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New dates for the north China Mesolithic

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The Mesolithic — as the 'time in between' — raises issues of definition, the more so as chronology is refined and the abruptness of environmental change at the end of the glaciation becomes clearer. This clarification of an unusual regional sequence is an instance.

The profound world-wide environmental and human adaptive change at the Pleistocene/Holocene boundary (Allen & O'Connell 1995; Flannery 1969; De Tapia 1992) has not been much studied in northern China (Crawford 1992: 13). Our research in Ningxia focuses on the human and environmental changes contributing to more intensive subsistence strategies and the eventual development of agriculture in China from an indigenous hunting and gathering base (Bettinger *et al.* 1994; Madsen *et al.* 1996; Wang & Yu 1996).

Before about 18,000 years ago, hunters and gatherers in northern China occupied a variety of habitats; fairly mobile, they pursued an array of large (especially *Gazella* and *Equus*) to small game, fish and shellfish; they employed blade and flake lithic technologies, and had no permanent shelters or storage facilities (Jia & Huang 1985: 220–21; Olsen 1990). Somewhat later, microlithic technology was added to the tool kit (Chen & Wang 1989), then ground stone, increased sedentism and, finally, agriculture. These shifts are apparent in the contrast be-

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Received 29 April 1997, accepted 3 August 1997, revised 1 September 1997.

ANTIQUITY 71 (1997): 985–93

FIGURE 1. *Location of Pigeon Mountain basin and archaeological localities mentioned in text.*

tween Late Palaeolithic and Early Neolithic sites around the margins of the Helan Mountains of Ningxia and Inner Mongolia (Madsen *et al.* 1996). Late Palaeolithic sites are less frequent, assemblages are small and relatively uniform. Early Neolithic sites are more abundant; larger, more diverse Early Neolithic assemblages suggest long-term residential bases, while smaller assemblages without microliths indicate short-term camps and specialized resource processing locations. Similar contrasts occur over a large region (FIGURE 1) in arid northern China and Mongolia (Bettinger *et al.* 1994; Fairservis 1993; Maringer 1950).

Nevertheless, because relatively few radiocarbon dates from north China refer to the critical transitional period 20,000–10,000 b.p. (*cf.* Tang & Gai 1986), it is difficult to tell when various technologies (e.g. blades, microlithics, grinding stones, ceramics, ground stone celts, etc.) were added to or lost from tool kits. Dating the introduction of microlithic technology, a key element of the later Upper Palaeolithic (Chen 1984; Chen & Wang 1989; Gai 1985), remains controversial: Tang & Gai (1986) believe that microlithics are present in the Shiyu, Shanxi site (28,945±1375 b.p), but others (Miller-Antonio 1991; Yamanaka 1993) see no evidence of microliths in Shiyu , Salawusu, Inner Mongolia (35,340 b.p.), or late Palaeolithic strata of Locality 1, Shuidonggou, Ningxia (26,230±800–17,250±250 b.p.). Dates for the best known microlithic sites in north China (Xiachuan, 23,900±1000–13,900±300 b.p., Xueguan 13,550±100 b.p., Hutouliang 11,000±100 b.p.) are problematic as they rely on bone or poor stratigraphic control (An 1983; Chen & Wang 1989; Wu & Wang 1985). The introduction of milling stones

