ARCHAEOLOGY

50,000-year-old Americans of Pedra Furada

Paul G. Bahn

LONG-awaited data from the Brazilian rockshelter of Pedra Furada have at last been made public, and they constitute convincing evidence that human occupation of the New World extends back at least 50,000 years. In defending his doctoral thesis[1], Fabio Parenti, co-excavator of Pedra Furada with Niède Guidon, publically presented his analysis of the site and its contents to a jury of examiners in Paris on 15 February. His defence was successful. The upshot will be the opening of a new era of investigation into the 'first Americans'.

The rockshelter at Pedra Furada viewed from the gate.

The sandstone rockshelter of Pedra Furada is one of several hundred painted shelters discovered and studied by Guidon in the Piaui region of north-eastern Brazil. In 1978 she began excavations in the site in order to date its rock art, which was confidently assumed to be of Holocene age (that is, less than 10,000 years old). When radiocarbon dates of Pleistocene age, extending back more than 30,000 years, started to emerge from the stratigraphy[2], the site and its excavator were thrust into the forefront of the debate in which one side (primarily North American) insisted that there was no human occupation in the New World before 12,000 or at best 15,000 years ago, and the other accepted far earlier dates from Pedra Furada, or sites at Monte Verde in Chile[3] and elsewhere.

Parenti commenced work at Pedra Furada in 1984, four years of digging being followed by four of analysis and laboratory work. No site had yet met all criteria necessary to convince sceptics that humans had been present in the New World so far back in the Pleistocene[4], so his task was clear from the outset. It was made all the harder because the sediments of the sandstone shelters of the Piaui region have destroyed all organic materials (other than charcoal fragments) in pre-Holocene levels. In addition, the Pleistocene levels of Pedra Furada contain tools made only of the quartz and quartzite pebbles from a conglomerate layer above the sandstone cliff, and pebble tools are notoriously difficult to differentiate from naturally broken stones.

Parenti's primary aim, therefore, after erosional, geomorphological and sedimentary study of the site and its surroundings, was to distinguish between human and natural agencies in terms of the site's contents in general, and of its lithic objects in particular. The stratigraphy comprised mostly sand as well as sandstone plaques that had fallen from the walls, with occasional rubble layers. It was a natural rubble 'wall' in front of the shelter which preserved the sediments within: in Piaui, only sites with such walls or those in protected locations contain Pleistocene layers. In all other shelters, the Pleistocene layers have been removed by flooding, because in Piaui that period was far more humid than the Holocene.

Within the Pedra Furada shelter, scattered through the stratigraphy, Parenti has identified over 150 'structures' — that is, arrangements of sandstone plaques, of pebbles, or of both. His analysis indicates that they cannot be natural, as they have no correlation with the areas where they would have fallen. The stones have been selected and arranged, though some pebbles subsequently moved since they can easily roll (the site has a 10° slope from east to west). It is impossible for the pebbles to occur naturally within the shelter; they would have fallen down the two watercourses in the cliff-face and along the shelter's drip-line outside the rubble wall[5]; besides, some circular arrangements of pebbles occur immediately adjacent to the shelter's back wall, some 15 metres from and upslope of the drip-line.

Parenti's basic rules for recognizing human agency in these structures are probably valid, but even when he applied the most stringent criteria he was left with no less than 50 Pleistocene structures which would be attributed to human agency on archaeological sites anywhere in the world; some contain traces of heating, such as burned stones and fragments of charcoal, and have been interpreted as hearths.

Where the pebbles are concerned, Parenti conducted a study of 3,500 stones fallen from the clifftop, and found that when they break — which is rare — the natural flaking never affects more than one side, never removes more than three flakes, and never produces 'retouch' or 'micro-retouch'. These observations became his benchmark for recognizing human artefacts at the site. Of some 6,000 pieces definitely considered to be tools, no less than 900 came from the Pleistocene layers (quartz and quartzite continued to be worked and used in the same way in the Holocene, but easily identifiable chalcedony pieces account for the high number of definite tools in that period). Even if the most stringent criteria of human agency are applied to the collection, Parenti has 595 Pleistocene pieces that he considers definite. Thousands more pebbles are ambiguous, and could be either natural or man-made.

Finally, the site also has a coherent series of 54 radiocarbon dates from 5,000 to 50,000 years before present. Thermoluminescence dates will be forthcoming.

The thesis-defence lasted for four hours (the thesis itself is a four-volume monster, weighing 7 kg). The combined experience of the jury is a measure of the quality of the interrogation. The panel was presided over by Yves Coppens, the palaeoanthropologist, and consisted of Niède Guidon herself; Claude Guérin, the palaeontologist in charge of studying the faunal remains from Piaui's

limestone sites; Jean-Philippe Rigaud, an expert on the Palaeolithic rockshelters and stone-tool industries of southwest France; Jean Chavaillon, an Africanist and expert on archaic stone tools; and Danièle Lavallée, a specialist in Andean prehistory. All six were convinced by Parenti's data, even though some (notably Lavallée) admitted to having had strong doubts about Pedra Furada in the past, and some were familiar with — and equally unconvinced by — the material from other controversial New World sites such as Calico, Pendejo and Old Crow. The thesis has effectively been through stringent — and public — peer review.

Regardless of the lack of early sites in North America, there is now solid archaeological evidence for a human presence in the New World tens of thousands of years ago. All other issues — such as when or how many times the Beringia land-bridge may have been crossed, or the technological origins of the Clovis point, or why the Piaui stone tool industry is so archaic — become secondary to that. There will no doubt remain sceptics, especially in North America. But in December an international meeting is to take place in Piaui to which the foremost of them have been invited. Seeing may then be believing. □

Paul G. Bahn, 428 Anlaby Road, Hull HU3 6QP, UK, is a freelance writer on archaeology.

