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THE PROBLEM OF ANTIQUITY OF MAN IN AUSTRALIA.

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Plates I-III.

To appreciate what is meant by antiquity of man, the significance of the term antiquity in this connection should be considered. The word may be used in the historical or in the geological sense. In the historical sense it applies to events or to man's handiwork during early Egyptian and Mesopotamian civilizations or even later; in the geological sense it involves much longer periods of time. The earliest historical traditions are generally supposed to date back 7,000 years; but the Pleistocene period is estimated to have ended some 15,000 or 20,000 years ago and all that has happened since then is geologically recent. In Europe the earliest fossil human bones are probably 130,000 years old, and the oldest stone implements 400,000 years. To grasp what these figures mean we may imagine ourselves walking down the avenue of time into the past and covering a thousand years at each pace. The first step takes us back to William the Conqueror, the second to the beginning of the Christian era, the third to Helen of Troy, the fourth to Abraham and the seventh to the earliest traditional history of Babylon and Egypt; but we have to continue more than twice as far before leaving geologically recent (Holocene) times and entering the Pleistocene period, 130 paces to Heidelberg man, and about a quarter of a mile to the oldest undoubted stone implements of Europe. Should we decide to continue our journey until we meet the most ancient fossil organisms, we would probably require a time-car, for the journey on the same scale would exceed 250 miles according to the latest estimates.

There is convincing evidence of the historical antiquity of man in Australia, and good reason to believe that he migrated there before the end of Pleistocene times. The data are set out in the following pages.

The problem is bound up with several others. Before Europeans arrived two types of mankind inhabited the Australian region, one being confined to the mainland, the other to Tasmania. Tasmanians, now extinct, differed from Australians in physical appearance and in cultural level. What are the affinities of these

two types with other races of mankind and with each other? Are they mixed or pure races? These are problems for physical anthropologists. The few fossil skulls found in Australia have Australoid or Tasmanoid characteristics, and there are no fossil remains that suggest that the Australian region was ever occupied by other types of mankind before the arrival of modern Europeans. The Australian wild dog, the dingo, was the only large terrestrial placental mammal, man excepted, living in the area and it is confined to the mainland. What are its affinities with other species of dog? Could it have evolved in Australia? If not, where did it come from? Did it find its way overland unassisted by man or did it come as the domestic dog of human immigrants who crossed stretches of sea by canoe? These are problems for zoological systematists and palaeogeographers, and the answers are of some importance since fossil dingo bones have been found associated with remains of extinct marsupials in deposits that suggest some geological antiquity. Did the Tasmanians once occupy the mainland of Australia or did they go direct to Tasmania from some other locality such as New Caledonia? If they migrated from Australia, did they do so by a land-bridge which once joined island and mainland, or by canoe after the land-bridge disappeared? If they once occupied the mainland and were later partly exterminated, partly absorbed by an invasion of Australoid migrants, do Australian aborigines retain traces of the racial intermixture? Geologists and anatomists can furnish the answers. Finally, we must assess the value of evidence for antiquity of human bones and artefacts found embedded beneath the surface; it must be based on knowledge of the relative ages of Pleistocene and Holocene horizons in Australia and their correlation with similar horizons in the northern hemisphere. This is the province of geologists.

The literature on these subjects is widely scattered in books and scientific periodicals, and no comprehensive statement of the problem of antiquity of man in Australia as it now stands has been published. In view of the recent discovery in a river terrace at Keilor near Melbourne of the fossil human skull (Pl. I) which is described elsewhere in this volume by Dr. J. Wunderly and Dr. Wm. Adam, as well as a second skull and limb bones, an attempt is made in the following pages to summarize current opinions on the subjects. These are widely divergent, and the problems offer an attractive field for further research.

Many further references to Australian Post-Tertiary geology could be added to the bibliography, but those selected will suffice for a general survey of the subject.

Australians and Tasmanians

Wood Jones (1935 b) summarized the most generally accepted current opinions on racial affinities of Australian aborigines. He said that the Australian belongs to the Dravidian race; he is not a black man nor does he have fuzzy hair; he is a member of the straight- or wavy-haired, brown-skinned race that has no near kinship with the true negro. The physical characters, blood groupings and culture of Australians all point to them as being the advance guard of the great pre-Dravidian migration that, starting probably in the Mediterranean region, spread across India into Ceylon and then to the Malayan region. With the Veddas of Ceylon and with other scattered remnants of this migration the Australian native has very real affinities.[1]

Wood Jones (1935 a) also gave a summary of what is known of the extinct Tasmanians. He said that in colour the Tasmanian was so dark a shade of brown that casual observers described him as black. The scalp hair was black and grew as crisp, frizzy little curls, but unlike the true peppercorn hair of the African negro, the hair of the Tasmanian grew to a considerable length. The average height of the men was five feet five and a quarter inches, more than an inch less than that of the average male Australian. The Tasmanian, according to him, was a primitive Negroid.[2]

Meston (1936) pointed out that Tasmanians had the dark skin, flat nose and wide nostrils adapted to hot climates, but disadvantageous in cool-temperate regions such as Tasmania; David (1924) also noted this point. The inference is that the race evolved under tropical conditions and migrated to Tasmania at a fairly late stage of its evolutionary history.[3]

Some investigators, however, have expressed other views concerning the racial affinities of Australians and Tasmanians.

Turner (1908) held that Australians and Tasmanians belong to distinct races, but a proportion of natives in southern and western Australia have skulls that point to possible intermixture and racial affinity with Tasmanians; he inferred that the Tasmanians were direct descendants from a primitive Negrito stock and had become specialized in many ways as a result of long isolation. Klaatsch (1908) considered that Australian aborigines are a relic of the oldest type of mankind. Keith (1910) concluded

1. For blood grouping see Cleland, Cleland and Johnston, Tebbutt, Tebbutt and McConnel, Lee, Birdsell and Boyd, Phillips, and F. J. Fenner (1939); for descriptions of skulls, Berry and Robertson, Büchner, Burkitt, Burkitt and Hunter, Fenner, Hrdlicka, Howells, Klaatsch, Morant, Robertson, Shellshear, Wagner, and Wood Jones; for teeth and palate, Campbell.

2. For descriptions of Tasmanian skulls see Berry and Robertson, Büchner, Crowther and Lord, Hrdlička, Morant, Ramsay Smith, Turner, Wagner, Wood Jones, and Wunderly; teeth and palate, Campbell (in Wood Jones, 1924).

3. See also Davies (1932).

that the Tasmanian is the most primitive type of Negro and the Australian the most primitive type of Negroid. According to Berry and Robertson (1914 a), Mollison's variation index shows that Tasmanians and Australians belong to a common stock, and that the Australian agrees much more closely with an admittedly mixed race such as modern Italians than with supposedly pure stocks such as Andamanese and Tasmanians; and that the Australian, as regards skull type, is less highly evolved morphologically than the Tasmanian. Sollas (1924) suggested that the Tasmanians are survivors of a primitive race elsewhere extinct or merged into a predominant alien population, and that the Australian is a survival from Mousterian times, but not a direct descendant of the Mousterian races of Europe. Hrdlička (1928) said that the Tasmanian is probably a mere local variant of the Australian. F. J. Fenner (1939), after examining in detail 1182 adult Australian skulls, divided them into three sub-types; two of these, occurring respectively in the coastal Northern Territory and the Queensland areas, are differentiated from the common southern type, which occurs over the greater part of Australia. He considers that these types are probably due to two factors: (a) fusion of Australoids with Tasmanoids, and (b) a later wave of Papuan and possibly Malayan infiltration into the northern part of the continent. He also considers that blood grouping, if reliance can be placed on the data, suggests that Melanesian infiltration has penetrated a considerable distance southward. Wunderly (1938 a, b), from an examination of Tasmanian skulls and other evidence, concluded that the Tasmanians were Negritos, but that the natives of the west coast were a mixed race of Tasmanian-Australian origin due to migration of Australian aborigines to this part of Tasmania one or two generations before Europeans arrived. Howells (1937) discussed various theories; that Australia represents the original home of mankind; that the Australians are descended from Neanderthal man; and that they are the product of a mixture between (a) a "White" and a Negrito or Negro stock, (b) two differing Negroid strains, or (c) Tasmanian and Polynesian. He considers that the Australian represents an earlier stage in the development of *Homo sapiens* than does any other existing race. From a survey of several hundred skulls of Pacific Ocean peoples, Wagner (1937) included the peoples of Tasmania, Australia, Melanesia and New Guinea in one large Australoid-Melanesian group. Craniological agreement which binds together this group includes many similarities, but not in all characters; some well-defined types, such as Australians and Tasmanians, can be demonstrated within the group. He says

that the Australian type extends throughout Australia, but there is some variation, probably due to migration of Melanesian people from the north, so that Australian skulls fall into six sub-types found respectively in Northern Australia, Queensland, West Australia, South Australia, New South Wales and Victoria. The similarity of Tasmanian and Australian skulls is striking, the Tasmanians being closer to the West Australian sub-group than to any of the others. Possibly an original Tasmanoid population in Australia was driven west and south by later incomers.