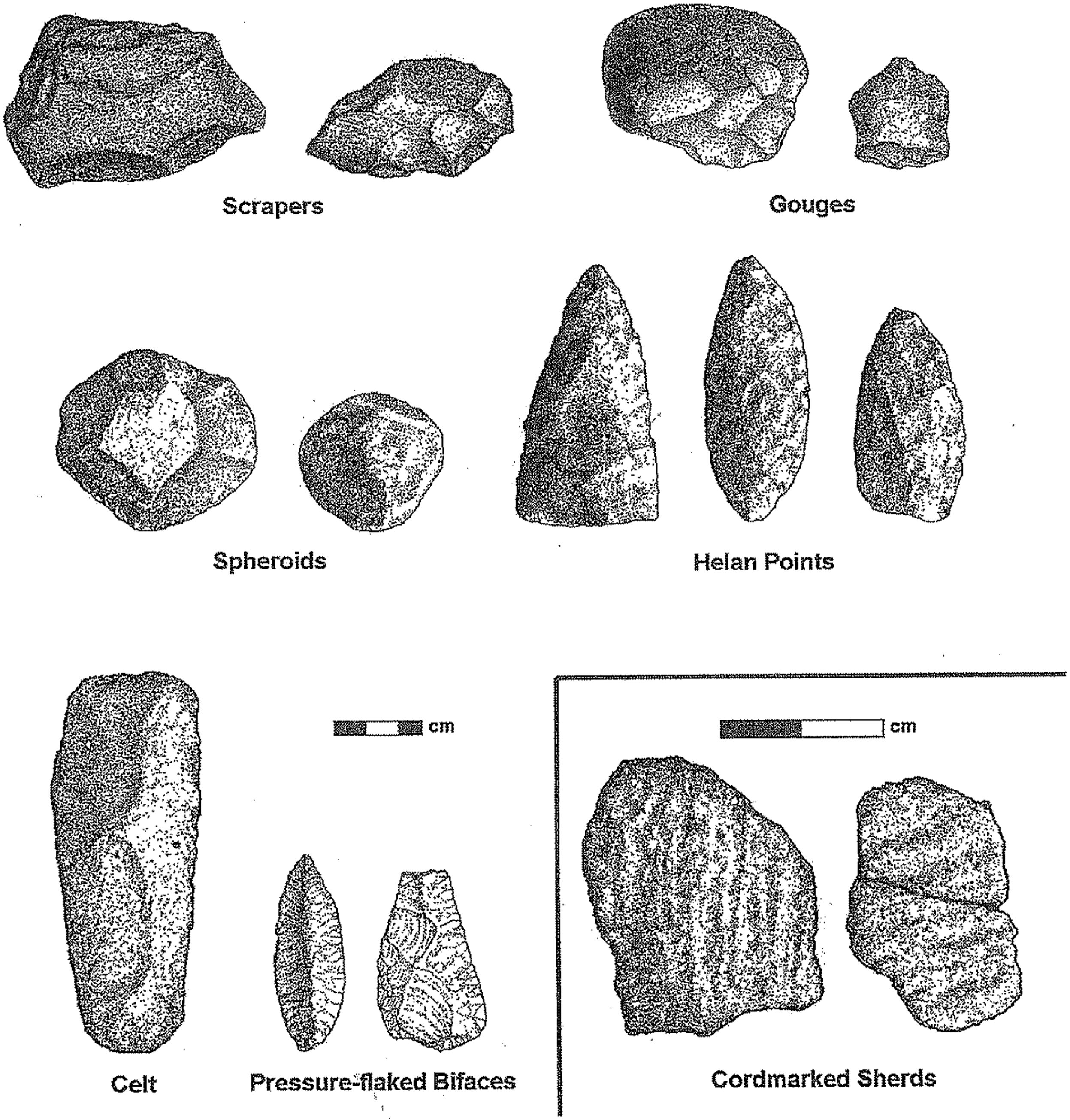

FIGURE 2. *Macrolithic tools; cordmarked ceramic sherds (inset).*

and stone axes, both reported from Xiachuan (Chen 1984; Jia & Huang 1985), are in similar temporal limbo.

Understanding the adaptive changes leading from Late Palaeolithic hunting and gathering to Neolithic agriculture depends on a firm chronology of technological change. To this end, we report a dated stratigraphic sequence from the Four Springs site (QG3) in Pigeon Mountain Basin, Ningxia. The Four Springs test excavations were part of research conducted in 1995 and 1996, including an archaeological reconnaissance of Pigeon Mountain Basin, and systematic surface collections and test excavations at several sites.

Pigeon Mountain basin

The Four Springs site is located in Pigeon Mountain basin (FIGURE 1), a shallow drainage basin heading in the foothills of the Helan Shan;

