Problematical Pleistocene Artifact Assemblage from Northwestern Spain

Abstract. *Interdisciplinary study of a Paleolithic site at Budiño, Louro Valley (province of Pontevedra), Spain, shows the presence of various tool-making techniques and types of tools in a single undisturbed site complex found* in situ *within Middle Würm colluvial deposits.*

A large number of surface collections of lithic artifacts have been made from the lower Miño Valley, along the Portugese-Spanish border, since 1920. On the basis of typology and patina of individual tools, several stages of Acheulian were claimed to exist here, together with industries of Middle Paleolithic (Camposanquian) and Epi-Paleolithic (Asturian) affinities (*1*). During the summer of 1963, a geologically stratified site, the first of its kind in Galicia, was excavated by Aguirre at Budiño (*2*), in the Louro Valley, a northern tributary of the Miño. The artifactual materials came from the lower of two colluvial mantles that overlie an alluvial terrace about 10 m above the Louro floodplain, near the 20.0-km post of the highway Vigo-Túy. Sixteen trenches with a total area of 191 m^2 were excavated and yielded 651 artifacts and 56 larger stones with possible or certain evidence of human workmanship.

The quartz and quartzite artifacts commonly occur in undisturbed, concentrated flaking sites, and in at least one cut there were two vertically distinct levels. At one locality, some 100 artifacts—many in mint condition—were found on a surface of less than 1.5 m^2, lying amid some 80 quartz pebbles and associated with a quartz boulder obviously used as an anvil. The acidic soil environment has preserved no trace of bone. In another area there are concentrations of charcoal, carbonized vegetable matter, and a little ash, which suggest a number of hearths. A remarkable variety of tool-making techniques and types of tools were found in undisturbed associations, with both archaic and apparently more evolved forms represented. The inventory includes choppers and chopping-tools, trihedral picks, so-called Camposanquian picks, Clactonian flakes and notches, proto-bifaces, evolved bifaces, denticulates, and several other flake tools (*3*). Yet there is no question that these are occupation sites of a single cultural complex, probably recording repeated temporary occupation of a moderately restricted area by prehistoric groups.

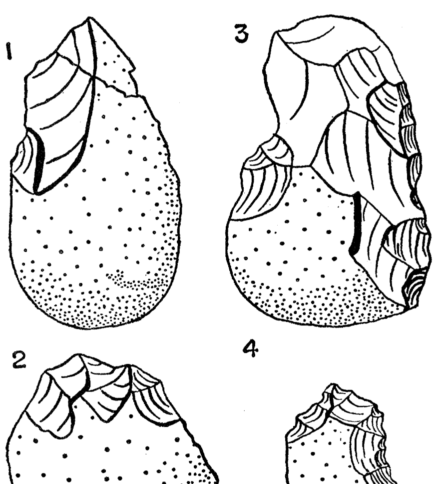

Fig. 1. Quartzite artifacts from Budiño. (1) Chopping tool (one-fourth size), (2) chopping tool (half size), (3) proto-biface (one-fourth size), and (4) denticulate (half size). [Drawn from photographs through the courtesy of Leslie G. Freeman]

One radiocarbon determination from the basal part of the lower colluvium (charcoal) yielded an age of 26,700 (+ 3600, − 2500) years before the present (Isotopes, Inc. code number 2174); another a little higher up in the stratigraphic sequence (fine charcoal and carbonized vegetable matter) gave 18,000 ± 300 B.P. (I-2175) (*4*). Both samples were intensively pretreated, but it is unlikely that a hiatus of 8 millennia marks the occupational record. However, three further C^{14} determinations from late Pleistocene colluvia on the nearby Atlantic coast indicate that the lower colluvium at Budiño postdates a warmer interval ("Paudorf" or Farmdale), being deposited during the early part of a cold interval with accelerated geomorphic activity (Main or Middle Würm-Wisconsin). All of the late Pleistocene colluvia of the Louro and Miño valleys rest disconformably on the "Low Terrace," while on the adjacent coast they sweep over marine abrasional platforms at + 10 to 12 m, + 6 to 7 m, and + 2.5 m. Three depositional units can be recognized from criteria based on stratigraphic and radiocarbon studies: the Mougás beds (Early Würm, older than 40,000 years), the Sanjián beds (Middle Würm, about 28,000 to 16,000 B.P.), and the LaGuardia beds (Late Würm). Each typically ranges upward from a colluvium of detrital organic matter, probably derived from the matted A-horizons of subalpine paleosols, to colluvial sheets and alluvial fans or cones. As congelifraction and periglacial bedding are not apparent, these coarse mineral deposits are attributed to accelerated runoff, sheetwash, and creep.

