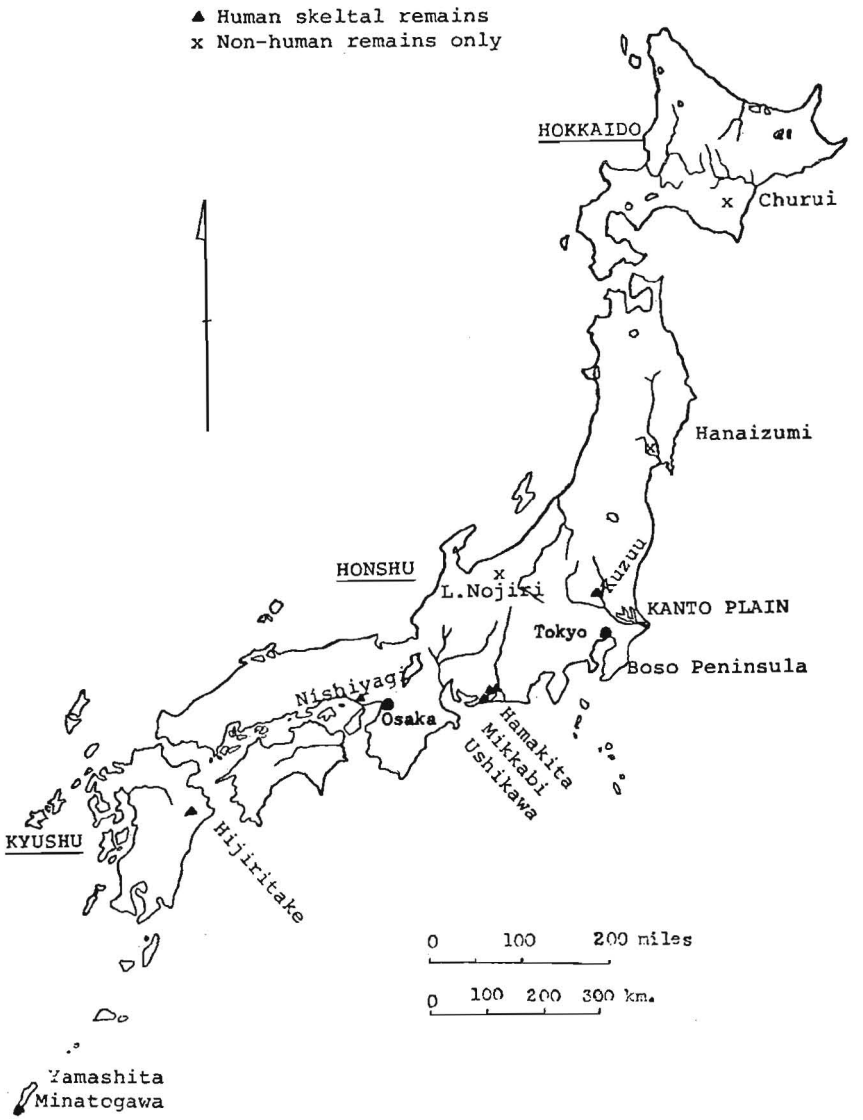

Fig. 2 Paleontological deposits mentioned in text.

("G" in Fig. 1, column 5), just below the Azuki Tuff horizon, the "Manchidani cold age" ("M" in Fig. 1) at about 0.5 million years, and the "Shinkori warm age" ("S" in Fig. 1) at about 0.4 million years. The Manchidani cold age is well known for the large number of cold-climate plant species obtained from the Manchidani Formation (Miki 1941). They include *Abies veitchii, Larix gmelinii, Picea bicolor, Pinus koraiensis, Betula platyphylla,* and *Menyanthes trifoliata.* The Shinkori warm age is characterized by the appearance of such species as *Syzygium buxifolium, Cinnamonum doederleinii,* and *Illicium religiosum.* In the Tokyo Bay area, indications of climatic fluctuations are less evident, but the marine fauna in the Chonan

Formation and in the basal and upper parts of the Kasamori Formation suggests colder temperature and lowered sea level (Itihara et al. 1973: 37–38; Kamei 1962: 24–25).

Mammalian Fauna

The diagnostic proboscidean fossil for the Lower Pleistocene is *Stegodon orientalis*, although *Elephas shigensis* continued from the Basal Pleistocene (Kamei and Setoguchi 1970; Ikebe et al. 1966). Other forms which have been obtained from formations that can be correlated with the Lower Pleistocene include such species as *Sus lyderkkeri*, a rhinocerid virtually identical to *Dicerorhinos mercki*, a tiger like *Felis youngi*, *Giraffa nipponica*, and *Bubalus*. These are species new to the Japanese archipelago, and both Hasegawa (1967) and Kamei (1965) feel that the Lower Pleistocene was the period of most active faunal migrations into Japan.

Human Remains

Land connection with mainland Asia is suggested not only by the appearance of new mammalian forms, but also by the first appearance in Japan of larch *(Larix gmelinni)* at Manchidani and *Syzygium buxifolium* and *Cinnamonum doederleinii* at Uegahara during the Lower Pleistocene (Kamei and K. Suzuki 1969). According to Aigner and Laughlin (1973), who argue that the cranium from Lantian 63706 (Kungwanglin) is older than the mandible from Lantian 63709 (Chenchiawo), *Homo* may have existed in North China as early as the Günz/Mindel Interglacial, or some 700,000 years ago. If so, it is not impossible that *Homo* may have arrived in Japan together with the new tree species and mammalian forms.

Convincing evidence that *Homo* did arrive in Japan, however, is yet lacking. T. Ono (1971) assigns lithic specimens obtained from Isogami, Yumachi (Tamatsukuri Lower), and Tashimagaoka in western Honshu to the Lower Pleistocene. None of these specimens were obtained under controlled conditions, and dating is based principally on assignments of topographic surfaces to glacial/interglacial episodes as extrapolated from the Alpine sequence.

3. Middle Pleistocene

Stratigraphic Units

In the Osaka area, various formations referred to as the "High Terrace Deposits" and the lower half of the "Middle Terrace Deposits" appear to represent the Middle Pleistocene (Fig. 1, column 5).

In southern Kanto, the Byobugaura Formation, attributed to a marine transgression (the Byobugaura Transgression), was probably deposited during a warm period between the Mindel and Riss Glaciations of western Europe. The Tama Loam, volcanic ejecta overlying the Byobugaura Formation, has traditionally been equated with the Riss Glaciation, and Figure 1 (column 6) follows this rough equation. It should be noted, however, that recent investigations suggest that the Tama Loam probably encompasses quite a long period of time during which several cycles of marine transgression and regression were repeated (Machida et al. 1974). Furthermore, Machida (1971) notes that there appears little hiatus between the Tama Loam and the Shimosueyoshi Loam whose base, at the horizon of the maximum marine

transgression, is about 130,000 F.T. years old. It is therefore possible that the deposition of the upper portion of the Tama Loam may have coincided with the early stage of the Riss/Würm Interglacial Stage.

Although the Lower Loam of northern Kanto is usually equated with the Shimosueyoshi Loam of southern Kanto, its lower part may partially overlap with the Tama Loam, because the base of the Lower Loam has not been determined.

Fauna

The mammalian fauna of the Middle Pleistocene is not well known, apart from the apparent disappearance of *Stegodon orientalis* and the expansion of *Elephas (Paleoloxodon) namadicus naumanni* in Japan.

Archaeological and Human Skeletal Remains

No definite evidence for human occupation of Japan has been obtained from Middle Pleistocene formations.

Although a "Middle Pleistocene" age was ascribed to the humerus fragment obtained from a limestone quarry at Ushikawa, near Lake Hamana, the authors state that the fossiliferous formation can be correlated with the Sahama Silt and Mikatagahara Gravel beds (H. Suzuki 1965; H. Suzuki and Takai 1959). According to K. Kobayashi (1965) these formations belong to the Upper Pleistocene of this paper.

Three of the thousands of lithic specimens recovered from the vicinity of the *Elephas (Palaeoloxodon) namadicus naumanni* skeleton at Churui, southern Hokkaido, were described by Yoshizaki (1971) as possible artifacts (Fig. 3). The horizon is older than 43,200 radiocarbon years, and is tentatively assigned to the Mindel/Riss Interglacial by Minato and Akiyama (1971) on the basis of the amount of acetylbromide-soluble constituents in the fossil wood from the horizon.