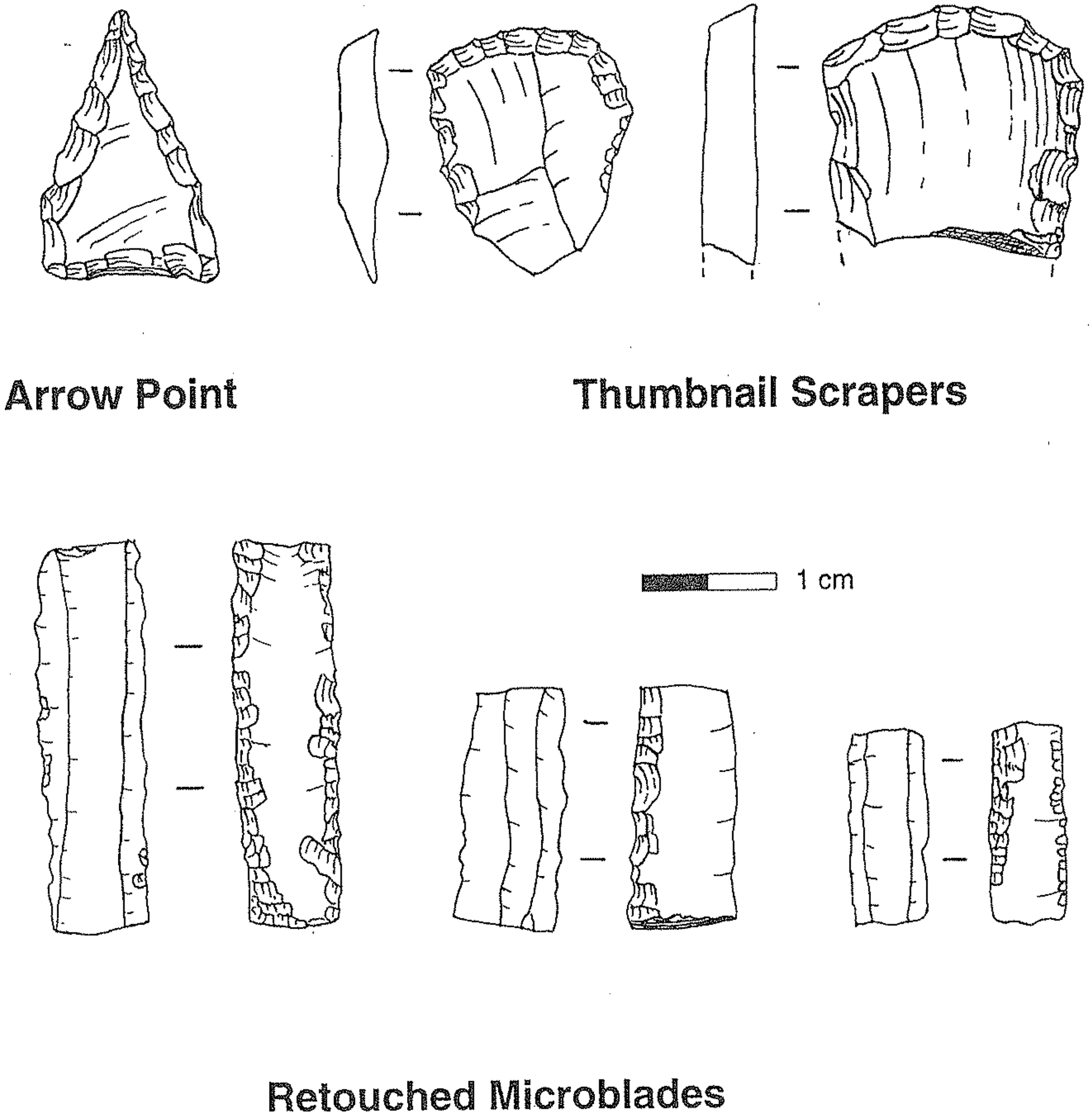

FIGURE 3. *Microlithic tools.*

elevation is about 1200 m asl and annual precipitation is less than 150 mm/year. The major streams, North River and South River, have seasonal flow. Surface sediments in the basin are course alluvial fan deposits; the sparsely vegetated surface is a heavily deflated gobi interrupted by isolated outcrops of bedrock, the largest of which is Pigeon Mountain, and stratified dune mounds surrounding springs. The largest mound is Four Springs, more than 100 m in diameter and 6 m high, while the smallest is less than 10 m diameter and 2 m high. Most of the mounds in the basin are associated with surface lithic scatters.