It is generally agreed that mankind and all other placental mammals originated outside the Australian region.

The ancestors of both Australian and Tasmanian aborigines no doubt reached Australia by way of that avenue of migration along which many races of mankind have passed towards the Pacific—the Malay Peninsula, Sumatra, Java, and New Guinea. Some Australoid and Negrito tribes are found among the races inhabiting Malaya and New Guinea. The fact that an Australoid skull of some geological antiquity has been found in New Guinea (F. J. Fenner, 1941), and that ancient Australoid skulls (Wadjak man) have been described from Java by Dubois (1920), lends strong support to the theory that the forefathers of the Australian race migrated along this route in the distant past. Dubois's claim that Wadjak man is of Pleistocene age has not been substantiated (von Koenigswald, 1937).[4]

Huxley, Wood Jones, Pulleine and others hold that the Tasmanians voyaged from New Caledonia; Howitt, Haddon, Wunderly, Meston and others consider that they migrated from the mainland of Australia across a land-bridge or by canoe. Howitt (1898) pictured both Tasmanians and Australians as arriving in Australia by way of a land-bridge formerly connecting Asia and Australia, which was broken at Wallace's line by a narrow stretch of sea that might be crossed in vessels no better than modern Australian bark canoes, the Tasmanians arriving first and occupying Tasmania while it still formed part of the mainland. Tindale and Birdsell (1942) claim that small tribes with Tasmanian affinities survive in the Atherton rain jungle, North Queensland; possibly, however, these tribes may have originated by infiltration of people from New Guinea or adjacent islands. The Keilor skull, which combines Tasmanian with Australian characteristics, supports the theory that Tasmanians once occupied the Australian mainland.

During Pleistocene glacial phases sea level fell, and Tasmania was connected or almost connected by land with Victoria; in

4. See also Fromaget (1940 a, b) and Mijsberg (1940).

interglacial periods it rose and the two were separated by water. There has probably been no land-bridge since mid-Pleistocene times; the reasons for this opinion are given in a later page. Under present conditions, the chain of islands between Wilson's Promontory and Tasmania provides an easy route for migration by boat, with no stretch of open water exceeding 30 miles and land in sight across every gap. Tasmanian canoes were very primitive, but the natives used them for visiting Tasman, Maatsuyka and other islands separated from Tasmania by stormy seas.

The Dingo

At one time it was considered that the dingo is a distinct species of dog peculiar to Australia (Etheridge, 1916), but Wood Jones (1921) demonstrated that it is merely a variety of the domesticated dog, *Canis familiaris,* with no claim to separate specific rank, and this opinion is endorsed by other zoological systematists. He says that the restricted genus *Canis* differs in dentition from the wild dogs of south-eastern Asia, the most probable immigrants in a "walk overland" colonization. He holds that the supposition that the dingo is indigenous, that its phylogenetic story was unfolded within the confines of Australia, is untenable, and when we come to inquire into the possibility of the dingo arriving in Australia unassisted by, and unassociated with, man, we are forced to own that the difficulties of the problem have not always been appreciated by those who have advocated this solution, for no land-bridge that could have admitted either the dingo or man, separately or in company, could have failed to be the high road of entry of a host of other placental mammals. "The progenitor of Talgai man came with his wife, he came with his dog, and with his dog's wife, and he must have done the journey in a seaworthy boat capable of traversing this unquiet portion of the ocean with his considerable cargo. Besides this living freight, and the food and water necessary for the adventure, he carried other things—he carried a knowledge of the boomerang, of the basis of the totem system, and various other cultural features, all bearing a strange suggestion of very distinctly western origin."

No trace of the dingo, living or fossil, has been found in Tasmania nor in the islands of Bass Strait, so it apparently did not reach south-east Australia until the land-bridge between Tasmania and the mainland had disappeared, and it did not accompany the Tasmanians as their domesticated dog.

Few human relics have been found associated with *Diprotodon, Thylacoleo* and other extinct marsupials, but fossil bones of the dingo occur with them in several places.

The Pleistocene Period

The outstanding feature of the Pleistocene or Quaternary Period is the series of rhythmic alternations from cold to mild climates which gave rise to glacial and interglacial phases. During the maximum glaciation, ice-caps covered most of northern Europe, America and Asia, and also Tasmania. Most glaciologists consider that glacial and interglacial phases were contemporaneous in both hemispheres. In Europe four glacial phases were separated by mild interglacial intervals and were succeeded by the present post-glacial phase. Some authorities, however, hold that there were more than four glacial epochs in North America; others consider that the two first glacial phases are Pliocene, not Pleistocene, in age (Boule, 1923), but this is merely a question of nomenclature. Interglacial phases probably lasted longer than glacial, and the second interglacial period greatly exceeds the others; to this period the oldest undoubted relics of mankind belong.

Several theories have been advanced to explain these climatic alternations, but none is generally accepted.

Changes in relative levels of land and sea are due to one of two causes or to a combination of both: increase or decrease in the volume of the oceans (eustatic changes), and local elevations or depressions of the earth's crust (tectonic movements). In Pleistocene times tectonic movements have been negligible in considerable areas.

During glacial phases, withdrawal of vast quantities of water from the oceans to form ice-caps and glaciers lowered sea level; in interglacial times ice melted and sea level rose. Interglacial climates must have been milder than the climate of to-day since strandlines then formed are now raised beaches owing to eustatic changes in sea level.

Daly (1934) estimated that the melting of existing Antarctic and Greenland ice-caps and existing glaciers would cause sea level to rise about 130 ft., but he pointed out that change in level would not be equal throughout the oceans for three reasons: redistribution of load on the elastic terrestrial globe causing deformation; slow transfer of plastic deep-seated matter consequent on that deformation; and cessation of gravitational pull on adjacent ocean waters by ice-caps. For the same reasons, the estimated quantity of water withdrawn or set free during glacial and interglacial phases can give only a rough indication of corresponding changes of sea level in any particular locality.

During glacial phases boulder-clay (tillite) accumulated beneath ice-caps, terminal moraines were formed at the margins of ice-

sheets and glaciers, and fluvio-glacial sands and gravels (outwash-aprons) spread beyond the moraines. Lowering of sea level changed parts of the continental shelves into dry land and exposed large areas of sand which was then blown by the wind and gave rise to dunes. In cold dry areas thick beds of dust (loess) accumulated, as they are doing to-day on the steppes of Southern Russia and Siberia; other regions, now arid, had abundant rainfall. River erosion became active and river valleys were deepened in response to low sea level.

During interglacial phases sea level rose, low-lying country was submerged, and new coast lines were established at higher levels. The flow of rivers was checked and alluvium was deposited in their valleys.

In response to these climatic and geographic changes, plants and animals, including mankind, migrated to and fro. Some species died out; of the genus *Homo* only *H. sapiens* survived.

Daly (1925) considered that in post-glacial times a world-wide strandline at about 10-20 ft. above present sea level was formed during a slight general fall in temperature about 4,000 years ago when water was abstracted from the oceans to thicken existing ice-caps; Milankovitch's radiation curve indicates about 10,000 years. Wright (1937), however, has brought forward evidence to show that the 15-foot raised shoreline of Western Europe is pre-glacial, not post-glacial nor interglacial.