The Budiño site is contemporary with the Sanjián beds. This is much younger than would normally be postulated on morphological grounds for the archeological materials that have been called Camposanquian (or Languedocian). Similarly the age that has been determined is much older than should be expected from an Asturian assemblage, if the "Asturian" were indeed immediately pre-Neolithic. This suggests the possibility that the terms Camposanquian and Asturian refer to a temporally and formally heterogeneous agglomeration of artifact collections, rather than to single, definable industrial complexes (*5*). It would seem advisable at this point to restrict the use of the term "Camposancos" to designate certain tool types.

Budiño represents an assemblage that is chronologically defined and stratigraphically correlated, characterized by a complex technology and typology. Generally speaking, the types of tools look archaic, but there are more refined forms present within each category. The appearance of the industry can be attributed in part to the nature of the raw materials employed (quartz and quartzite), but certainly the element of cultural choice is also involved.

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References and Notes

1. See F. Bouza-Brey and J. M. Alvarez-Blasquez, *Trabalhos de Antropologia e Etnologia* (Porto) **14** (Fasc. 1–2), 3 (1952); J. M. Alvarez-Blasquez and F. Bouza-Brey, *Cuadernos de Estudios Gallegos* (Madrid) **13**, 201 (1949). A similar approach was taken in the classification of the Portugese Paleolithic, which is remarkably similar to that of northwestern Spain, by H. Breuil and G. Zbyszewski [*Comun. Serv. Geol. Port.* **26**, 1 (1945)].
2. For a preliminary report on the archeology see E. de Aguirre, *Excavaciones Arqueológicas en España* **10**, No. 31 (1964).

3. ——, *ibid.*, plates 5–12.
4. The geomorphology and stratigraphy of the Budiño site are described in K. W. Butzer, *Eiszeitalter Gegenw.*, in press.
5. For further critical and partly controversial opinions on the Asturian of northern Spain, see M. Crusafont-Pairó, *Speleon* (Oviedo) **14**, 77 (1958); F. Jordá-Cerdá, (Actos) *V. Congreso Arqueológico Nacional* (Zaragoza, 1959), pp. 63–66; and ——, *Memorias, Servicio de Investigaciones Arqueológicas* (Diputación Provincial de Asturias, Oviedo, 1958), vol. 3, pp. 1–97.
6. Field work supported in part by a grant-in-aid from the Wenner-Gren Foundation for Anthropological Research (E. de Aguirre) and NSF grant GS-17814 (F. C. Howell). Sedimentological studies and radiocarbon dates were made possible by a second Wenner-Gren grant (K. W. Butzer). We are indebted to P. Biberson (Musée de l'Homme, Paris) and L. G. Freeman (University of Chicago) for valuable discussion.

25 April 1967

Autosomal Phosphogluconic Dehydrogenase Polymorphism in the Cat (Felis catus L.)

Abstract. *Three patterns of 6-phosphogluconic dehydrogenase activity were obtained by starch-gel electrophoresis of blood from domestic cats. Genetic analysis indicates control of these patterns by a pair of alleles at an autosomal locus. Presence of three enzymatically active bands in heterozygotes and of single bands in homozygotes is compatible with at least a dimeric structure for the enzyme.*

Electrophoretic enzymatic variants in diploid organisms were reviewed by Shaw (*1*). No reports on species of the order Carnivora exist. We now report the findings of polymorphism of 6-phosphogluconic dehydrogenase (6-PGD) activity in hemolyzates of blood from domestic cats (*Felis catus* L.) and patterns from single individuals of four other species of Felidae. The manner of inheritance for these variants has been determined in the domestic cat by controlled breeding (*2*).

Blood for electrophoresis was collected into an anticoagulant mixture of acid, citrate, and dextrose with 2.4 g of inosine per 100 ml of solution (*3*). For electrophoresis (*4*), a hemolyzate was prepared by freezing and thawing one part of blood mixed with two parts of water. Horizontal starch-gel electrophoresis was carried out in a tris-ethylenediaminetetraacetate-boric acid buffer (*5*) as described by Porter *et al.* (*6*). Cell-free hemolyzates were placed in slots in the gel with filter-paper wicks. Protein separations were accomplished by running the gel at 4°C overnight (16 to 18 hours) at 350 volts with 25 ma of current. At *p*H 8.6 in this buffer system, the 6-PGD migrates toward the anode.