Lithic technology
Lithic assemblages in Pigeon Mountain Basin have two technological components. The *macrolithic* includes cores and tools made on metamorphic greenstone, quartzite, and fine-grained sandstone stream pebbles and cobbles; scrapers and gouges made on flakes and (less fre-

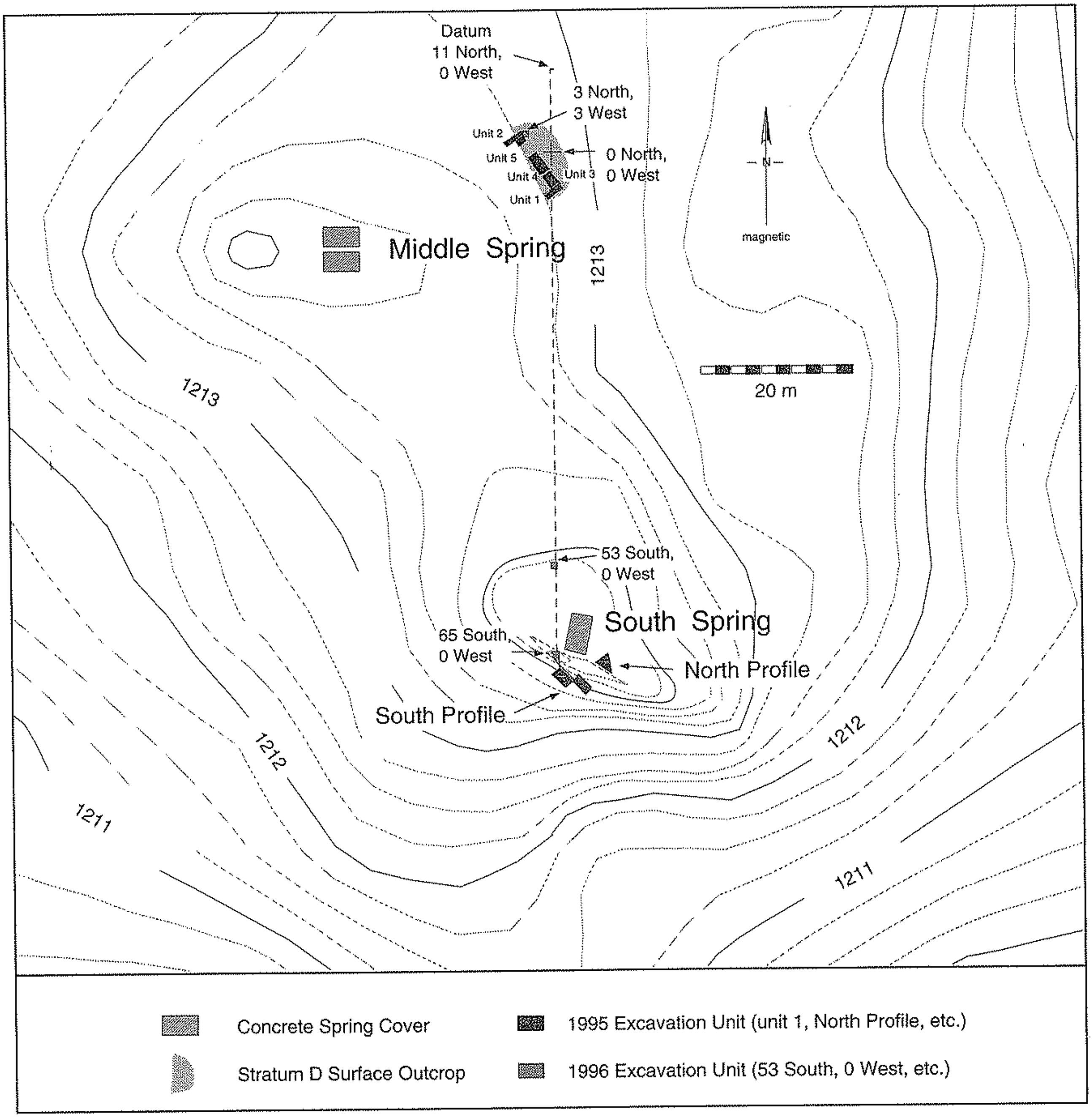

FIGURE 4. *Four Springs (QG3) site: areas tested in 1995 and 1996. Contour interval: 0·25 m.*

quently) blades derived from cobble reduction; battered chunks; unifaces and bifaces (Helan Points); and debitage (FIGURE 2). The *microlithic* component, mostly chert and chalcedony, includes microblades (some retouched) and microblade pebble cores; small (thumbnail) end scrapers; retouched flakes and occasional blades; occasional small triangular concave-base arrow points, bifaces; and debitage (FIGURE 3). Sometimes present are: partially ground celts made on flaked blanks or elongate, rounded stream cobbles; plain or cordmarked pottery (FIGURE 2, inset); and thin, lightweight, grinding stones, but only one grinding stone has been found in stratigraphic association with the flaked stone materials.