In many regions evidence of the early glacial and interglacial phases has been obliterated wholly or in part by erosion during succeeding phases, and correlation of raised beaches with river terraces, and of drowned valleys with glacial phases consequently presents many problems. The highest raised beaches due to eustatic changes are not necessarily the oldest, but they must rather be correlated with the mildest interglacial phase.[5]

If climate is governed by periodic changes in the orbit of the earth, there are astronomic data for estimating Pleistocene chronology in years (Zeuner, 1935); the method is based on detailed stratigraphical investigations of glacial deposits, river terraces and loess in Central Europe, and on Milankovitch's (1930) solar radiation curve (Fig. 1). This curve (Fig. 1) is the mathematical solution of a problem in astronomy concerning periodic changes in some elements of the earth's orbit that cause corresponding fluctuations in the total radiation received by the earth from the sun. The period covered is the past 600,000 years. Changes in Pleistocene climates indicated by the full geological

5. For general accounts of the Pleistocene, see Boule (1923), Sollas (1924), Daly (1934) and Wright (1937).

record correspond so closely to maxima and minima in the solar radiation curve that there seem to be sound reasons for correlating them. In Central Europe there were four Pleistocene glacial phases—the Würm, the Riss, the Mindel and the Günz—each with

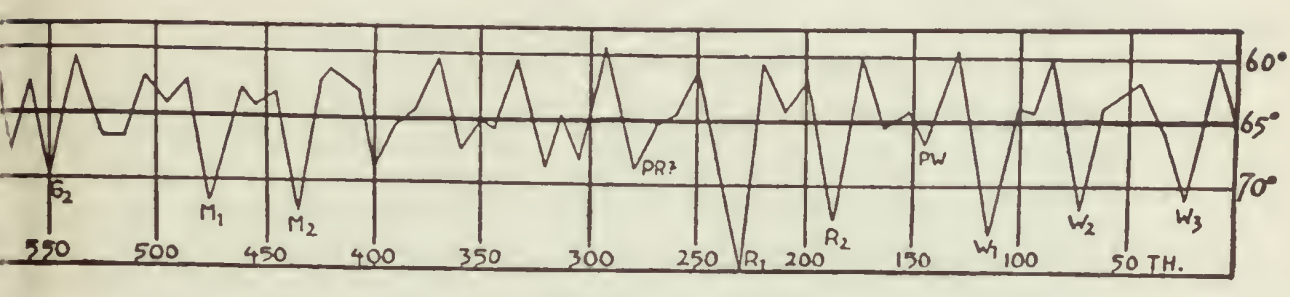

FIG. 1.
Milankovitch's Solar Radiation Curve. (From Zeuner, 1935.)

more than one climax of cold; these are dated from the solar radiation curve as follows:

	Years		Years
Post-glacial	—	Interglacial M/R .	—
Würm 3	18,000	Mindel 2	430,000
Würm 2	67,000	Mindel 1	472,000
Würm 1	112,000	Interglacial G/M .	—
Interglacial R/W .	143,000	Günz 2	545,000
Riss 2	183,000	Günz 1	586,000
Riss 1	286,000		

According to this chronology, *Homo heidelbergensis* flourished about 130,000 years ago, and *H. sapiens* migrated into Europe after the close of Würm 1 about 40,000 years later; palaeolithic culture in Central Europe dates back about 400,000 years; mesolithic appeared after the close of Würm glaciation; and neolithic began 7,500 years ago. In the Near East neolithic culture began earlier.

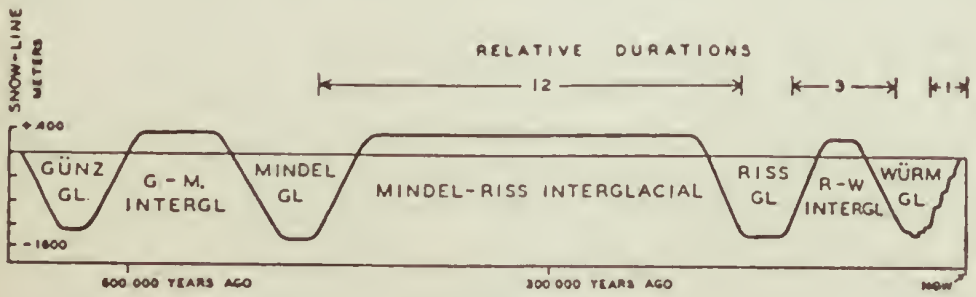

FIG. 2.
Penck and Brückner's Pleistocene Time Dragon.

Penck and Brückner (1909) from purely geological evidence worked out a time scale for Pleistocene stages in the Alps, and their estimates agree in a general way fairly well with the figures given above. Their quantitative graph (Fig. 2) is reproduced from Daly (1934).

Australian Post-Tertiary Geology

Towards the end of the Tertiary period, Australia and Tasmania underwent a tectonic uplift which ushered in the present cycle of erosion. The old Murray Gulf, until then occupied by the sea, was drained; and the Darling, the Murrumbidgee and the Murray, which had previously entered the sea by separate mouths, were engrafted to form a single river system. At a later stage a flat-domed anticline arose across the lower course of the stream; through this the river has cut a gorge 200 ft. deep in places, and for 150 miles between Loxton and Murray Bridge, South Australia, it flows through this canyon (Howchin, 1929). In early Pleistocene times the climate became colder and culminated in successive glacial phases, evidence of which can be seen in Tasmania, at Mount Kosciusko, New South Wales, and in the Owen Stanley Range, New Guinea. Below the snow line the country was well watered during the glacial and possibly the interglacial phases, but then desiccation began and the modern arid climatic cycle in Central Australia was inaugurated. Successive eustatic alternations of high and low sea level gave rise to raised beaches and drowned strandlines. Hodge Smith and Iredale (1924), from geological and biological evidence, concluded that an old shore-line extends along the 70 fathom (420 ft.) submarine contour from Broken Bay, New South Wales, to south-eastern Tasmania. Other strandlines at about 200 ft. and 70 ft. below sea level have been recorded (Cotton, 1926). Similar drowned valleys have been observed in Tasmania (Lewis, 1934, Edwards, 1941). The highest known raised beach, 380 ft. above present sea level, at Ooldea in South Australia, contains fossils which Chapman (1920) regarded as Lower Pleistocene. In the south-east of South Australia a series of dunes, generally consolidated and roughly parallel to the coast, and remains of successive elevated coast lines extend as far as Narracoorte, about 60 miles inland (Tenison Woods, 1862, Howchin, 1918, C. Fenner, 1931, Tindale, 1933, Crocker, 1941). The Narracoorte "Range" follows along a fault scarp which has been revealed by marine denudation in some places and is masked by dunes in others. If the raised strandlines correspond with interglacial high sea levels, and the consolidated dunes were formed during glacial epochs, this district may furnish a key to

Pleistocene history; Hills (1939 b), however, holds that tectonic movements caused the coast to retreat to its present position. In many parts of Australia are remains of a raised beach at about 15-20 ft. above sea level containing mollusca and foraminifera which suggest a climate somewhat warmer than that of the present day (Howchin, 1923, Tindale, 1933). This beach does not appear to correspond with Wright's pre-glacial 15-foot beach of Western Europe, but was probably formed during the slight general post-glacial refrigeration already mentioned; Daly (1934) estimated that the change happened about 4,000 and Cotton (1926) 3,000 to 5,000 years ago, but Milankovitch's curve indicates 10,000 years. River terraces exist at various heights up to 100 ft. above present stream level. Extensive dunes fringe the coast in many places; the older consolidated dunes contain remains of extinct marsupials and in places are covered with volcanic ash, and the youngest dunes are still accumulating. Hills (1939 a) considers that the consolidated dunes were formed during the low-water glacial phases, and that the comparatively minor dunes of loose sand are post-glacial.

Some Australian raised beaches and submerged shore-lines may be due principally or entirely to eustatic changes in sea level; but tectonic movements in certain localities are indicated by such features as the anticline across the lower course of the Murray River (Howchin, 1929), and in north-western Victoria and adjoining areas by elevation during Pleistocene and Holocene times accompanied by faulting and warping (Hills, 1939 b). If we accept as approximately correct Daly's estimate that the melting of all ice-caps and glaciers would raise average sea level about 130 ft., the Ooldea raised beach at 380 ft. above present sea level and about 80 miles from the coast must have been elevated, at least in part, by tectonic movement. The fact that volcanoes were active in south-eastern Australia during Pleistocene and post-Pleistocene times suggests that earth movements were in progress.

The problem of correlating Pleistocene glacial deposits, river terraces, raised beaches, submerged strandlines, sand dunes and alluvial deposits in Australia has not yet been solved. We have no knowledge of the order in which extinct marsupials died out, and consequently their fossil remains do not date the deposits in which they are found; some species and genera possibly did not survive the early Pleistocene stages, but others such as *Diprotodon* appear to have lived until recent times; *Thylacinus* and *Sarcophilus* are extinct on the mainland but survive in Tasmania.

