filaments and began to propagate a new pair, (Fig. 3). It is not possible at present to give a detailed account of the processes which constrain filaments to grow in this manner although it is certainly associated with the structural characteristics of the catalyst particle.

R. T. K. Baker
P. S. Harris
S. Terry

Applied Chemistry Division,
AERE Harwell,
Didcot, Oxfordshire, UK

Received August 30, 1974.

[1] Baker, R. T. K., Barber, M. A., Feates, F. S., Harris, P. S., and Waite, R. J., *J. Catal.*, **26**, 51 (1972).
[2] Baker, R. T. K., Harris, P. S., Thomas, R. B. and Waite, R. J., *J. Catal.*, **30**, 86 (1973).
[3] Baker, R. T. K., and Waite, R. J., *J. Catal.* (in the press).
[4] Baker, R. T. K., and Harris, P. S., *J. Phys. E.*, **5**, 793 (1972).
[5] Hofer, L. J. E., Sterling, E., and McCartney, J. T., *J. Phys. Chem.*, **59**, 1153 (1955).
[6] Boehm, H. P., *Carbon*, **11**, 583 (1973).

Ancient boomerangs discovered in South Australia

During excavation in a South Australian peat quarry in January 1974, a wooden tool industry was found buried in basal peat formed between 10,200 ± 150 BP (ANU-1,292) and 8,990 ± 120 BP (ANU-1,293). Chert tools and chipping debris associated with swamp side encampment were also recovered from shoreline clays and underlying muds. Three implements associated with this industry are complete boomerangs (Fig. 1), suspected of being made from *Casuarina stricta* (Drooping Sheoak), a species growing above the swamp today. Although exact ages for the boomerangs are still to be determined, the finds provide the oldest evidence of the boomerang in the world and the collection as a whole is one of the most technologically complete in the Australian archaeological record. The collection of more than 25 wooden implements includes a simple short spear, at least two types of digging stick, and a barbed javelin fragment carved from a single piece of wood. Although several other implements were recovered complete, their functions are as yet unknown.

Featuring robust working edges made on large flake cores, typically worked into convex steep-edged scrapers, the stone tool industry conforms well to the 'Australian core-tool and scraper tradition' described for the 26,000-yr-old Lake Mungo industry[1,2] and to which Pleistocene components at Keilor, Kenniff Cave, and Burrill Lake might also be assigned. Citing ethnographic examples and microscopic evidence, several researchers, particularly Jones[3], have ascribed to these forms heavy wood-working tasks such as planing, cutting, debarking, and scraping—precisely the tasks Wyrie Swamp stone tools are believed to have performed. But, whereas food preparation/procurement roles are suspected of being present in the lithic technology, no direct dietary or faunal evidence was uncovered.

Current palaeobotanical studies of the peat deposits in the region made by John Dodson at the Australian National University (ANU) indicate trends in peat accumulation which appear to correlate with prehistoric utilisation of the bog. Principal Aboriginal visitation took place during an initial shallow water phase characterised by fluctuating wet, and occasional dry, episodes dated to between 10,200 and 9,000 yr ago. During this period, when the swamp was small, its shoreline became the scene of numerous tool-making and hunting and gathering activities centred on resources at the water's edge. However, 9,000 yr ago an increasingly more permanent water stand rose to cover most of the gently sloping bank, burying the shoreline debris and displacing tool-making on to the adjacent steep dune slopes. Evidence for subsequent use of the swamp appears

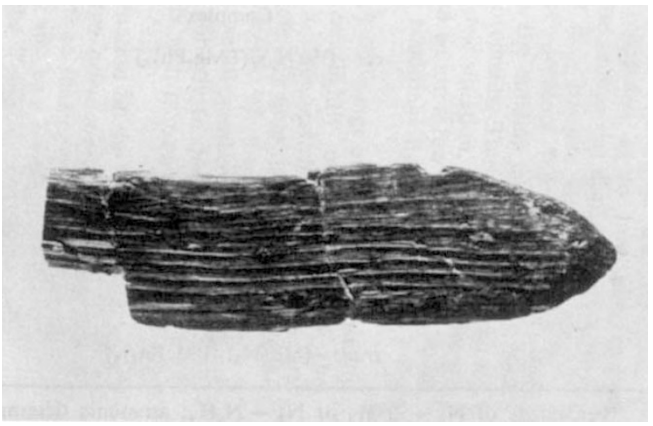

Fig. 1 This fragment of a fourth boomerang from Wyrie Swamp has been identified as *Casuarina stricta* root. Measuring 11 cm, it has been treated with polyethyleneglycol and freeze-dried.

infrequently until 7,930 ± 160 BP (ANU-1,377), possibly in response to the relocation of aquatic plant resources.

We can therefore see the Australian Aborigine emerging from the Pleistocene equipped with a tool kit as vital to the exploitation of the local environment then as it was yesterday, and just as complex. Exactly how long this technological tradition previously existed is as yet unknown but the possibility that the boomerang soared over the shores of Lake Mungo 16,000 yr earlier seems more plausible as a result of discoveries at Wyrie Swamp.

R. A. Luebbers

Department of Prehistory,
Australian National University,
Canberra, Australia

Received September 30; revised October 29, 1974.

[1] Bowler, J. M., Jones, R., Allen, H., and Thorne, A. G., *World Archaeol.*, **2**, 39–60 (1970).
[2] Barbetti, M., and Allen, H., *Nature*, **240**, 46–48 (1972).
[3] Jones, R., *Nature*, **246**, 278–81 (1973).

The reduction of mono-coordinated molecular nitrogen to ammonia in a protic environment

We have reduced ligating molecular nitrogen (dinitrogen) to ammonia in yields of up to 90% at a single metal site. This reaction is important for its possible application to our understanding of the chemical mechanism of the reduction of dinitrogen to ammonia by nitrogenase, where the reduction may occur at a single molybdenum ion site[1]. Our reaction occurs when compounds of the type $[M(N_2)_2(PR_3)_4]$(I; M = Mo or W; R = alkyl or aryl) are treated at room temperature with sulphuric acid in methanol solution:

$$[M(N_2)_2(PR_3)_4] + H_2SO_4 \xrightarrow{MeOH} 2NH_3 + N_2 + \text{other products} \quad (1)$$

This reaction was performed in a vacuum so that the evolved gases could be analysed and measured. On mixing the reagents, one molecule of nitrogen gas was rapidly evolved with a trace of dihydrogen. The remaining dinitrogen was spontaneously