Although some of the archaeological materials recovered from the Nyu area in northeastern Kyushu were originally assigned to the Mindel/Riss Interglacial stage (Nippon Kyusekki Bunka Kenkyu Iinkai 1968), the investigators now accept that the specimens could be of any age since the Interglacial, as they occur only in the weathered part of the Nyu Mud Formation.

4. UPPER PLEISTOCENE

Stratigraphic Units

In the Osaka Bay area (Fig. 1, column 5), the upper part of the "Middle Terrace Deposits," the "Lower Terrace Deposits," and the lower part of the "Recent Alluvial Deposits" represent the Upper Pleistocene of this paper. Itihara et al. (1973: 31–32, Table 1) indicate that the "Middle Terrace Deposits" correspond to the period of warming climate, the "Lower Terrace Deposits" correspond to the period from the maximum climatic amelioration to the maximum deterioration, and the "Recent Alluvial Deposits" date from this maximum deterioration to the present time.

For southern Kanto, a number of radiometric determinations are available for pumice and buried soil horizons within volcanic ash layers. It has been stated earlier that Machida's stratigraphic study on Oiso hills, near the Fuji-Hakone volcanic

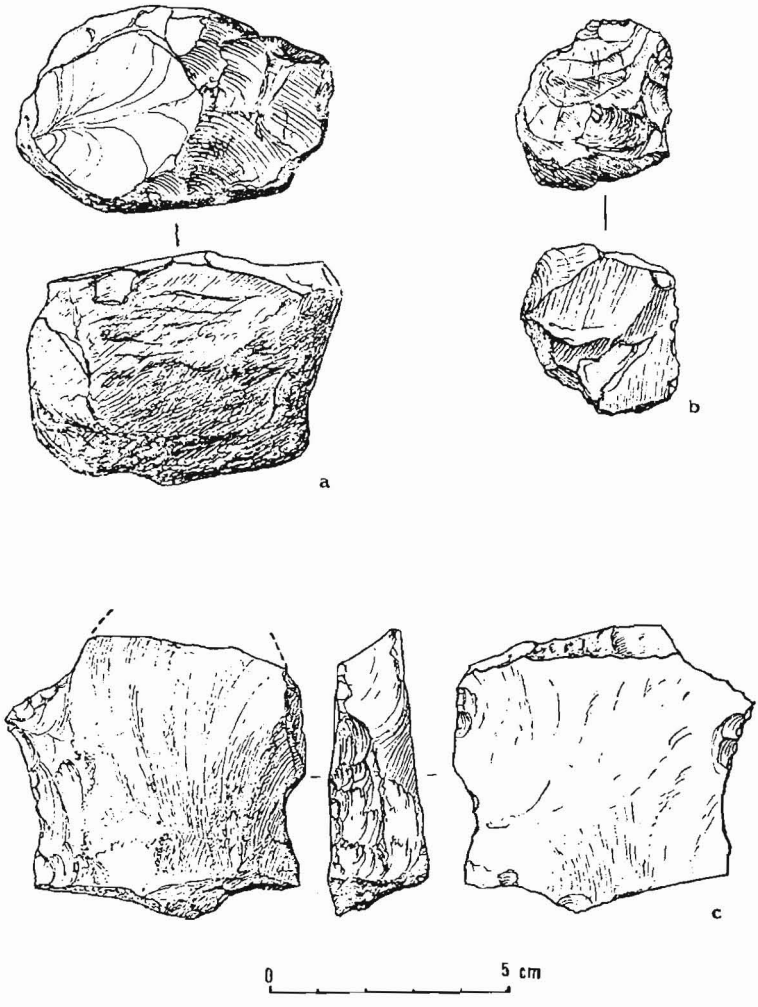

Fig. 3 "Possible artifacts" from Churui, Hokkaido (after Yoshizaki 1971).

source (Machida 1971), suggests that the upper part of the Tama Loam should probably be included in the Upper Pleistocene as defined here. Apart from this section of the Tama Loam, for which a great deal more needs to be known, the major stratigraphic units of the Upper Pleistocene in southern Kanto are the Shimosueyoshi Loam (ca. 130,000–60,000 B.P.), the Musashino Loam (ca. 60,000–30,000 B.P.) and the Tachikawa Loam (ca. 30,000–10,000 B.P.). It will be noted that the Shimosueyoshi marine formation, which has been treated as the time-stratigraphic unit for the early Upper Pleistocene (e.g., K. Kobayashi 1965; Kotani 1969), is omitted. The omission is based on Machida's observation that there appears to be little, if any, hiatus in volcanic ash deposition between the Tama and Shimosueyoshi loam formations. It would therefore seem advisable to consider the Shimosueyoshi Formation as being partially contemporaneous with the Tama and the Shimosueyoshi loam formations.

The Shimosueyoshi Formation is a marine formation deposited during a period of a major marine transgression known as the Shimosueyoshi Transgression. Although there has been a controversy as to whether the Shimosueyoshi Transgression should be equated with the Eemian or Holstenian times, it now seems clear that it coincided with the Eemian. Machida and Suzuki (1971) state that the maximum transgression occurred at about 120,000 to 130,000 F.T. years ago, when pumice falls KlP-6, KlP-7, and KlP-8 occurred, and receded by the time of KmP-1, which is dated as 98,000 ± 12,000 F.T. years B.P. Subsequent periods of high sea levels formed the Obarudai surface, at about 80,000 B.P., and the Misaki surface, at about 60,000 B.P. The Tachikawa surface, which is lower than the present sea level, was probably formed about 30,000 B.P., judging by the fluvial extension of this surface. The Musashino Loam rests on the Misaki surface and the Tachikawa Loam on the Tachikawa surface. The relationship between horizon marker pumice and sea level changes, as presented by Machida and Suzuki (1971), is shown in Figure 4.

I propose to divide the Upper Pleistocene of Japan into three stages: the Shimosueyoshi Stage (up to 60,000 B.P.), the Musashino Stage (60,000–30,000 B.P.), and the Tachikawa Stage (30,000–10,000 B.P.). In the remainder of this paper, horizon markers, chronometric determinations, mammalian fauna, human skeletal remains, and archaeological assemblages are discussed for each of the three stages.

Shimosueyoshi Stage

Horizon Markers and Chronometric Determinations

The Shimosueyoshi Loam overlies the Tama Loam, with the boundary marked by a layer of dark soil. This soil layer, which may reach as much as 2.5 m on the Oiso hills, is the best developed of all the buried soil layers in the loam formations. It may be due to relative quiescence of volcanic activity, to climatic amelioration, or to both (Machida 1971). Just above the buried soil are several layers of pumice, of which KlP-6, KlP-8, and KlP-13 have been dated by the fission-track method (Table 1, sample nos. 10–12). The ages of the pumice KlP-6 and KlP-8 are reversed, but are within the ranges of error of the determinations. The base of the Shimosueyoshi Loam, therefore, is approximately 130,000 years B.P.

From the pumice layers in the middle part of the Shimosueyoshi Loam, obsidian samples suitable for fission-track dating were available from the KmP-1 (sample no. 9, Table 1) and the KmP-7 (sample no. 8, Table 1). Sample numbers 3–7, for zircon from the Pumice Fall I (Pm-I), define the boundary between the middle and the upper parts of the Shimosueyoshi Loam.

The Obarudai Pumice (OP, sample no. 2, Table 1) is situated in the upper part of the Shimosueyoshi Pumice.

The Lower Loam of northern Kanto is largely contemporaneous with the Shimosueyoshi Loam, although, as stated above, its basal part may be as old as the Tama Loam. The uppermost part of the Lower Loam also appears to be younger than the boundary between Shimosueyoshi Loam and Musashino Loam, for the Yunokuchi Pumice (UP), which marks the boundary between the Lower and Middle Loam formations of northern Kanto, is situated above the Tokyo Pumice (TP) in the lower part of the Musashino Loam (Arai 1962: 67–69).