Lewis in 1923 demonstrated three Pleistocene glacial phases in Tasmania and in 1933 he gave a more detailed account of them.

He used local names for identified phases since he was not convinced that they are contemporaneous with Pleistocene glacial phases in the northern hemisphere. He could find no evidence of a fourth phase corresponding to the fourth phase of Europe. The three phases are:

1. The Margaret; the latest, mountain tarn stage.
2. The Yolande; the most obvious, cirque-cutting stage.
3. The Malanna; an ice-cap stage, the oldest and most extensive, but preserved only as fragments.

Lewis considered that his investigations do not preclude other glaciations. There may be (1) an obliterated pre-Malanna glaciation; (2) a glacial phase between the Malanna and the Yolande; or (3) a subdivision of the Malanna into more than one phase.

He said that the Malanna ice-cap covered from a third to a half of Tasmania. It was followed by a lengthy interglacial phase during which he considers that the Pieman, the Derwent and other rivers cut gorges 1,000-2,000 ft. deep in hard rocks. Yolande glaciation moulded the topography of those parts of the island more than 2,000 ft. above sea level and is responsible for the most obvious cirques, moraines and glacial deposits, but it lasted a much shorter time than the Malanna and was less intense. An interglacial phase probably followed; Lewis could not prove this, but considered available evidence pointed to it. The third, least intense and most recent glacial phase is the Margaret, which gave rise to mountain tarns.

Tentative proposals for correlating non-glacial Pleistocene features with glacial phases have been suggested by David (1924), Tindale (1933), Lewis (1934) and Edwards (1941). None of these authors indicates whether heights of raised beaches and terraces were measured by instruments estimated by eye.

David assigned the maximum Tasmanian ice-sheets and the ice-cap of Mount Kosciusko at 5,000 ft. to the Mindel phase, and moraines of the Tasmanian National Park at 2,500-2,800 ft. to the Riss. He considered that erosion of V-shaped valleys superimposed on older U-shaped valleys of the Pieman River, Tasmania, and of the Snowy River at Kosciusko began in the Riss-Würm interglacial phase, and that the extensive rock platform at 65-85 ft. above sea level in the Ringarooma Valley and the peat deposits of Mowbray Swamp, both in Tasmania, were formed at the same period. To Würm glaciation he assigns lake basins in the Tasmanian National Park at 3,200-3,500 ft.; glaciation at Blue Lake, Kosciusko, at 6,150 ft.; and the newest torrent gravels of Eastern Gippsland, Victoria. Minor post-Würm glaciation followed at the

Tasmanian National Park near the 4,000 ft. contour and also gave rise to high-level tarns at Kosciusko and moraines near Townshend's Pass in the same district at 6,400-6,700 ft. This was followed by deglaciation, rising sea level, volcanic eruptions at Mount Gambier, South Australia, and Tower Hill, Victoria, and then by a negative eustatic movement in sea level of about 10-15 ft.

In Tasmania Lewis recognized raised beaches and river terraces at 50-100 ft., 40-50 ft. and 5-15 ft. above sea level, and drowned valleys at 150 ft., 30-60 ft. and 20 ft. below sea level. He tentatively correlates these and other features with the three glaciations. Conglomerates of quartzite pebbles at 50-100 ft. above sea level in southern Tasmania, claypan deposits underlying Mowbray Swamp,[6] and the Helicidae sandstone (consolidated dunes) at 100 ft. on the islands of Bass Strait he regards as pre-Malanman. The channel of the Derwent River is eroded to 150 ft. below sea level and the strandline must have dropped by this amount; he correlated this with eustatic lowering of sea level during Malanna glaciation, when Tasmania and Australia were united by a land-bridge. River terraces and raised beaches at 40-50 ft. he assigns to the Malanna-Yolande interglacial phase; the conglomerates of these terraces in southern Tasmania consist almost entirely of pebbles of dolerite and Permo-Carboniferous mudstone. Vast changes in physiography took place during the Malanna-Yolande interglacial phase. There is some evidence of river erosion 30-60 ft. below sea level which he considers to correspond with the Yolande phase. The formation of the 5-15 ft. raised beaches and the lowest river terraces he correlates with the Yolande-Margaret interglacial phase. The development of existing river courses and a channel 20 ft. below the floor of the Derwent estuary he attributes to the Margaret glacial phase. Since the latest glaciation he considers that there has been a progressive rise in sea level and that the valley of the Derwent has been drowned as far upstream as New Norfolk.

Edwards observed in north-west Tasmania at least two raised shorelines, one at 5-15 ft. and the other at 40-50 ft., with river terraces at corresponding heights and, in the Mersey and Forth valleys, suggestions of a third strandline at about 100 ft. above sea level in the form of doubtful remnants of river terraces; Johnston (1888) had noted a raised beach at this level on Chappell Island. The valley of the Tamar can be clearly followed on the Admiralty Chart to 15 fathoms and less clearly to 20 fathoms, and contours of submarine valleys in the neighbourhood of Hunter Island and Three Hummocks Island can be traced to 25 fathoms,

6. For notes on Mowbray Swamp see Noetling (1911).

indicating a submerged shoreline at 120-150 ft. Many basalt-filled valleys pass below sea level and there is some geological evidence that they are older than the 120-150 ft. submerged strandline, but no depth can be suggested for the corresponding submerged shore. He considered that in view of the magnitude of eustatic changes in sea level, there can be little doubt that successive glacial and interglacial stages are contemporaneous throughout the world, and that Tasmanian river terraces and strandlines must be correlated with those of the northern hemisphere. There is considerable evidence for a world-wide eustatic fall in sea level of about 15-20 ft. in post-glacial times and we should therefore expect four sets of terraces, but in Tasmania, where the record is not complete, only three have been demonstrated. In his opinion the 40-50 ft. raised strandline may correspond to the Riss-Würm interglacial stage, and the 100-150 ft. strandline to the Mindel-Riss stage; according to figures given by Daly (1934) for corresponding raised beaches in Europe and North Africa, their heights are of about the right magnitude. The 120-150 ft. submerged strandline is older than the 40-50 ft. raised beach and presumably younger than the 100-150 ft. raised beach, and on the suggested correlation it should correspond to the Riss glacial stage. The pre-basaltic strandline should be correlated with an earlier glacial stage, possibly the Günz, but he points out that the basalt-filled valleys may have been brought to their present positions by faulting.

David's, Lewis's, and Edward's tentative correlations of Australian Pleistocene and Holocene phenomena are tabulated on the adjacent page.

Tindale (1933) recorded six raised strandlines between Narracoorte, South Australia, and the present coast. They are situated at heights ranging from about 15 ft. to 220 ft. above sea level on the seaward side of parallel lines of dunes. He correlated them with six raised beaches on the Atlantic coast of the United States investigated by Cooke (1930). Below are tabulated Tindale's and Cooke's names for the South Australian and American terraces, Cooke's tentative correlation with glacial and interglacial phases (American nomenclature), and the equivalent European periods according to Daly (1934):

S.A. Strands	U.S.A. Strands	Glacial and Interglacial Phases	
Woakwine	Pamlico	Mid-Wisconsin	Mid-Würm
Reedy Creek	Chowan	Peorian	Riss-Würm Intergl.
West Avenue	Wiscomico	Sangamon	Riss-Würm Intergl.
East Avenue	Sunderland	Yarmouth	Mindel-Riss Intergl.
Cave Range	Coharie	Aftonian	Günz-Mindel Intergl.
Narracoorte	Brandywine	Pre-glacial	Pre-glacial

	David, 1924	Lewis, 1933, 1934	Edwards, 1941
Post-Glacial . . .	Progressive fall in sea level. 10-15 ft. raised beach. Eruptions at Tower Hill and Mt. Gambier. Deglaciation with rising sea level.	Progressive rise in sea level.	5-15 ft. raised beaches and terraces.
Würm Glaciation (Margaret) . .	Last severe glaciation. Lake basins, National Park, Tasmania, and Mt. Kosciusko.	Margaret glaciation. River channel 20 ft. below floor of Derwent estuary.	
Riss-Würm Interglacial (Yolande-Margaret) . . .	V-shaped superimposed on U-shaped valleys of Pieman and Snowy Rivers. Ringarooma flats excavated. Mowbray Swamp peat deposits.	5-15 ft. raised beaches. Lowest river terraces.	40-50 ft. raised beaches.
Riss Glaciation (Yolande) . . .	Moraines, National Park.	Yolande glaciation. River erosion probably to 60 ft. below sea level.	120-150 ft. submerged strandline.
Mindel-Riss Interglacial (Malanna-Yolande) . . .		Raised beaches at 40-50 ft. River terraces at corresponding heights. Gorges cut 1000-1200 ft. deep.	100-150 ft. raised beaches.
Mindel Glaciation (Malanna) . . .	Maximum ice-sheets, Tasmania. "Calotte" ice, Mt. Kosciusko. Kosciusko-Snowy River moraines.	Malanna glaciation. River erosion to 150 ft. below sea level.	
Günz-Mindel Interglacial			

	David, 1924	Lewis, 1933, 1934	Edwards, 1941
Günz Glaciation .		? Malanna glaciation in part.	? Submerged basalt-filled valleys.
Pre-Glacial		Gravels at 50-100 ft. Helicidae sandstone at 100 ft. Claypan deposits underlying Mowbray Swamp.	