The reduction strategy for Pigeon Mountain microblade cores closely resembles the Xiachuan technique, while Helan Points resemble unifaces and bifaces from Hutouliang, Xiachuan, and Xueguan (Chen 1984; Chen & Wang 1989). Pigeon Mountain lithic assemblages are quite simi-

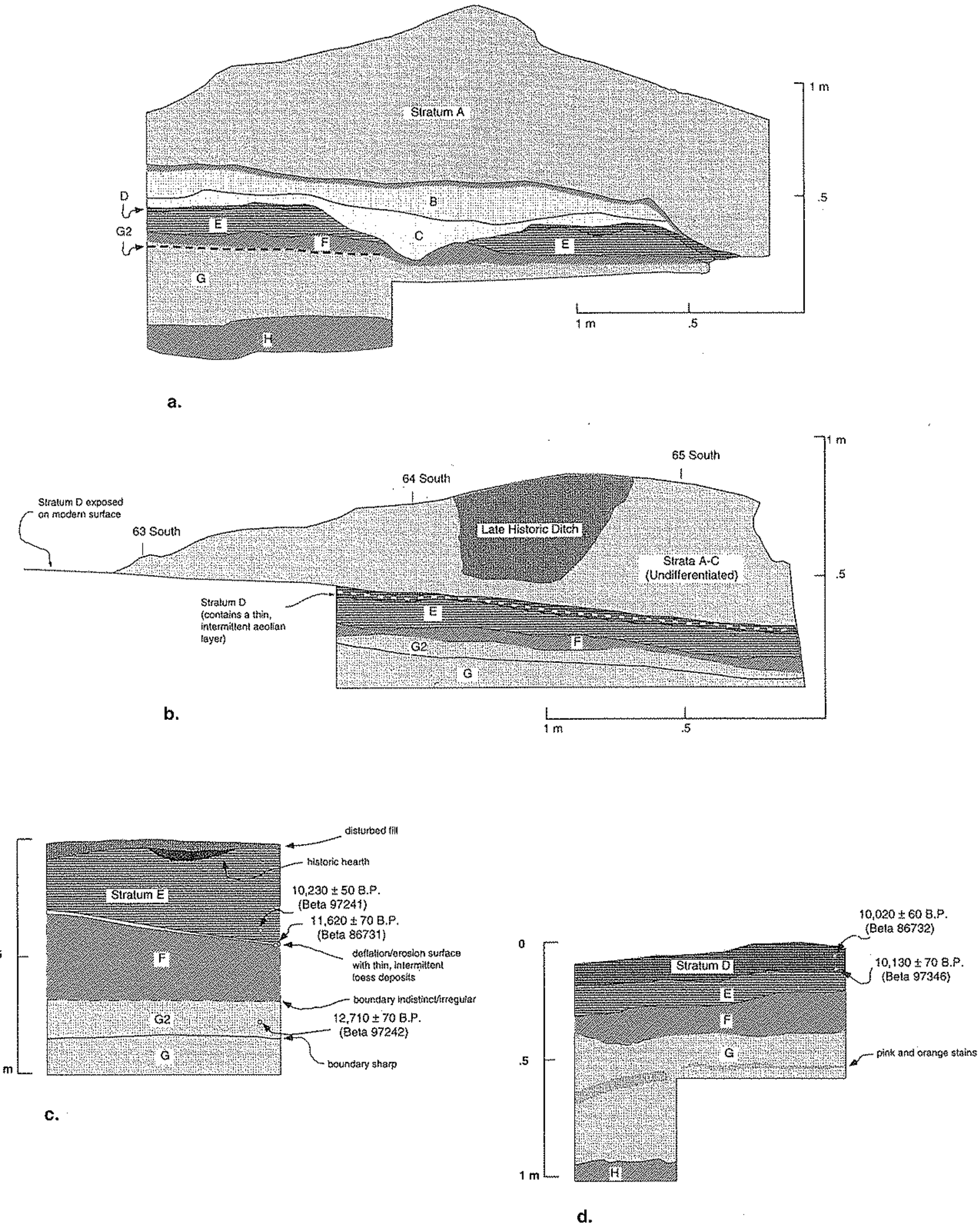

FIGURE 5. *Four Springs (QG3) stratigraphic profiles.* (a) *Southern and* (b) *southwestern profiles of South Spring;* (c) *west wall, Unit 53S/0W, and* (d) *east wall, Unit 3N3W.*