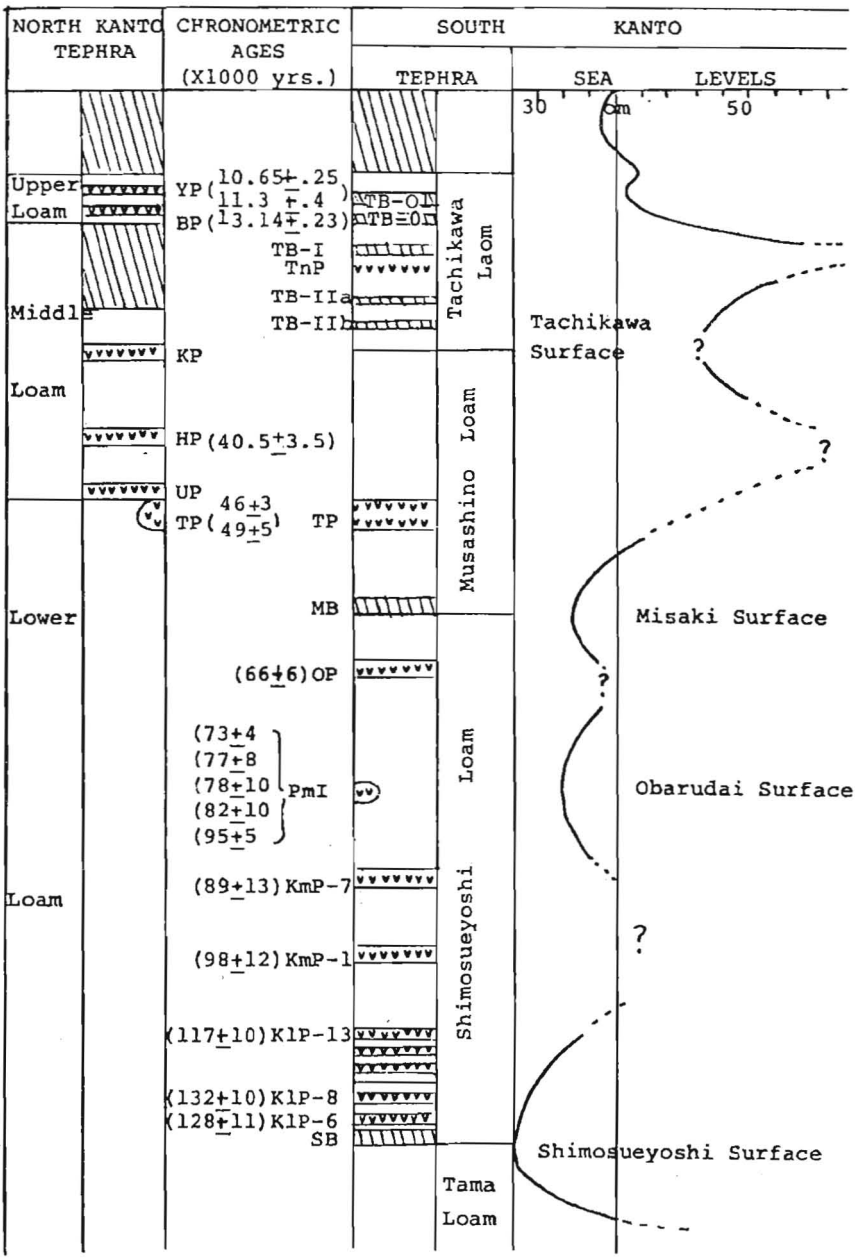

Fig. 4 Late Quaternary stratigraphy of the Kanto Plain. *YP*, Itahana Yellow Pumice; *BP*, Itahana Brown Pumice; *TB*, Tachikawa Buried Soil (-0, -I, -IIa, etc.); *TnP*, Tanzawa Pumice; *KP*, Kanuma Pumice; *HP*, Hassaki Pumice; *UP*, Yunokuchi Pumice; *TP*, Tokyo Pumice; *MB*, Musashino Buried Soil; *OP*, Obarudai Pumice; *PmI*, Ontake Pumice Fall I; *KmP*, Middle Kissawa Loam Pumice (-1, -2, etc.); *KlP*, Lower Kissawa Loam Pumice (-6, -8, etc.).

TABLE 1. FISSION-TRACK AGE DETERMINATIONS ON PUMICE HORIZONS IN SOUTHERN KANTO
(Machida and Suzuki 1971)

SAMPLE NUMBER	TEPHRA DESIGNATION	SAMPLE	F.T. YRS. B.P.	LOCATION
1	TP	Obsidian	49,000 ± 5,000	Daikanyama, Hakone
2	OP	Obsidian	66,000 ± 6,000	Daikanyama, Hakone
3–7	Pm-I	Zircon	73,000 ± 4,000	Sagami City and Uenohama Town
		Zircon	77,000 ± 8,000	
		Zircon	78,000 ± 10,000	
		Zircon	82,000 ± 10,000	
		Zircon	95,000 ± 5,000	
8	KmP-7	Obsidian	89,000 ± 13,000	Tsuchiya, Oiso hills
9	KmP-1	Obsidian	98,000 ± 12,000	Tsuchiya, Oiso hills
10	KIP-13	Obsidian	117,000 ± 10,000	Tsuchiya, Oiso hills
11	KIP-8	Obsidian	132,000 ± 10,000	Tsuchiya, Oiso hills
12	KIP-6	Obsidian	128,000 ± 11,000	Tsuchiya, Oiso hills

Fauna

A large number of *Elephas (Paleoloxodon) namadicus* specimens have been obtained from the marine Shimosueyoshi Formation and correlative formations, from southern Kyushu to northern Honshu. In addition, *Cervus (Depéretia) praenipponicus* is present (Kamei 1965).

The fact that neither of the mammalian species is new to Japan may argue for the isolation of the Japanese archipelago during the Riss/Würm Interglacial, but Saburo Nishimura (1974) strongly argues for the existence of a land bridge between southwestern Honshu and the Korean Peninsula. He points out that (1) fish species which appear to have entered the Japan Sea during this interglacial are all from the Okhotsk or Bering Sea area, and (2) the distribution of *Rhizopsammia* and *Oulangia*, two coral species resistant to cold water, indicates their entry into the Japan Sea around northern Honshu through the Tsugaru Strait (Saburo Nishimura 1974:196).

Human Skeletal Remains

If the human skeletal materials recovered by Naora in 1931 were contained in the *Parastegodon* Bed, they are of Basal Pleistocene age (cf. the Basal Pleistocene above). However, Naora (1954: 141–161) is most emphatic in insisting that the innominate bone, at least, was contained in his "*Paleoloxodon* Bed." This is the *Nishiyagi* Bed of Ikebe (Ikebe et al. 1966: 49), which is one of the "Middle Terrace Deposits." If this was indeed the case, the innominate specimen, on which Hasebe (1948) observed many "primitive" characteristics, should date to the early Upper Pleistocene. The 1948 reinvestigation of the area, unfortunately, failed to produce any further evidence.

Archaeological Materials

Naora (1931) also described several bone and stone specimens which he felt were modified by man. Two of the stone specimens, which survived the bombing of

Tokyo during World War II, were reexamined by Serizawa (1970*b*), who feels that they are a chopper and a chopping tool made of chert, rather similar in workmanship to those which have been recovered from the northern Kanto Plain since 1965.

Of the eleven nonceramic assemblages recovered from the Hoshino site in Tochigi City, the materials of Cultural Horizon 8 (Fig. 5), 9, 10, and 11 (Serizawa 1969, 1970*c*) should belong to the Shimosueyoshi Stage (Arai 1971: 321, Fig .4). Serizawa and Aizawa (1970) recovered a large quantity of chert specimens from Locality D of the Iwajuku site (Fig. 6). They are reported to occur in many layers and some of these are probably of Shimosueyoshi age. From Fujiyama, also in northern Kanto, Aizawa extracted several specimens, including the two which Serizawa (1965) described as a chopper and a chopping tool. A large number of chert specimens also were obtained from Akabori Iso by Aizawa. At Akabori Iso, and at Fujiyama as well, specimens occur below the Yunokuchi Pumice. Arai (1971), however, urges