Contour maps prepared by Noetling (1909) from soundings recorded on Admiralty charts show that a lowering of sea level by 25 fathoms (150 ft.) would almost connect Tasmania and Australia by land, and a fall of 30 fathoms (180 ft.) would complete the land-bridge.[7] Lewis (1934) correlates the greatest fall in sea level that he found in Tasmania, about 150 ft., with the Malanna glacial phase, and Edwards (1941) with the Yolande. If either of these opinions is correct, and there have been no appreciable tectonic movements, island and mainland have been separated by sea since the second or third Pleistocene glacial epoch, a period antedating the migration of *Homo sapiens* into Europe.

The fauna of Tasmania and adjacent islands in Bass Strait differs from that of the Australian mainland in several respects, suggesting that the two regions have been isolated from each other long enough for evolutionary changes to have taken place. The Tasmanian region is small and its topography and climate resemble those of the adjacent mainland, particularly Gippsland. Differences in fauna may be illustrated by birds and mammals. Tasmania has about 200 species of birds, most of them in common with Australia, of which about one-fourth are passerine, a ratio of 1 to 3 in contrast to a ratio of 1 to 1 on the mainland. Of nine good species confined to the Tasmanian region, two are restricted to Tasmania proper and seven are also found on adjacent islands. In addition, many well-defined subspecies are peculiar to this region. Tasmania has 32 species of land mammals; two monotremes (Platypus and Echidna), 20 marsupials, and 10 placentals (rats and bats). The Echidna is a subspecies confined to Tasmania and adjacent islands. Twelve of the marsupials are found also in Australia, but eight good species and three subspecies are restricted to the Tasmanian region; of these, four species are found only in Tasmania, and four species and three subspecies also inhabit adjacent islands. *Macropus billardieri,* one of the

7. For supplementary soundings see Dannevig (1910).

species now confined to the Tasmanian region, became extinct on the Australian mainland only 70 years ago; and bones of two others, *Thylacinus cyanocephalus* and *Sarcophilus ursinus*, are found in Holocene deposits on the mainland (Mahony, 1912, Hale and Tindale, 1928). Among the placentals, two rats are confined to Tasmania, the others being also found in Australia. For the above details of birds and mammals I am indebted to George Mack and C. W. Brazenor respectively. The fact that the fauna of islands in Bass Strait is essentially Tasmanian indicates that these islands continued to be connected by land with Tasmania long after the Tasmanian region and the Australian mainland were separated by sea.[8]

Geological Evidence of Human Antiquity in Australia

Fossil or sub-fossil human bones have been found in a few Australian localities. Those from Talgai, Aitape, and Keilor are very probably of Pleistocene age: geological evidence of the age of the Keilor skulls and bones seems irrefutable. There are insufficient data on which to base even a guess at the age of the Tartanga bones, except that they are much younger than the Pleistocene anticline through which the Murray in this locality has cut its canyon, but considerably older than those found in the adjacent Devon Downs rock shelter. Evidence concerning the identification and age of the alleged human tooth from the Wellington Caves bone-breccia is unsatisfactory. The Devon Downs bones and the mineralized skulls found at Cohuna and elsewhere in the Murray valley are geologically recent though probably ancient in the historical sense.

Many claims for antiquity of man in Australia have been based on artefacts found, or alleged to have been found, in consolidated dunes, beneath lavas or tuffs of the Newer Volcanic period, in beds containing bones of extinct marsupials, associated with raised shorelines, or buried beneath alluvium. The Newer Volcanic eruptions probably began in Pliocene or early Pleistocene times and continued after the Pleistocene period came to an end, and we know nothing about the order in which various extinct mar-

8. For further details of Australian Post-Tertiary geology see W. Anderson (1890 a), Andrews (1902), Aurousseau and Budge (1921), Bryan (1925), Cameron (1901), Campbell (1910), Chapman (1928), Chapman and Gabriel (1918), Chapman and Mawson (1925), David (1907, 1932), David and Etheridge (1890 b), Dennant (1887), Etheridge (1876, 1890), Etheridge and others (1896), Grant and Thiele (1902), Gregory (1861), Hall (1909), Hardman (1883, 1884, 1885), Harper (1916), Hart (1893), Hills (1940 a, b), Howchin (1887, 1912, 1918, 1923), Hunter (1909), Jack and Etheridge (1892), Jackson (1902), Johnston (1888), Jutson and Coulson (1936), Keble and Macpherson (1943), Kitson (1900, 1902), Lucas (1887), Marshall and others (1925), Murray (1887), Pritchard (1910), Richards and Hedley (1925), Singleton (1941), Saint-Smith (1912), Selwyn (1854), Somerville (1920), von Sommer (1849), Süssmilch (1922), Whitehouse (1940), Woods (1862), Woodward (1894), and Woolnough (1912).

supials died out or when they became extinct; unless there is corroborative evidence, mere association with volcanic rocks or with strata containing bones of extinct marsupials does not prove that artefacts are of Pleistocene age, but geological evidence strongly suggests that the Myrniong artefacts belong to this period. Some shell middens are associated with inland shorelines about 10 ft. or 20 ft. above present sea level, which are probably about 4,000 years old; if this estimate is correct, and the middens were formed not long before sea level fell, these middens are ancient in the historical, but not in the geological sense, and the men who made them lived at about the time that Abraham went into the land of Canaan; it is possible, however, that these shorelines are more than 4,000 years old. In some localities deposition of alluvium is still in progress, in others it has long ceased; evidence for antiquity of bones and artefacts covered by alluvium therefore depends on local conditions.

The Wellington Tooth Fragment

Since some confusion exists concerning this specimen, its full history is given below.

The first to observe bone-breccias in the Wellington caves appears to have been George Rankin, of Bathurst, New South Wales, in 1830; later in that year Major Thomas Mitchell visited the caves and collected fossil bones, which he sent to Sir Richard Owen. Mitchell (1838) published an account of the caves with plans and a list of fossil marsupials collected there and determined by Owen.

Krefft (1867, p. 91) wrote: "*Homo,* Melanian variety. Bones of the extremities found in a cave at Wellington Valley, being—left and right femur, left and right tibia, left and right humerus, portion of fibula"; he makes no suggestion that the bones were ancient or fossilized. On p. 112 he says that in one of the Wellington caves "human remains were obtained, but though very old they are not fossil."

The history of the exploration of the caves between 1867 and 1882 is set out in a New South Wales Parliamentary Paper (Anonymous, 1882). At the suggestion of Sir Richard Owen, the New South Wales Parliament in 1867 voted funds for the exploration of the caves by the Curator of the Australian Museum, at that time Gerard Krefft. In October, 1869, Krefft reported that he had sunk two shafts in the bone-breccia and had obtained many fossil bones, including those of *Thylacoleo, Diprotodon, Nototherium,* and *Canis dingo*; he also gave a "List of photographs of Australian fossils for transmission to Professor Owen, F.R.S.,"

in which, under Plate II, he mentions "the 5th metatarsal bone of a man (recent)." Owen, in a letter to Krefft, dated January 8th, 1870, remarked: ". . . the only disappointment was the absence of human remains and works; but this is an instructive negative fact and accords well with former experience of research in the Wellington Caves." Krefft's more detailed list of fossils, dated May, 1870, makes no mention of human bones or teeth. In a geological report made in the same year, Professor A. M. Thomson, who visited the site with Krefft, said that "in the caves at Wellington no vestiges of man, whether in the shape of bones, weapons or works of art, have been discovered."