The gels were sliced horizontally for staining of the cut surface by a modification (*7*) of the method of Fildes and Parr (*8*). A square of Whatman No. 1 filter paper was cut to fit the surface of the sliced gel, and stain was poured over the filter paper. Incubation for 1 to 2 hours at 37°C gave clearly delineated bands of 6-PGD activity. Fixation was by soaking in 50 percent methanol for 2 to 3 days, and gels were stored by wrapping in polyvinyl chloride sheeting.

Cats showed either a single fast band (phenotype A), a single slow band (phenotype B), or three bands (phenotype AB) which correspond in mobility to both the fast and slow band with an additional band of intermediate mobility. A mixture of bloods with A and B phenotype produced A and B bands without an intermediate third band (Fig. 1a).

Among the Felidae other than the domestic cat, single specimens of blood were obtained for each of the species *Panthera tigris* L. (tiger), *Panthera pardus* L. (panther), *Felis rufa* Schreber (bobcat), and *Felis lynx* L. (lynx). All these, except the tiger, which was newborn, were adults. The 6-PGD zymograms for these species and two of the three variants in domestic cats (Fig. 1b) show that, in the blood of tigers, panthers, and lynxes, active components migrate at a much greater rate than in that of the domestic cat. All bands from the Felidae show migration rates greater than those of the usual human 6-PGD type.

The genetics of the 6-PGD patterns in domestic cats were defined by test matings of animals with known 6-PGD phenotype. The total number of matings for each cross (Table 1) includes reciprocal crosses of each appropriate type except in the "A by B" mating. In this group, all dams were of the B phenotype, and all sires were of the A phenotype. Distribution of offspring phenotypes from reciprocal crosses were consistent with single-locus, two-allele controlled inheritance, and therefore the groups were combined. Single bands, either A or B, resulted from apparent homozygosity for the alleles at the locus involved. The AB (three-band) pattern was found in the corresponding heterozygotes. The frequencies of each phenotype from the different matings with adequate numbers do not deviate significantly from the expected frequencies. This manner of inheritance is the same as that described for all other animals examined, except for *Drosophila* in which a sex-linked 6-PGD was found (*9*).

Because a standard nomenclature for the genotype of the 6-PGD system is

Table 1. Results of controlled matings for genetic analysis of 6-PGD inheritance. From the phenotypes of 110 offspring, inheritance is determined to be autosomal with control by two alleles, Pgd^{A} and Pgd^{B}, at the locus. Abbreviations: M, male; F, female.

Matings	Phenotypes of offspring (No.)					
	A		AB		B	
	M	F	M	F	M	F
A × B			4	7		
A × A	3	4				
AB × A	4	3	7	5		
AB × AB	4	1	12	12	3	5
AB × B			7	10	7	9
B × B					1	2

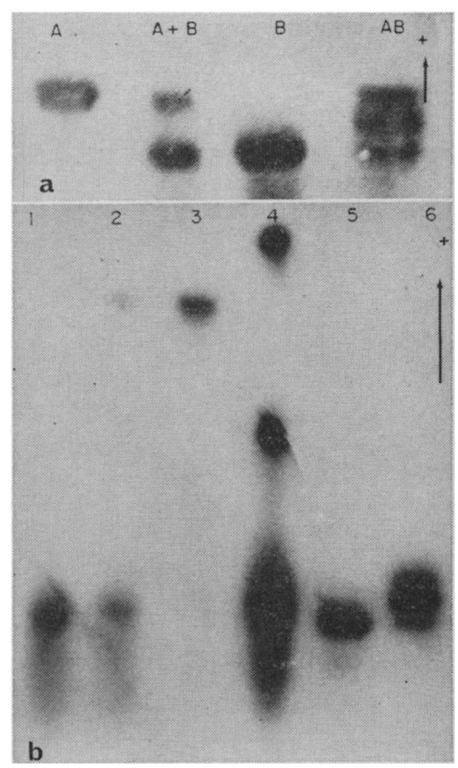

Fig. 1. (a) Starch-gel electrophoretic patterns of 6-PGD activity in the domestic cat, showing the A, A + B mixture, B, and AB phenotypes. The lack of an intermediate band when blood of A and B phenotypes are mixed for electrophoresis contrasts with the AB phenotype pattern and supports polymeric structures for the active enzyme. (b) The four species of Felidae and two cat phenotypes are: 1, bobcat; 2, lynx; 3, panther; 4, tiger; 5, domestic cat B; and 6, domestic cat AB.