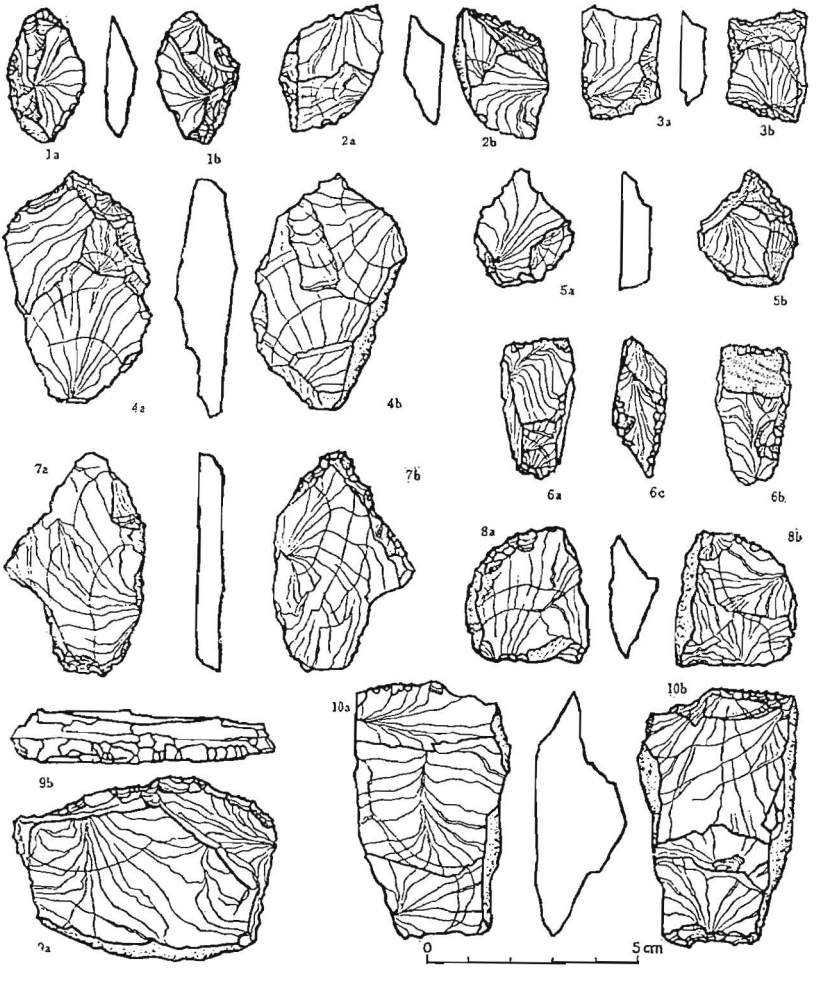

Fig. 5 Lithic specimens of Horizons 7 and 8 of the Hoshino Site, Tochigi Prefecture. *1–3*, "proto-knives"; *4, 5, 7*, "flake points"; *8, 9*, "scrapers"; *6, 10*, "choppers" (Serizawa 1974).

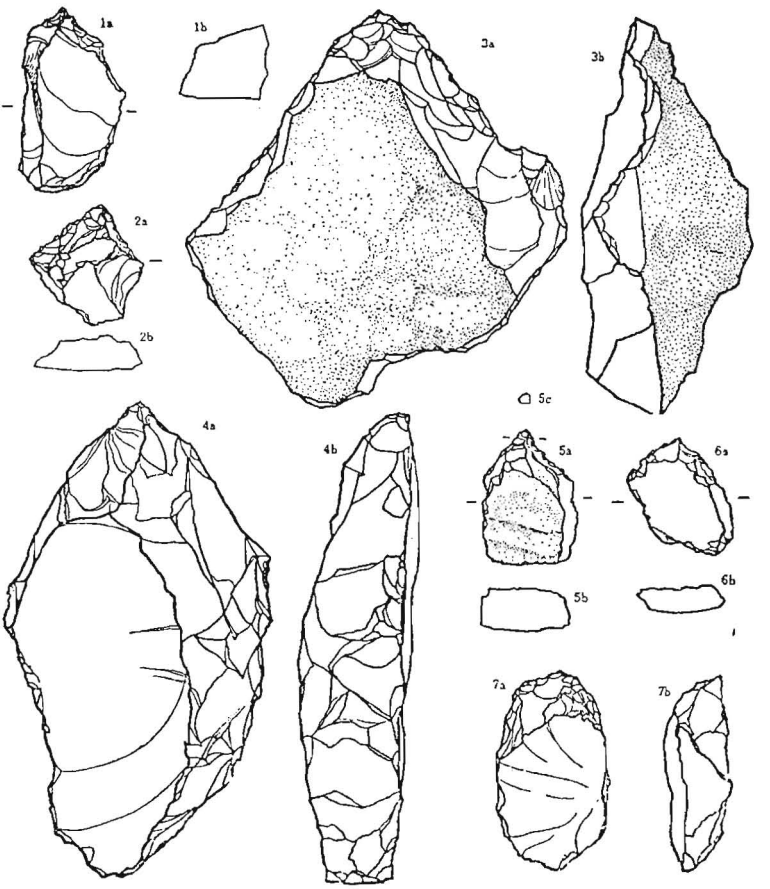

Fig. 6 Lithic specimens from the Iwajaku D locality (Serizawa 1970*c*). Scale: approx. 4/10.

extreme caution on the part of archaeologists in evaluating these specimens, because the specimen-bearing horizons at Iwajuku D locality are in talus gravel, while those at Akabori Iso and Fujiyama are probably in volcanic mudflow deposits. Finally, the quartzite specimens recovered from the Sozudai site in northeastern Kyushu are assigned by the investigators (Serizawa 1965) to a period shortly after the formation of the Shimosueyoshi surface.

Musashino Stage

Horizon Markers and Chronometric Determinations

The Tokyo Pumice (TP) is situated in the lower part of the Musashino Loam and is dated as 49,000 ± 5,000 F.T. years B.P. The Tokyo Pumice is occasionally present in northern Kanto as well.

Yunokuchi Pumice (UP) marks the boundary between the Lower Loam and Middle Loam of northern Kanto. It occurs slightly above the Tokyo Pumice.

Hassaki Pumice (HP) occurs at the middle position in the Middle Loam of northern Kanto and is dated to 40,500 ± 3,500 (Tk-31) by the radiocarbon method.

Kanuma Pumice (KP) is in the upper part of the Middle Loam of northern Kanto (Fig. 4).

Fauna

The faunal specimens obtained from limestone fissure caves in the Kuzuu area in northern Kanto are known to have occurred below the Kanuma Pumice (Shikama 1949). Of these I tentatively assign the younger group, collectively known as the Upper Kuzuu Fauna, to the Musashino Stage, although it is quite possible that it may be even older. This fauna includes *Cervus (Sinomegaceroides) yabei*, which is similar to *Sinomegaceros ordosianus*, the Siberian wolf *(Canis lupus hodopylax)*, *Ursus arctos*, and *Cervus yesoensis*. The latter two occur only in Hokkaido today. On the other hand, *Elephas (Paleoloxodon) namadicus* appears to have reached Hokkaido during early Würm times.

The faunal materials certainly suggest a land connection of the Japanese archipelago with the Asiatic mainland, as well as the land connection between Hokkaido and Honshu. It is interesting to note that Saburo Nishimura (1974: 185) observes that the Japan Sea area, covering northeastern China, the Amur-Manchurian region, Korea, and Honshu, was one of the refugium areas during the Würm. If animals of the central Asian steppe migrated to this refugium area, man could also have arrived in Japan with the Ordos fauna.

Human Skeletal Remains

Although Naora (1954) felt that some of the primate bones recovered from the Kuzuu area belonged to a primitive hominid, they appear to exhibit characteristics too unusual for an Upper Pleistocene hominid.

The humerus fragment from Ushikawa, reported as being of a "Middle Pleistocene" age (cf. the Middle Pleistocene above), may also be assignable to the Musashino Stage, if the elements of the Upper Kuzuu Fauna recovered from the vicinity indeed indicate contemporaneity of the animal and human bones.

From the Yamashita-cho Cave in Naha City, Okinawa, immature specimens of femur, tibia, and fibula were obtained in 1969 (Takamiya, Kin, and Suzuki 1975). Investigators suggest that the skeletal remains belong to a charcoal horizon radiocarbon-dated to 32,000 $\pm$ 100 B.P. (Tk-78).

Archaeological Assemblages

The Gongenyama I assemblage, consisting of three bifaces, scrapers, and flakes (Maringer 1956), was reported to have occurred below the Hassaki Pumice (Arai 1962). Also assignable to the Musashino Stage are the bifacially prepared tools and flakes known as the Fukui Horizon 15 assemblage (Fig. 7), which has been dated as being older than 31,900 C-14 years (Serizawa 1967). There is no question whatsoever about human workmanship on these specimens.