In another publication, not recorded in the Parliamentary Paper, Krefft (1870) referred to the fractured crown of a molar tooth, probably human, found in the Wellington caves, and four years later (Krefft, 1874) he wrote: "I have found the fractured crown of a human molar tooth in the same matrix as *Diprotodon* and *Thylacoleo* at Wellington in this colony. Man may therefore have been the contemporary of these animals and also of *Dromornis*." These are apparently Krefft's only published references to the tooth. None is given in the Parliamentary Paper of 1882. Krefft's appointment at the Australian Museum was terminated in August, 1874.

Etheridge (1891) re-examined the fragment, which consists of about two-thirds of the crown broken off from the remainder of the tooth, and wrote—"that it is the crown of a human molar is, I think, beyond much doubt; but to guard against mistake I placed the specimen in the hands of Mr. P. R. Pedley,[9] who corroborates Mr. Krefft's determination." The tooth, though mineralized to the same extent as the marsupial teeth, was not in the matrix, and Etheridge was not convinced that it came from the bone-breccia. He mentioned a recent unmineralized skeleton of an aboriginal woman found in No. 2 cave; this is possibly the "human remains" recorded by Krefft in 1867. Later, Etheridge (1916) found among the Krefft MSS. in the Mitchell Library in Krefft's own handwriting an explanation of the plates that had been published in the Parliamentary Paper referred to above. In explanation of Plate 12, Krefft wrote: "Figs. 3 and 4. Side view, natural size, and view from above enlarged of a human molar tooth, taken from the solid breccia of Wellington Cave by the writer." Attached to these documents is what appears to be a small plan of the work going on at the caves under Krefft's supervision, but possibly prepared by the workman in charge, giving depths and details; in a footnote to this plan occurs the following remark: "In a

9. Pedley was then a leading dentist in Sydney.

well-hole where Krefft found human skeleton in red breccia." This skeleton, as far as I can ascertain, had never before been mentioned in any publication, and Dr. Walkom, Director of the Australian Museum, has informed me that no record of it can be found in the Australian Museum.

C. Anderson (1926) considered that the fossil bones of the bone-breccia are those of animals which either fell through sink holes or were swept in by flood waters; that they probably differ considerably in age; and that the human tooth, therefore, may possibly belong to a later period than some of the other bones.

Finally, Dr. T. D. Campbell has kindly allowed me to say that in 1935 he had an opportunity of briefly examining the specimen, and in notes made at that time he recorded that the attrition of the tooth fragment does not appear to accord with that usually found on aboriginal molars; and this appearance, together with other features, left in his mind a definite doubt that the tooth fragment is human.

Both geological evidence of antiquity and specific determination of the tooth are unsatisfactory.

The specimen is in the Australian Museum, Sydney.

The Talgai Skull.

The Talgai skull was found in 1884 by a man employed at Talgai Station, near Clifton, Darling Downs, Queensland, and was in private possession until 1914, when it was forwarded to Professor Edgeworth David. Shortly afterwards, David and Wilson (1914) published a preliminary note on the skull. Stewart Smith (1918), who described it in detail, says that late in 1914 Professor David visited Talgai and there found the original discoverer, then a very old man, who pointed out to within a few yards the spot in the bank of the gully where he had found the skull 30 years previously. He said that it protruded from the bank about 3 ft. above the bottom of the gully. Here black soil 6 or 7 ft. thick overlies red-brown clay, and according to the finder, the skull was embedded in the upper part of the clay. No bones of extinct marsupials have been found at this site, but they have been found in similar clay at various places in the Darling Downs, such as King's Creek, 10 miles from Talgai. David supplied Stewart Smith with geological notes and the section reproduced in Fig. 3.

The skull is that of a male youth with unerupted wisdom teeth. It is mineralized and has been considerably distorted by pressure of the clay in which it was embedded.

Geological evidence cannot be regarded as satisfactory since it depends on the memory of an untrained observer who found the

specimen 30 years before he pointed out the site to David; but colour, state of mineralization, and distortion of the skull are similar to those characteristic of skulls of extinct marsupials found in the red-brown clay of the Darling Downs. Whether this formation is Pleistocene or Holocene in age has not been determined, but it is probably Pleistocene.

According to Stewart Smith the skull is very primitive,

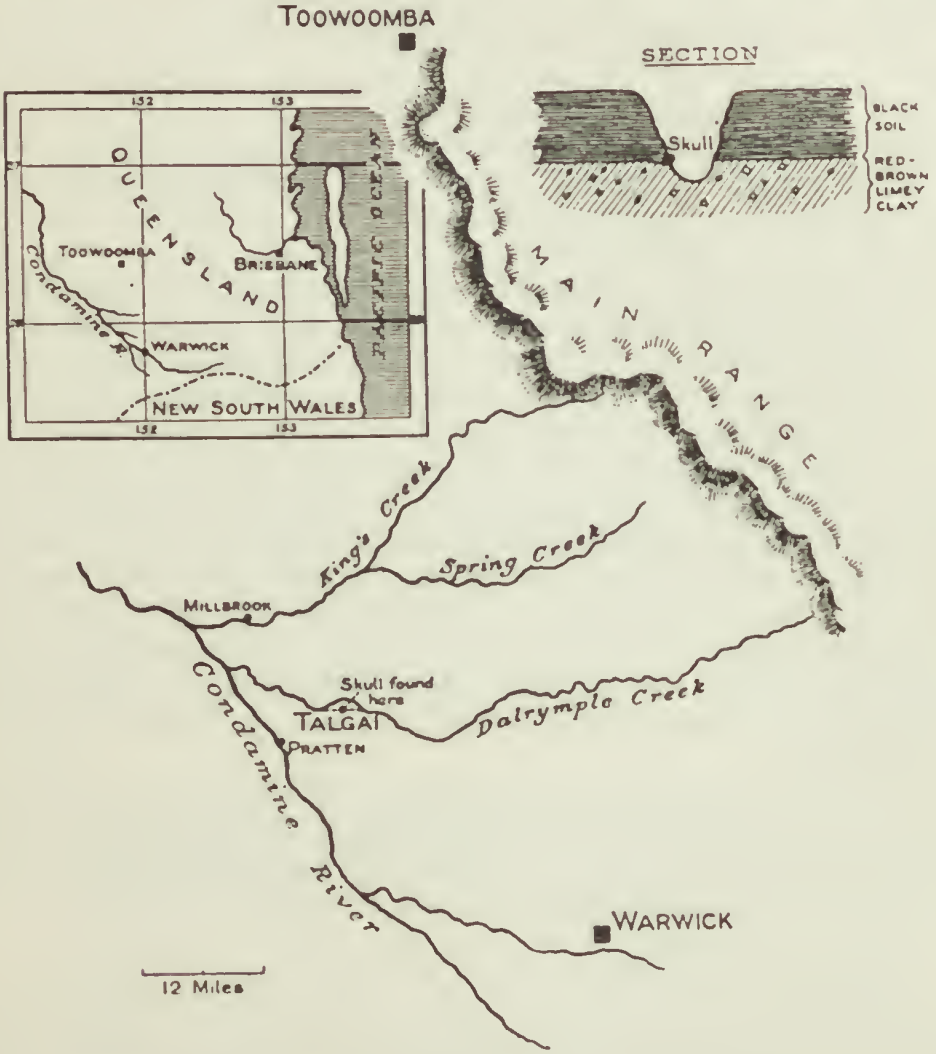

FIG 3.
Talgai: Locality Plan and Geological Section. (Stewart Smith, 1918.)

especially in respect to the large facetted canine teeth, but it is undoubtedly of the Australian type, and available evidence fails to reveal Tasmanian affinities. He said that the cranium is similar in all respects to the cranium of the modern Australian, and the facial skeleton is of Australian type; but in the palate and canine

teeth there are, in conjunction with the most primitive characters found in modern skulls, others more ape-like than have been observed in any living or extinct race, except *Eoanthropus*. Burkitt (1928) concluded that the position and facetting of the canine teeth fall into line with those of modern aboriginals, but that the teeth anterior to the molars are more primitive, especially in size; and that Stewart Smith's conclusions regarding the primitive character of the palate remain unaltered. He said that the palate of the Talgai skull with unerupted wisdom teeth is as large as the palate of the average modern adult male aboriginal with the full complement of molar teeth.