lar to assemblages in the northern Alashan of Inner Mongolia (Maringer 1950), and the Shabarakh Usa locality in Mongolia (Fairservis 1993). Pigeon Mountain macrolithics share some technological attributes with the Late Palaeolithic materials from Shuidonggou Locality 1 about 20 km across the Yellow River, but the Locality 1 assemblage contains more blades, fewer tool types, and no Helan Points (Yamanaka 1993; Wang & Yu 1996). There are microlithics and Helan Points at Shuidonggou Locality 2, which has yet to receive formal attention.

Test excavation at Four Springs

Four springs at QG3 give the site its name and support a large spring mound rising about 6 m above the surrounding desert adjacent the south bank of the South River. An aeolian lag of lithic debitage and tools surrounds the base of the mound; artefacts are less abundant on its surface. In 1995 and 1996, test excavations were placed adjacent the wind-cut north and south faces of the south spring, and in a dark artefact and bone-rich patch of soil exposed at the surface east of the middle spring (FIGURE 4).

The stratigraphic sequence at South Spring is shown in FIGURE 5a. Unconformable on the Plio-Pleistocene San Zhi Ma Hong Tu paleosol (Stratum H), aeolian Sand I (strata G, G2, and F) is massive, well-sorted and fine-grained. Probably deposited at the end of the last glaciation about 15,000 b.p., it is likely a local expression of the Malan loess (An *et al.* 1993). Stratum G2, a thin (2–13 cm) layer of poorly sorted, coarse, pebbly sand probably related to increased spring flow appears only in South Spring profiles (FIGURE 5b). Stratum F, the top 20–25 cm of Sand I, is the B horizon of a palaeosol; its upper surface is an erosional unconformity with no evidence of the A horizon. Two $^{13}C/^{12}C$ corrected radiocarbon assays on charcoal provide terminal dates for Sand I (FIGURE 5c). A sample from within G2 in 53S/0W (FIGURE 5c) dates to 12,710±70 b.p. (Beta-97242), while charcoal from the deflationary surface of Stratum F in the North Profile dates to 11,620±70 b.p. (13,814–13,341 BP; Beta-86731).

This deflation surface is overlain by a second aeolian sand (Sand II, strata E and D) on which an incipient palaeosol is developed. A large charcoal fragment collected from within well-bedded Stratum E in unit 53S/0W (FIGURE 5c), dates to 10,230±50 b.p. (Beta-97241). Stratum D, an organic A Horizon, is formed on the surface of Sand II. Two $^{13}C/^{12}C$ corrected radiocarbon assays from charcoal samples recovered from within Stratum D in unit 3N/3W (FIGURE 5d) are 10,130±70 b.p. (Beta-97346) and 10,020±60 b.p. (12,034–11,006 BP; Beta-86732). The aeolian deposition of Sand II is thus bracketed to a period of 1600 radiocarbon years between 11,600 and 10,000 b.p. Strata C, B and A are aeolian sediments of the late Holocene.

Artefact distribution

TABLE 1 summarizes the stratigraphic distribution of artefacts recovered from test excavations grouped by Middle Spring and South Spring areas, along with artefacts from the unsystematic general surface collections. Excavated volumes in the two excavation areas are roughly similar, and excavated lithic assemblages are comparable (441 items at Middle Spring, 319 at South Spring).

Stratigraphy, radiocarbon dates and artefact distribution suggest that the earliest occupation of Four Springs was adjacent South Spring during deposition of strata G and F; the occupational focus shifted to Middle Spring during deposition of strata E and D. This horizontal stratification reveals differences between Middle Spring and South Spring assemblages in relative amounts of macrolithic and microlithic artefacts that may address technological change in the transitional period (TABLE 2). Macrolithic debitage is more abundant than microlithic debitage (TABLE 2a) in Sand I, and relatively less abundant in Sand II (df 1, Chi Square =126·87; p = 0·0001). A similar contrast between site areas (TABLE 2b) is also significant (df 1, Chi Square =183·98; p = 0·0001). Although the sample of excavated macrolithic tools is small, all five are from South Spring, including two from Stratum G. An arrow point, and two anvils (pitted stones probably used as rests for microblade cores) are unique to Middle Spring. The generally older deposits at South Spring produced only one retouched microblade and the only excavated macro-tools (5 scrapers). These data may indicate an increasing displacement of macrolithic technology by microlithic technology after 11,600 b.p.