After the first excavation at Hoshino, Akutsu (1966) suggested that the pumice between Cultural Horizon 2 and Cultural Horizon 3 is the Kanuma Pumice (Fig. 4). According to this interpretation, all the assemblages below would have belonged to the Musashino Stage or older. Arai (1971) convincingly argued that this pumice was a secondary deposit of the Kanuma Pumice, whose primary horizon is Akutsu's

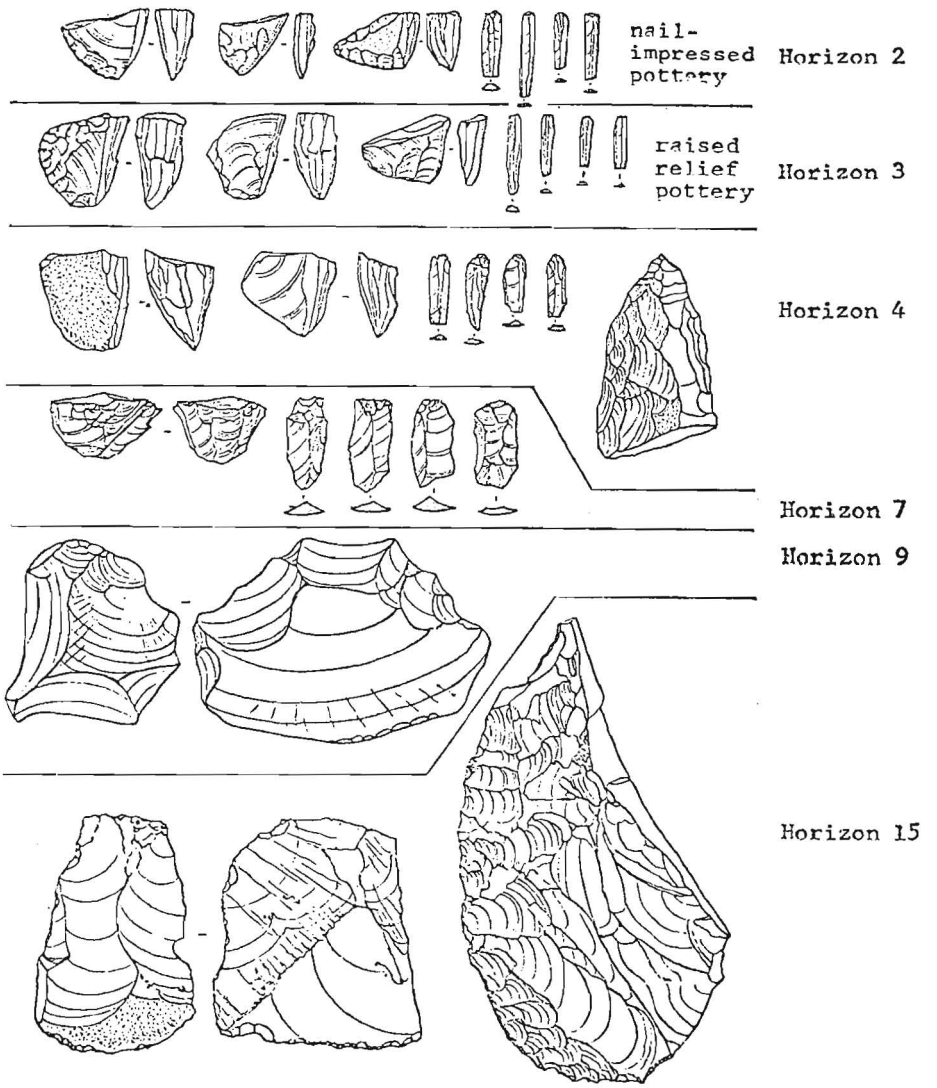

Fig. 7 Stratigraphic sequence and representative artifacts of Fukui Cave, Northern Kyushu (after Kamaki and Serizawa 1967).

"Moka Pumice." I accept Arai's interpretation, and assign Cultural Horizons 5, 6, and 7 (Fig. 5) to the Musashino Stage.

The materials of Cultural Horizons 6 and 7 (Fig. 8) of the Mukoyama site (Serizawa 1971), and some of the Iwajuku 0 (Zero) assemblages (Fig. 6) should also be assignable to the Musashino Stage.

Tachikawa Stage

Horizon Markers and Chronometric Determinations

The two major buried soil zones (variously called "black bands," "dark bands," "buried humus," or "stained zones") in the Tachikawa Loam have often been used

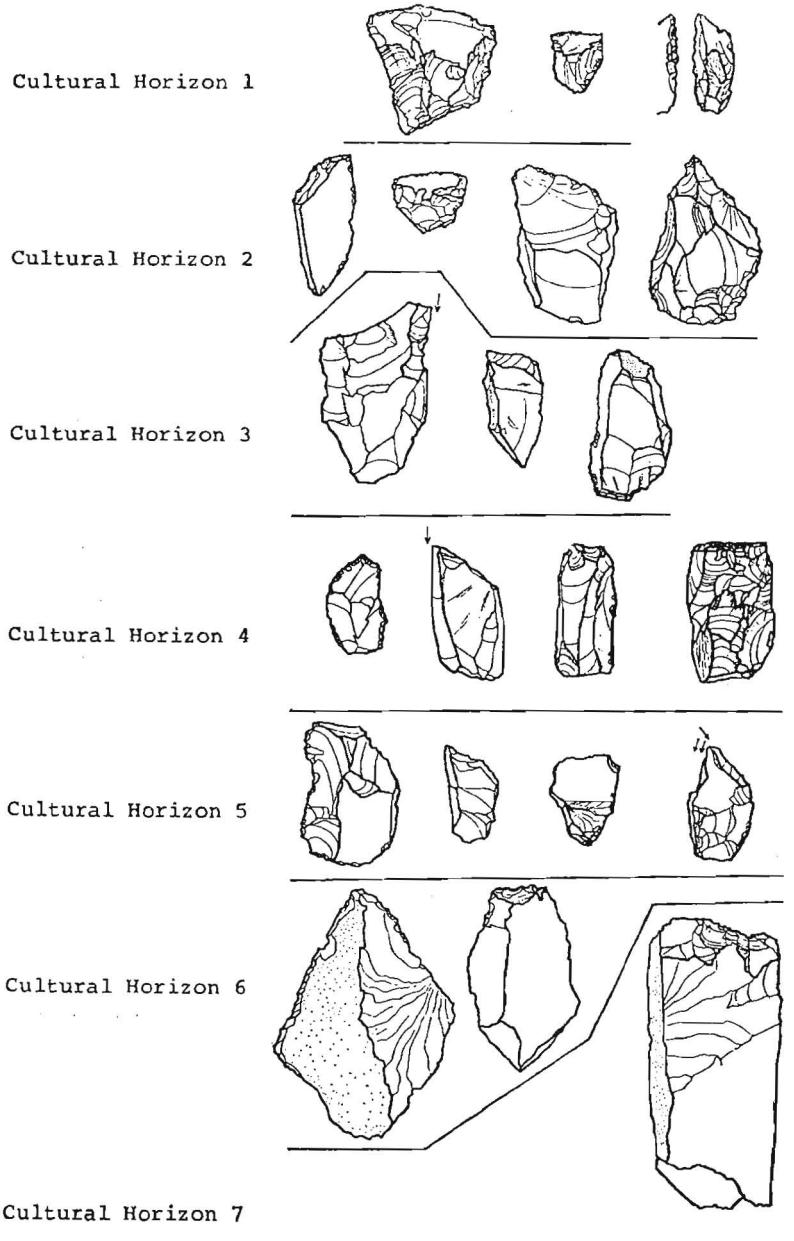

Fig. 8 Artifacts from the Mukoyama site, Tochigi Prefecture (after Serizawa 1974).

as horizon markers. The Kanto Loam Research Group (1965) proposed to divide the Tachikawa Loam into four parts, of which three were bounded by a buried soil zone. Machida et al. (1971), however, point out the difficulty of correlating buried soil zones in different parts of the Kanto Plain. While there exists only one buried soil zone in Chiba Prefecture, far away from the Fuji-Hakone volcanic

sources, as many as four or even more layers of dark zones are discernible in the Sagamino area near the volcanoes.