Campbell (1925) remarked that measurements of the teeth of the Talgai youth are greater than average measurements of corresponding teeth of modern aboriginals, but, with few exceptions, all lie within the extreme range.

Wood Jones (1934 a) published dioptrographic drawings of the palates of a large modern aboriginal skull from Wentworth, New South Wales, and of the Talgai skull. He says that the teeth of the Wentworth skull are worn and the canines are absent, but even with this disadvantage it clearly demonstrates the fact that the Talgai skull has no real claims to be considered outside the range of variation of the recent aboriginal. He adds that since Stewart Smith's original publication, investigations by Campbell and Burkitt have rightly tended to diminish the importance of certain features taken by Stewart Smith to indicate a peculiarly ape-like dentition; and that it is fair to say that the Talgai skull should be regarded as that of a young aboriginal with large palate and large teeth, but still not wholly outlandish even in regard to these features.

Dr. J. Wunderly has informed me that some canine teeth extracted in the Melbourne Dental Hospital from jaws of Europeans are larger than any recorded for Australian aboriginals.

The skull is in the Anatomy School, University of Sydney.

The Tartanga Skeletons

Tartanga lies in the Murray River canyon near Nildottie, South Australia, where the valley is a mile wide and is bounded by cliffs of Tertiary limestone about 40 ft. high. The river is over 100 yards across and the narrow low-lying island where the bones were found separates the stream from Tartanga lagoon.

Part of a human skeleton exposed by erosion at Tartanga was sent to the South Australian Museum in 1928 by W. R. Roy, of New Devon Downs. In consequence, Hale and Tindale (1928) excavated both this site and the adjacent Devon Downs rock

shelter with great care. Palates and teeth of human skulls they discovered were examined by Dr. T. D. Campbell.

Hale and Tindale cut a trench across the outcrops of five layers of consolidated sand and clay having a total thickness of about 6 ft. 6 in.; these beds dip eastwards at a low angle, and they are overlain to the east by recent unconsolidated mud and silt. The first-found fossil skeleton was exposed by denudation in the uppermost consolidated layer. These and other human bones found at this site are heavily stained with iron oxide and considerably mineralized.

In the top layer was the much fragmented skeleton of a child with a fairly complete skull, of which the authors give measurements and dioptrographic drawings. Dimensions of all teeth except the unerupted third molars are greater than the average recorded for Australian aborigines, the second incisor being equal to the maximum, but, as in the Talgai skull, the upper third molars are of less than average size. The estimated area of the palate is 3,600 sq. mm., a size found only in exceptionally large Australian adult male skulls, but the teeth suggest a child 10-12 years old. The body had apparently been buried from the upper part of the bed in which it was found. In the next underlying bed were portions of a left maxilla, the right ramus of a lower jaw and three loose teeth. The teeth, which indicate a child about 12 years old, are large, and crenulation of the occlusal surface of the second and third molars is more marked than is usual in teeth of modern Australian aborigines. In the third bed from the surface were the greater part of the bones of the trunk and a skull fragment; this was a burial, apparently from the upper part of the uppermost bed.

With the bones was evidence of occupation of the site—burnt stones, food debris, flakes of quartz and chert, and implements of chert and bone. Shells of a freshwater mussel are abundant; the shell is relatively thicker than that of *Unio rittatus*, which lives in the neighbouring lagoon, but otherwise resembles it, and Hale and Tindale gave this mussel specific rank with the name *Unio* (*Hyridella*) *provittatus*.

The authors conclude that full discussion of the Tartanga remains must await detailed study; that material at present available suggests an early Australian race linking Talgai man with modern aborigines; and that geological and physiographic features indicate at least some antiquity.

Tindale (1941) suggested that the Tartangan may have resembled the Tasmanian aboriginal, but he brought forward no evidence to support this view; he adds that Tartangan man

seemingly lived immediately prior to the formation of the post-glacial (12-20 ft.) marine terrace.

The bones were in a deposit formed after the river had cut its canyon through the Pleistocene anticline previously mentioned.

All specimens are in the South Australian Museum, Adelaide.

Devon Downs Human Remains.

At Devon Downs cliff shelter, occupational detritus, where excavated by Hale and Tindale (1928), was about 20 ft. thick and divided into twelve layers. The shelter had previously been described and figured, but not excavated, by H. L. Sheard (1927).

Human remains were found in the second, third, fourth, sixth, and eleventh layers from the surface. None was mineralized. In layer 2 were the bones of a young baby; a burial. In layer 3 a child of 15 to 18 months old had been buried; the skull was almost complete, and most of the other bones were recovered; deciduous teeth are all present and are very large. From layer 4 a deep grave penetrated layer 5 and part of layer 6; it contained a child's skeleton and an almost complete human lower jaw; the teeth are similar to those from layer 3. In layer 6 were the greater part of a lower jaw, some teeth, and a few fragments of the calvarium of a child about 5 years of age; the jaw and teeth resemble those of recent young aborigines of similar age. In layer 11 was a single, much-worn crown of a left deciduous incisor; it is large but considerably worn by attrition.

Hundreds of artefacts and animal remains were distributed throughout the occupational detritus. Bones of *Sarcophilus,* now confined to Tasmania, occur in the lower layers.

The authors believe that the accumulations in Devon Downs shelter are younger than the Tartangan strata; that the artefacts in successive layers of the well-stratified occupational detritus indicate five successive cultural phases; and that faunal modifications are possibly due to changes in climate.

The thickness of stratified detritus and variation in artefacts and fauna in successive layers indicate that the shelter was used by aborigines for many centuries.

All specimens are in the South Australian Museum, Adelaide.

The Keilor Skulls and Bones.

Two mineralized human skulls and some other bones were found in undisturbed ground at a depth of 19 ft. in a terrace adjoining the Maribyrnong River and 45 ft. above river level. The sandpit where they were found is a mile north of Keilor village, which lies 10 miles north-west of Melbourne. The sandpit was worked by

R. Hughes, sand contractor. Except for two small pieces of bone near the foramen magnum and a hole in the side made by the pick of the workman who unearthed it, one skull is complete, but its lower jaw is missing. It is large and it combines Australoid with Tasmanoid characteristics in about equal proportions. Anatomical descriptions of the specimen as a whole by Dr. J. Wunderly and of the palate and dental arch by Dr. William Adam will be found elsewhere in this volume of Memoirs, together with notes based on geological investigations by R. A. Keble and Miss Hope Macpherson, which indicate that it dates back to the Riss-Würm Inter-

FIG. 4.
Quartzite Flake, Keilor.

glacial phase of Pleistocene times. The second skull and most of the other bones have not yet been received by the Museum.

Mr. Hughes has supplied the following note on the circumstances of the discovery:

"Early in October (about Oct. 10th), 1940, a fossil human skull was found by James White, who was employed by me, in a pit which I opened for moulding sand near the junction of Dry Creek and the Maribyrnong River about one mile north of Keilor. I was present at the time together with Thomas Murphy. White was working on the face of the pit when his pick went through the skull and broke it into three pieces. It was about 15 ft. below the surface of the ground and 18 in. above the floor of the pit. One fossilized limb bone and several other fragments of bone were found alongside the skull. The sand above the bones showed no signs of having been disturbed by a burial and the skull could not have fallen from above since it was embedded in undisturbed sand. We washed off the sand with which it was coated. I took the skull and pieces of broken bone to the National Museum on November 4th, 1940, and left them there. Some weeks later Mr. Mahony, Mr. Keble and Mr. Brazenor of the National Museum visited the sand pit with me and I pointed out to them the spot where the skull was found. Up

to this time the face of the pit at this point was in the same condition as when the skull was found. Since then five pieces of another skull were found at the same level and about six feet distant from the first skull."

(Signed) R. Hughes, Aug. 22nd, 1942

Dr. E. S. Hills found a quartzite flake protruding from undisturbed sand in the wall of the pit close to the spot where the skull was unearthed. The flake (Fig. 4) is evidently an artefact.

Owing to war-time conditions it has been impossible to carry out systematic excavation and sieving of sand to find other bones, teeth and artefacts.

One skull, some fragments of bone and the quartzite flake are in the National Museum of Victoria, Melbourne.