1. Parenti, F. *Le gisement quaternaire de la Toca do Boqueirão da Pedra Furada (Piaui, Brésil) dans le contexte de la préhistoire américaine. Fouilles, stratigraphie, chronologie, évolution culturelle* thesis, Ecole des Hautes Etudes en Sciences Sociales, Paris (1993).
2. Guidon, N. & Delibrias, G. *Nature* **321**, 769–771 (1986).
3. Dillehay, T. *Monte Verde: A Late Pleistocene Settlement in Chile*. Vol. 1, *Palaeoenvironment and Site Context* (Smithsonian Institution Press, Washington, 1989).
4. Lynch, T. *Am. Antiq.* **55**, 12–36 (1990).
5. Guidon, N. & Arnaud, B. *Wld Archaeol.* **23**, 167–178 (1991).

PSYCHOLOGY

Weighing of the talents

John Sloboda

WHAT determines whether people make exceptional contributions to a particular field of endeavour? High scholastic grades or psychometric measures of intellectual ability — such as IQ test scores, or other estimates of general cognitive activity ('*g*') — are by no means the best predictors of eventual excellence. Talent comes in many forms, and such qualities as perseverence, curiosity and self-confidence, as well as relevant experience, are often more crucial to high achievement.

Such was the seemingly uncontentious message to emerge from a recent meeting* (though very little else in this field can be described as uncontentious). The underlying question to be addressed was an age-old one, that of whether individual differences in achievement are best accounted for in terms of genetic differences or environmental differences. A bald 'either-or' stance is inappropriate — there is general acknowledgement that the characteristics of an individual are a result of an interaction of genetics and environment. There are well-established methods for estimating the relative contribution of heredity and environment to a behavioural measure within a population, by examining the degree to which it varies among people of greater and lesser degrees of genetic and environmental relatedness (for example identical twins, fraternal twins and children raised apart from their biological parents). These studies have typically shown contributions of heredity to IQ of the order of 50 per cent[1].

There is an unhappy tendency to jump from such findings to the conclusion that genius is in some sense predetermined in one's genes, and that, no matter how favourable the environment, a person without a special genetic 'spark' will never reach the heights of achievement. There are several cogent objections to such a sweeping conclusion, amounting, in the words of one participant (H. Gardner, Harvard University), to a denial of the "hegenomy of *g*".

In the first place, to show that some behavioural measure is heritable does not imply that it is immutable. Several speakers referred to *mono-savants*, individuals of low IQ who nonetheless show outstanding performance in one specific area of expertise[2]. There are, for example, *savants* whose abilities to memorize music equal or even outstrip the feats reported of Mozart. It is clear that these levels of performance were achieved through continual practice, even if, as some at the meeting claimed, individuals with high IQ might have achieved the same levels of performance with less effort.

Second, familial studies provide only a crude gross measure of similarity of genetic material between different individuals, making detailed causal explanations of correlations between genetics and behavioural outcomes impossible. However, advances in molecular gen-

* *Ciba Foundation Symposium No. 178, Origins and Development of High Ability*, London, 25–27 January 1993.

RÉSUMÉ

Bright spark

IF you can make lasers with photons, why not with pions, subatomic particles created in high-energy collisions? Like photons, pions have integral spin, which means they obey the laws of Bose–Einstein statistical physics. One consequence of these rules is that the emission of one bose particle encourages the emission of another — that is how a laser amplifies light radiation. The trouble is calculating what actually happens in the strongly interacting nuclear plasmas generated in high-energy collisions. But S. Pratt has succeeded in devising a fast program to do this (*Phys. Lett.* B**301**, 159–164; 1993). Collisions using relativistic lead nuclei, planned for CERN in 1994 to recreate the conditions of the Big Bang, should also create the circumstances necessary for pion lasers, he estimates.

Protection business

OUR DNA is vulnerable to many unwholesome influences, and were there no mechanisms for scanning the genome for lesions and then repairing them we should soon fall prey to such conditions as xeroderma pigmentosum, which often leads to skin cancer. Chu and his associates identified a protein missing in one variant of the disease and have now taken the first steps towards characterizing its action (B. J. Hwang & G. Chu *Biochemistry* **32**, 1657–1666; 1993). It is a monomer, found only in the nucleus, and merely two molecules per megabase are needed to maintain constant surveillance of the DNA. This is because it binds to damaged nucleotides more strongly than to pristine ones by six orders of magnitude. The supposition is that having found its target it attracts other proteins that effect the process of excision and repair.

No two ways

MULTIFACETED buckminsterfullerene is now findings its way into electronic devices. A. J. Heeger and colleagues have made a diode by sandwiching a layer of C_{60} and a layer of the conjugated polymer MEH-PPV between gold and indium/tin oxide electrodes (N. S. Sariciftci *et al. Appl. Phys. Lett.* **62**, 585–587; 1993). The polymer is a semiconducting material, already used in prototype devices (Heeger's group has made a flexible light-emitting diode with the material). And C_{60} has been shown to be an '*n*-type' semiconductor, able to accept electrons from *p*-type materials (such as MEH-PPV). Having seen photoinduced electron transfer at MEH-PPV/C_{60} interfaces, Heeger and colleagues set about making the *pn* diode. As hoped, they found the forward current to be 10^4 times the reverse current, and illuminated, the diode gives photocurrents and photovoltages.