It now appears that the Tanzawa Pumice (TnP in Fig. 4), which manifests itself as an unusual concentration of glassy tephra at about the middle position in the Tachikawa Loam, may serve as a useful horizon marker in correlating buried soil zones (Machida et al. 1971). The buried soil below the Tanzawa Pumice has been named TB-II, which may occur in two layers, TB-IIa and TB-IIb, as at the Tsukimino site in Sagamino and at the Nogawa site in Musashino. The buried soil above the Tanzawa Pumice is referred to as TB-I. At the Tsukimino site, two more buried soil layers were present, which are now known as TB-0 and TB-0I.

It is a difficult task, at this time, to reconcile a number of radiocarbon, fission-track, and obsidian-hydration age determinations pertaining to these zones of buried soil. Almost all the radiocarbon determinations were made on humus, either as a whole or in its various fractions, and the effect of the slightest contamination on the extremely small amount of organic matter in the soil samples appears to manifest itself in large discrepancies among the dates.

Radiocarbon determinations for the lower buried soil (TB-II) are as follows (Machida et al. 1971):

Upper Part

GaK-3577	27,300 + 2,300 (nonhydrolyzable humic acid) − 1,800	Sagamino
GaK-3579	18,600 ± 600 (humin)	Sagamino
GaK-3596	21,400 + 1,200 (fulvic acid) − 1,400	Sagamino

Middle Part

GaK-1130	19,500 ± 600 (humin)	Seijo, Musashino
	24,900 ± 900 (humic acid)	Seijo, Musashino
GaK-3590	23,000 ± 700 (nonhydrolyzable humic acid)	Seijo, Musashino
GaK-3591	24,000 + 1,000 (humic acid) − 900	Seijo, Musashino

Lower Part

GaK-3573	21,500 + 2,100 (fulvic acid) − 1,700	Sagamino
GaK-3574	25,700 + 3,100 (humic acid) − 2,400	Sagamino
GaK-3575	19,800 ± 600 (humin)	Sagamino

In addition, Masao Suzuki (1974: 401) reports an obsidian-hydration/fission-track date of 25,200 ± 800 years, obtained on 9 samples from the Heidaizaka IX horizon, and that of 21,100 ± 1,020, based on 5 samples from the Tsukimino site. Both of these are considered to refer to the TB-II zone.

Radiocarbon determinations for the next buried soil zone (TB-I) include the following:

GaK-1129	17,000 ± 400 (humic acid) 15,350 ± 350 (humin) 19,800 ± 500 (total humus)	Seijo, Musashino
GaK-3588	15,800 ± 400 (nonhydrolyzable humic acid)	Seijo, Musashino
GaK-3580	20,500 ± 800 (total humus)	Sagamino
GaK-3581	18,500 + 700 (total humus) − 600	Sagamino
GaK-3586	21,700 + 1,800 (humic acid) − 1,400	Sagamino
GaK-3587	20,700 ± 900 (nonhydrolyzable humin)	Sagamino

Masao Suzuki (1974: 401) reports the following obsidian hydration fission-track dates pertaining to the TB-I zone:

Tsukimino site, Kanagawa Prefecture	20,700 ± 250	(23 samples)
	18,500 ± 350	(23 samples)
Sengawa site, Tokyo	19,400	(1 sample)
Nogawa site, Tokyo	18,500 ± 1450	(9 samples)
Bikunibashi site, Tokyo	18,400	(4 samples)
Sakashita site, Tokyo	18,300 ± 600	(3 samples)

The single radiocarbon determination of 20,500 ± 800 (GaK-2363) on charcoal contained in the TB-0 zone at the Tsukimino site may turn out to be "too old" in view of the range of determinations for the TB-1 zone listed above.

The TB-01 zone of the same site was dated as 13,500 + 400, − 300 (GaK-3582) by the radiocarbon method (on total humus) and as 15,000 ± 450 years by the OB-FT method on 9 samples (Masao Suzuki 1974: 402).

Because of large margins of error, we could not assign precise dates for the periods when conditions favorable to humus accumulation prevailed. These conditions include warm climate and certain types of vegetation, as well as quiescence, if not cessation, of volcanic activity when a small quantity of fine-grained tephra was supplied (Machida et al. 1971). Nevertheless, it is possible that the two major buried soil zones of the Tachikawa Loam, TB-II and TB-I, were formed before and after the maximum glacial expansion and maximum sea level depression. In Niigata Plain on the Japan Sea coast of Honshu, radiocarbon determinations of 20,900 ± 600 years B.P. (GaK-431) and 20,300 ± 600 years B.P. (GaK-433) on peat at − 140 m are suggested to represent the date of the maximum marine depression (Minato et al. 1967).

A dark zone can be observed in loam formations of northern Kanto as well, but it is difficult at present to correlate this zone with the buried soil zones of southern Kanto. It is probable that the dark zone of northern Kanto in fact corresponds to both TB-I and TB-II of south Kanto (T. Kobayashi et al. 1971: 244). Extrapolating

from a determination on wood contained in the Maebashi Mudflow, Arai (1967) suggested that the dark zone of north Kanto, in which such archaeological assemblages as Iwajuku I, Takei I, Isoyama, and Hoshino (Cultural Horizon 4) were contained, was somewhat older than 24,000 C-14 years. More recent determinations from the Iwajuku site indicate a younger age: 17,680 ± 580 (GaK-4586); 15,660 ± 540 (GaK-4587). Since both determinations are on humus, we encounter once again the problem of contamination. It is likely, at any rate, that the northern Kanto dark zone covers a considerable length of time, and it could be referred to as a horizon marker only in a very broad sense.

Fauna

The "Hanaizumi Fauna," dated at the type locality in northern Honshu and elsewhere to about 20,000 C-14 years, include the following species (Kamei 1962):

Asiatic wild ass or hemione *(Equus hemionus)*
Mongolian wild horse *(Equus caballus ferus)*
Bison (*Bison priscus* Bojan or *Leptobison hamazumisensis* Matsumoto)
Wild cattle *(Bos primigenius)*
Giant deer *(Sinomegacros ordosianus)*
Elephas (Paleoloxodon) namadicus naumanni

In addition, S. Kato (1975) refers to the occurrence at Hanaizumi of moose *(Alces kinryuensis)*, and feels that the moose and the bison are elements of the "Mammoth Fauna," which may have migrated from Siberia through Hokkaido as far as northern Honshu. The mammoth itself, however, is known only from Hokkaido.

Human Skeletal Remains

Cranial and postcranial materials obtained from limestone fissure caves at Mikkaibi (H. Suzuki 1962) and Hamakita (H. Suzuki 1966) near Lake Hamana in central Honshu and from a stalactite cave at Hijiridake in northern Kyushu (Ogata 1967) probably belong to the Tachikawa Stage. All the specimens were considered by the investigators to be *Homo sapiens sapiens*.

Because a few small obsidian artifacts occurred in Hijiridaka Cave, Ogata (1967), who compared the cranium to Skull no. 101 from the Upper Cave of Chou-kou-tien, assigned the specimen to the final Pleistocene.

Although Takai (1962) suggested that the Mikkabi Man was contemporaneous with elements of the Upper Kuzuu Fauna collected from a nearby locality, I feel that the results of fluorine tests (Tanabe 1962, 1966) may be interpreted to indicate an age difference, with the human bones being younger than the Upper Kuzuu Fauna. The Hamakita specimens were contained in a deposit accumulated in a cave that was formed after 30,000 B.P. (Chinzei 1966).

A specimen that is better dated appears to be the "Minatogawa man" from Okinawa. Masao Suzuki (1973: 313) mentions a radiocarbon determination of 18,200 years B.P. for this specimen, but, as with the "Yamashita man" referred to under the Musashino Stage, the material has not yet been fully described in print.

Archaeological Assemblages

Detailed description of archaeological assemblages from the Tachikawa Stage is

beyond the scope of this paper, because they number more than 1000. While most of these assemblages postdate the maximum glacial expansion of some 20,000 years ago, emergency archaeological investigations in recent years have brought forth some additional evidence that the archipelago indeed was inhabited by human groups prior to 20,000 B.P.