Faunal remains

Faunal remains from strata D and E in Middle Spring are mostly macerated large mammal long bones, ribs and teeth (likely small horse or donkey), with some small mammal and bird bones. The few South Spring specimens include fragments of sheep or goat-sized long bone, as well as fragments of tooth enamel, unidentifiable to taxon. We cannot say if the paucity of bones from South Spring is due to differential preservation or difference in diet.

	general	Middle Spring strata*				South Spring strata**								site
	surface	**S**	**D**	**E**	**F**	**S**	**C**	**D**	**E**	**E/F**	**F**	**F/G**	**G**	**total**
microtechnology														
end scraper	5	1	4						2	1	1			14
flake tool	14		1	2						1	2		1	21
retouched microblade	3		8							1				12
arrow point			1											1
biface	5													5
anvil			2											2
microblade core	19	3	6	1		3		2		2	4			40
microblade	4	44	126	7	1	2		17		2	7		2	212
debitage	50	19	105	20	4		1		5	3	13	7	4	231
macrotechnology														
helan point	16													16
gouge	3													3
scraper	6									2	1		2	11
flake tool	26													26
blade tool	2													2
spheroid	6													6
debitage	58	58	89	47	17		3			91	101	13	26	503
ground stone														
celt	14													14
grinding stone	3										1			4
hand stone	2													2
ceramic														
historic	2													2
plain	2													2
cord-marked	2													2
fauna														
cut & polished bone			1											1
bones and teeth		103	448	331	21				2	3	13			921

* Units 1, 2, 3, 4, 5, and 3N/0W
** South Profile, North Profile, 53S/0W, 63S/0W, 65S/0W, and 67S/1E
Tests produced relatively few tools, but diagnostic macro- and microdebitage is common.

TABLE 1. *Four Springs (QG3) surface and excavated artefacts by stratum.*

	Sand I	Sand II
Microlithic debitage	27	280
Macrolithic debitage	144	136

TABLE 2a. *Distribution of microlithic and macrolithic debitage by major stratigraphic unit.*

	South Spring	Middle Spring
Microlithic debitage	60	263
Macrolithic debitage	32	153

TABLE 2b. *Distribution of microlithic and macrolithic debitage by site area.*

Conclusions

The Pigeon Mountain basin stratigraphic sequence corresponds to other loess/palaeosol, lake stand and vegetational sequences in the region (Madsen *et al.* n.d.) which together suggest the Younger Dryas in central and western China was a period of colder and drier climatic conditions, with a reduced summer monsoon influence very much like other cold periods in the Late Quaternary palaeoclimatic sequence of China. Our research indicates technological elaboration and innovation associated with this cold, dry interval, and provides the first firm dates and chronological framework for these changes. At 12,700 b.p., microblades struck from boat-shaped and wedge-shaped pebble cores were used with an array of large tools and points; seed grinding tools apparently were present by 11,600 b.p.; retouched microblades, heretofore thought to date to the Late Neolithic (Gai 1985: 234), and arrow points, were in use by 10,200 b.p.

Although our research sketches the broad outlines of environmental and cultural changes in north China at the Pleistocene/Holocene transition, we lack data to see the details of technological change. We have recovered numerous animal bone fragments and teeth, but these must be analysed to inform about prehistoric diet, and we need information about the role of plants. At the same time, we must continue our stratigraphic analyses and refine the chronology for the transitional period. In pursuit of long-term regional research goals, we will continue to look for sites in Ningxia that chronologically bracket Four Springs.

Acknowledgements. This work is supported by National Science Foundation (SBR-9410923), National Geographic Society, Ningxia Cultural Relics Bureau, Ningxia Institute of Archaeology, Ningxia Provincial Museum, Intermountain Research, Utah Geological Survey, University of California (Davis) and Laser Technology, Inc.

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