In the southern Kanto Plain, small archaeological assemblages were recovered from the "X" stratum below the TB-II zone at Heidaizaka (Oda and Keally 1974*a*), Kurihara (Oda and Keally 1973), Nishinodai (Oda and Keally 1974*b*), and Nakazanya (Oda et al., personal communication, 1974). A few flakes approaching the length/width ratio of "blades" are present in some of the assemblages, but most of the débitage is irregular, with flakes showing little modification apparently utilized as tools. Particularly noteworthy is the occurrence, at Kurihara, of an edge-ground axe (Oda and Keally 1973). A similar edge-ground axe is reported from Sanrizuka in Chiba Prefecture, where a radiocarbon date of 29,300 ± 980 B.P. apparently pertains to the horizon from which the axe was obtained (Michinosuke Suzuki 1975). Archaeological assemblages with irregular débitage and undifferentiated tool types appear to continue in the southern Kanto Plain up to the end of the buried soil zone I (TB-I of Fig. 3).

In the northern Kanto Plain, the Cultural Horizon 5 of the Mukoyama site (Fig. 8), between the Kanuma Pumice (KP) and the buried soil zone, may belong to the early part of the Tachikawa Stage, if not the last phase of the Musashino Stage. The assemblage consists of chert specimens, including some *kiridashi*-like forms (Serizawa 1971). The buried soil zone of northern Kanto, as stated above, probably represents both the TB-I and TB-II of southern Kanto. In this zone were contained such assemblages as Iwajuku I, Isoyama, Takie I, Mukoyama Horizon 4, and Hoshino Horizon 4. They consist of some blades and numerous flakes with minimal retouch. Edge-ground tools were present at Iwajuku I and Isoyama.

In northern Honshu, the Locality B assemblage of the Kamiyachi site, which includes unifacially retouched triangular points of shale, is considered by the investigators to date to the period of terrace formation, to which a radiocarbon determination of 29,600 ± 1,700 (GaK-2157) is applicable (Yoneji and M. Kato 1969). It now appears that Naora (1959) correctly assessed the significance of the unusual conditions of animal bones and antlers recovered from the fossiliferous formation of Hanaizumi. S. Kato (1975) and T. Kobayashi (1975) now accept that several of the *Bison* ribs are intentionally cut and polished into points. S. Kato (1975: 76–77) also notes the existence, in the Hanaizumi collection, of a blade and a disc-shaped core, but provenience of these stone specimens is uncertain. In this connection, it may be added that recovery of a point made of *Sinomegaceros* limb bone and a *Paleoloxodon* ivory with encircling groove has been reported from Lake Nojiri in north-central Honshu, another locality which appears to have been favorable for preservation of organic remains.

Apart from the "possible artifacts" associated with the *Paleoloxodon* at Churui, the earliest dated assemblage from Hokkaido comes from the Sankakuyama locality of the Shukubai site, where small inversely retouched obsidian flakes (Fig. 9) were recovered from a horizon dated 21,450 ± 750 B.P. (GaK-4346) by the radiocarbon method. Obsidian-hydration dates on five samples also pointed to 21,000 years B.P. (Yoshizaki 1974). The assemblage from Shimaki near Kamishihoro, dated by the

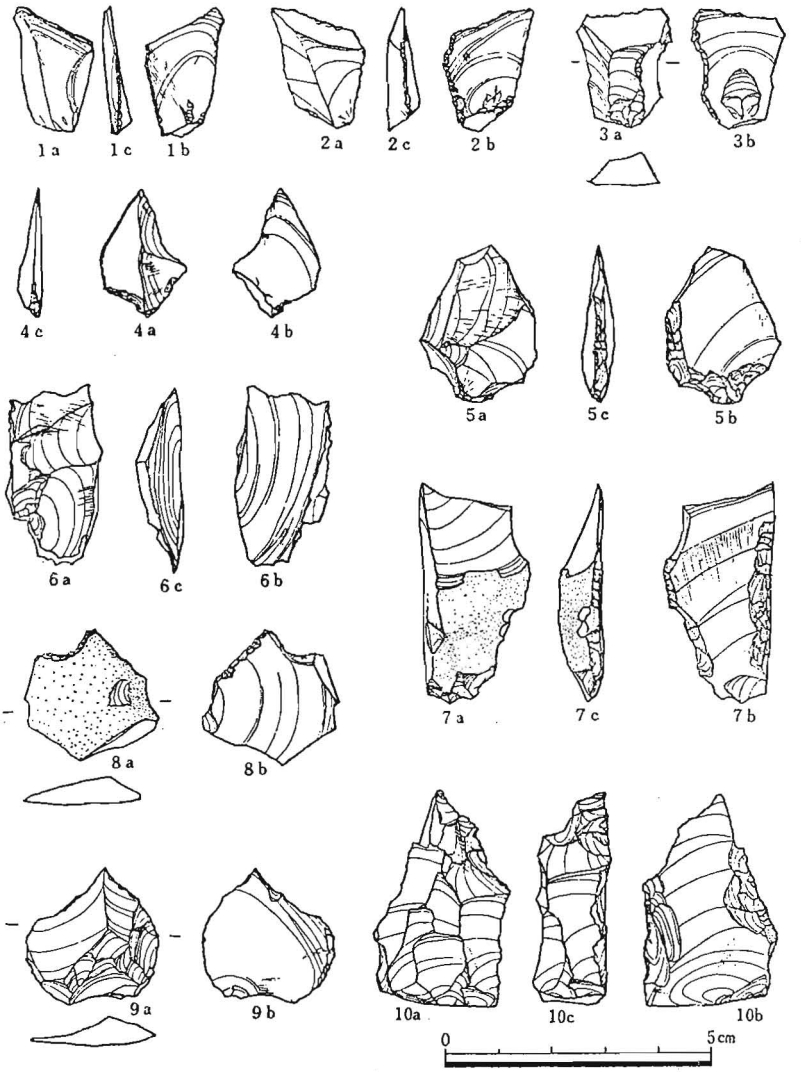

Fig. 9 Obsidian artifacts from Sankakuyama, Hokkaido. *1–7*, "knives"; *8–10*, "points" (Yoshizaki 1974).

obsidian-hydration method to some 19,000 years, also consists of flakes, although a single blade has been recovered from the surface (Tsuji 1973, S. Kato 1975).

While the numerous assemblages based on the classic blade technique have not been securely dated for the sites in Hokkaido, a radiocarbon determination of 18,500 ± 450 B.P. (GaK-3780) was obtained on charcoal from a fire pit at Odaino in northern Honshu (Kikuchi 1975). The assemblage includes steeply backed blades, known as the "Sugikubo knives," as well as burins on blades. Radiocarbon determinations from Lake Nojiri in central Honshu, where the Sugikubo site is located, suggest the 18,000–15,000 period as the temporal range of the Sugikubo assemblage. It is tempting to suggest a possible connection between

the appearance of the classic blade technique and the arrival of the Hanaizumi Fauna about 20,000 years ago, when the lowered sea level would have connected the Japanese archipelago with the mainland of Asia. It should be noted, however, that Serizawa (1970*a*) argued for the indigenous development of the classic blade technique in Japan, and Yokoyama (1970) attempted to demonstrate the evolutionary technological trend from Sozudai through Hoshino to later assemblages based on classic blade débitage.

In any event, the indications of sudden increase in human population and rapid cultural change beginning about this time are undeniable. The overwhelming majority of archaeological assemblages from the Kanto Plain date to the period after the formation of the TB-I zone. Tool types become more standardized with a variety of steeply retouched blades, including the form known as the "Moro knives" and the *kiridashi*-shaped tools, although something approaching the *kiridashi*-knives did occur in the Mukoyama Horizon 5. Some of the blades are finished into small geometric forms. Stratigraphic and typological studies of various "knives" have been presented by Oda (1969) and Sato (1970).

Bifacial foliates appear to have been added to the tool inventory in central Honshu about 13,000 B.P. Aizawa (1957, 1967) reported that leaf-shaped points occurred between the Itahana Brown Pumice (BP) and Itahana Yellow Pumice (YP) at Motojuku in northern Kanto, and above the Itahana Yellow Pumice at Akabori-Ishiyama. The radiocarbon ages for these pumice horizons (cf. Fig. 4) are consistent with a number of fission-track/obsidian-hydration age determinations by Masao Suzuki (1974) for assemblages from southern Kanto and Nagano Prefecture. Obsidian-hydration dates further suggest that micro-blades detached from conical cores were added to the tool-kit in central Honshu at about 12,000 B.P. although a radiocarbon determination of 14,300 ± 700 B.P. (GaK-604) has been obtained for the Yasumiba assemblage from the Pacific side of central Honshu (Sugihara and S. Ono 1965).

Perhaps the aspect of Japanese Paleolithic best known to the English-speaking world concerns the various techniques of detaching micro-blades from boat-shaped cores, thanks to the analyses by Hayashi (1968), T. Kobayashi (1970), and Morlan (1967*b*). According to obsidian-hydration dates (Katsui and Kondo 1965), Morlan's "Horoka technique" appears to begin in Hokkaido as early as 17,000 B.P., while the temporal range of Yoshizaki's Yubetsu technique (1961) is between about 14,000 and 12,000 B.P. S. Kato (*in litt.* dated Tokyo, 20 October 1975) states, however, that fission-track determinations suggest that all the assemblages from the Shirataki area are younger than 13,000 B.P. At Kakuniyama in northern Honshu, the stratigraphic position of micro-blades with cores of the Yubetsu type is older than a pumice fall dated as 10,740 ± 340 B.P. (GaK-1639) and 10,480 ± 220 B.P. (GaK-1637) (Uno and Ueno 1975). Of the two radiocarbon determinations for the Araya assemblage, 13,200 ± 350 B.P. (GaK-948) is clearly more acceptable than 7,390 ± 120 (GaK-685). At Fukui Cave in northern Honshu, micro-blades are associated with pottery in horizons dated to 12,700 ± 500 B.P. (GaK-950) and 12,400 ± 350 B.P. (GaK-949).

Conclusion

Some years ago, I stated that geographical marginality of the Japanese archipelago,

with respect to the Eurasian continent, should not be overemphasized, and that our knowledge of Paleolithic Japan may contribute significantly to our understanding of major culture-historical events in northeastern Eurasia, and by extension, to the prehistory of the New World (Ikawa 1970).

It is of interest, therefore, to find Saburo Nishimura, a marine biologist, arguing that the Japanese archipelago was connected with the mainland of Asia all through the Pleistocene, until toward the very end. He maintains (1974: 199) that, because warmwater fauna of Indo-Western Pacific origin have not been sufficiently differentiated in the Japan Sea, there probably was no open water between Korea and Japan until postglacial times. He also states that even during interglacial times, the

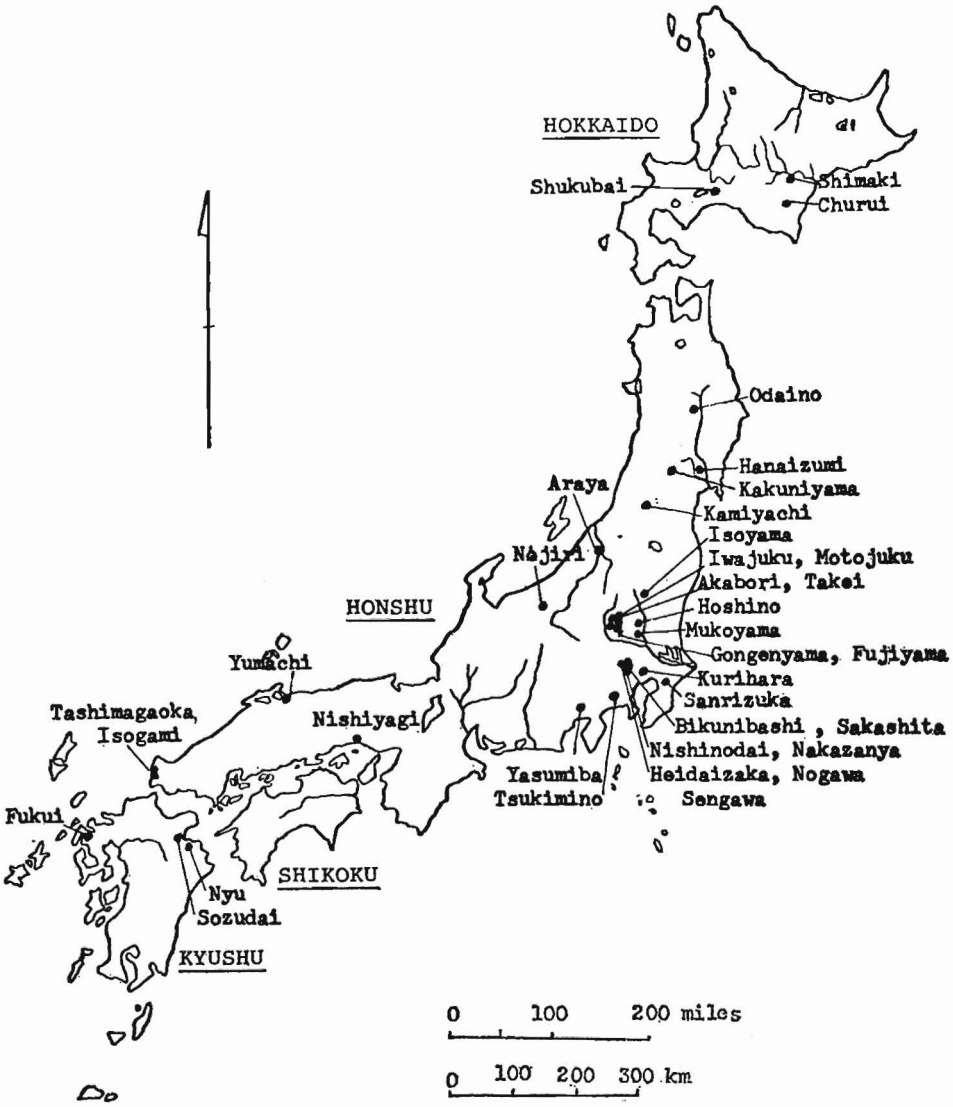

Fig. 10 Archaeological sites mentioned in the text.

Japan Sea was a bay open to the Pacific Ocean only in the north, between Hokkaido and Honshu, or rather in the area of the present Ishikari Plain of southwestern Hokkaido (1974: 192–199).

I am not qualified to judge the nature of evidence presented by Saburo Nishimura. However, his data, together with the evidence that a series of terrestrial faunal groups arrived in Japan from the mainland, are enough to discount the argument that the Japanese archipelago was not inhabited by human groups until the last glacial maximum of some 20,000 years ago because it was impossible for them to reach by land until then. In the foregoing pages, I have presented relevant data for the Basal, Lower, and Middle Pleistocene, and three stages (Shimosueyoshi, Musashino, and Tachikawa Stages) of the Japanese Upper Pleistocene. It now seems incumbent upon archaeologists to review the archaeological materials on their own terms, with respect to the stratigraphic evidence and the evidence for human workmanship.

No solid evidence of human occupation exists for the Basal, Lower, and Middle Pleistocene. Of course it is true that detailed tephrochronological information and chronometric determinations which help us assess the stratigraphic positions of archaeological materials are lacking for these early formations. Small groups of migrants may have arrived during the Shimosueyoshi Stage (130,000–60,000 B.P.) of the Upper Pleistocene, although the nature of artifactual evidence for such assemblages as Sozudai, Hoshino Cultural Horizons 8, 9, 10, and 11, the Iwajuku Zero, and Akabori Iso remains controversial.

Through the Musashino Stage (60,000–30,000 B.P.) and the earlier part of the Tachikawa Stage, until about 20,000 B.P., the size of human population in the Japanese archipelago appears to have remained very small. However, the nature of the archaeological evidence is now more acceptable. It includes the Gongenyama I assemblage, which is probably older than 40,000 B.P., the Fukui Horizon 15 assemblage (older than 31,900 B.P.), and a few edge-ground axes from southern Kanto, which are between 25,000 B.P. and 30,000 B.P.

Sudden increase in population, diversity in technological traditions, and rapid cultural change begin about 20,000 B.P. Technological innovations include the production of blades by the classic blade technique, several methods of micro-blade detachment, execution of flat retouch to produce bifacial foliates, application of abrupt retouch to manufacture a variety of retouched blades and points, and production of ceramic vessels. Much work has been done by Japanese colleagues to arrange the materials within a typological-chronological framework. However, the task of understanding the nature of diversity with reference to technological traditions, ecological adaptations, and stylistic differentiations remains for the future.

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