The Aitape Skull

This specimen is mentioned since New Guinea is close to Australia, the skull is Australian in type, and there is geological evidence of its antiquity. It was described by F. J. Fenner (1941).

Aitape District is situated in the western part of the Mandated Territory of New Guinea. In 1929, P. S. Hossfeld, of the Northern Australian Geological Survey, found fragments of a fossil human skull *in situ* in a bed of littoral marine clay outcropping in the east bank of Paniri Creek near Barida Village, Aitape, 10 miles from the coast and about 300 ft. above sea level. The skull was overlain by 4 ft. of undisturbed littoral deposit containing marine mollusca, and above this by 6 ft. of gravel on which rested soil. The littoral marine deposit forms part of the Upper Wanimo Series which is considered by Survey authorities to be Pleistocene in age. There is no record of other mammalian bones at this site.

The fragment was broken into four pieces while being unearthed. Three of these fitted together accurately. The reconstructed calvarium comprises the greater part of the frontal bone, parts absent being the left external angular processes and both orbital plates. The nasal process is almost entire, and the sutural impressions of the nasal bones and the nasal processes of the maxilla are preserved. On the right side, the sutural impression of the frontal process of the zygomatic bone is undamaged. Portions of both parietal bones are present, their broken edges running roughly parallel to the coronal suture and about three centimetres behind it. The specimen shows no evidence of being waterworn. Fenner suggests that the fragment is portion of the skull of a female about 45 years of age. He discusses its racial affinities and considers that it belonged to an individual not differing greatly from the southern type of modern Australian aboriginal, but he adds that occasional rare Australoid types of New Guinea skull

differ from the Aitape fragment little more than do average Australian skulls. There are no characters suggesting affinities with Tasmanians; the absence of the paramedian parietal groove, stressed by Wunderly as characteristic of Tasmanians, and the fairly obvious narrowness of the parietal region definitely excluding this possibility.

The skull is in the Australian Institute of Anatomy, Canberra.

Other Fossil Human Remains

Basedow (1925) mentioned the fossilized posterior half of the left parietal of a human skull found in "Pleistocene (or Pliocene?)" gravels SSE. of Tennant's Creek district, Central Australia. He gives no exact locality, no indication of how the age of the deposit was determined, nor at what depth the specimen was found, nor who discovered it. I can find no record of where the specimen now is. H. M. Hale and N. B. Tindale, of the South Australian Museum, have informed me that they handled the specimen some years ago, and that Basedow then told them that it had been found on the surface; it was stained brown but not mineralized, and in their opinion it did not suggest geological antiquity. After Basedow's death they prepared his collections for submission to the Institute of Anatomy, Canberra, which afterwards purchased them, but the specimen was not then recognized among his effects.

The Melbourne *Argus* of December 6th, 1915, published the following note:

"While digging out marl at Jimmy's Point, Lakes Entrance, a labourer recently unearthed three human skulls, evidently of very primitive type. They were near the base of the escarpment, and about ten feet from the grassed surface. Each of them was in a remarkably good state of preservation. Professor Flynn from Tasmania, who was making an official tour of inquiry at the Lakes with the Chief Inspector of Fisheries, Victoria, examined the skulls, and said he would report to the Melbourne University, and that they were of great archaeological interest."

I have been unable to find what became of these skulls; they are not at the Melbourne University.

Under favourable conditions, such as contact with water carrying carbonates in solution, organic matter may be rapidly mineralized. There are certain springs in which twigs, etc., become coated and impregnated with carbonate of lime in a few weeks. Mineralization of human bones cannot therefore be taken as proof of geological antiquity; the age of the deposit in which the bones are found and evidence that they are contemporaneous with it, not subsequent burials, are the only acceptable proofs of geological antiquity.

However, since mineralization of bones predisposes some people to attribute geological antiquity to them, Australian examples with no claim to such antiquity are mentioned below.

In the surface deposits of the vast alluvial plain through which the Murray, its anabranches and tributaries wander, mineralized human skulls and other bones have been found at or close to the surface at Renmark, Swan Hill, Cohuna, Moulamein, Nyang, Balranald, Euston, and Nacurrie. Alluvium has here accumulated to a depth of at least 150 ft. during Post-Tertiary times, and all surface deposits are Holocene.

Except in the case of the Cohuna skull, no claim has been made that these skulls differ from those of modern Australian aborigines. Wood Jones, who examined some of them, is of the opinion that there are no morphological features by which they can be differentiated from those of modern aborigines (Wood Jones, 1934; Mahony and others, 1936). F. J. Fenner (1938) described two of them (a child of 4 or 5 years old and an adult), both pathologic, together with three similarly pathologic skulls of recent aborigines, and he found that in features other than pathologic the adult skull is typical of the adult male Australian.

The Cohuna skull, however, has had some fame to which, as shown below, it is not entitled. It was found during the excavation of an irrigation channel near Cohuna, Victoria, in November, 1925, at a depth of two feet in red loam. No other human bones were discovered at this place, but normal aboriginal skeletons were unearthed close by at about the same depth. George Terry of Cohuna brought the skull under notice. A geological report on the site made by the writer of this paper in March, 1926, recorded that there is no evidence of geological antiquity; the report was published some years later (Mahony and others, 1936). Dr. W. R. Browne has informed me that he agrees with this opinion after examining the site in 1940 in company with Professors Priestly, Burkitt and Shellshear. The skull was acquired by Sir Colin Mackenzie, Director of the Australian Institute of Anatomy, who did not describe it but sent some data, with measurements and a tracing along the middle line of the skull, to Sir Arthur Keith. Keith (1931) published an account based on this information, and expressed the opinion that it is the most primitive known type of human skull. The error arose from the fact that Mackenzie mistook for bone the adhering mineral incrustation, which is up to a quarter of an inch thick in places; for this information I am indebted to Professor A. N. Burkitt. Professor J. L. Shellshear has kindly allowed me to say that, after Sir Colin Mackenzie's death, he removed the incrustation, and that from his observations

on the skull he finds that it falls within the range of modern aboriginal skulls, to which it is similar in all respects. Campbell (1943) says that the intact, major portion of the Cohuna dental arch is typical of a large aboriginal dental arch.

Shellshear (1939) described a partly mineralized normal aboriginal skull found on the beach of Stradbroke Island, Queensland.

The flexed, desiccated body of an aboriginal partly encrusted with stalagmite was was found in one of the Mosquito Plain caves near Mount Gambier, South Australia (Woods, 1862). It was exhibited in a number of towns in Australia and Tasmania as a "Petrified Woman," and is reported to be now in a Berlin museum. It was probably a recent burial similar to that described by Tindale and Mountford (1936). Other records of recent human remains found in caves are given by Etheridge (1893) and by Etheridge and Trickett (1905); as a rule aborigines fear dark caves and do not enter them.

Artefacts

At the Doone tin mine in north-eastern Tasmania, stanniferous sands and gravels were treated by sluicing the sides of an open cut with a powerful jet of water. A stone implement was found in material brought down by sluicing, and David (1923) claimed that it is contemporaneous with the stanniferous sands which he believed to be Pleistocene in age and of fluvio-glacial origin. The writer of this paper examined the implement soon afterwards and noticed that one side was more weathered than the other, which suggested that it had long lain on the surface of the ground and had then fallen into the open cut. Meston (1936) gave reasons for believing that it had fallen from the surface and that it is of recent origin.

In the Derwent Valley, Tasmania, is a midden which Lewis (1934) correlated with the Yolande-Margaret (Riss-Würm) interglacial phase, but Meston has shown that it is almost certainly modern.

Consolidated calcareous dunes in the Warrnambool district, Victoria, extend along the coast and are overlain in places by bedded tuff ejected from Tower Hill. These dunes may have been formed during one of the Pleistocene glacial phases (Hills, 1938 a). The dune rock was formerly quarried for building purposes, and some of the slabs bore impressions of footprints of large struthious birds. In 1890 a slab quarried at a depth of 50 ft. displayed impressions supposed to resemble human footprints and also marks such as would be made by two people sitting side by side on soft sand (Officer, 1892). The specimen is in the

Warrnambool Museum, but the stone is friable and the impressions are almost obliterated; photographs taken while they were distinct were published by Branco (1905) and by Klaatsch (1906). Gregory (1904) rejected as man-made both tracks and other impressions. The tracks are narrow and are identical in shape with those made in snow by kangaroos (Noetling, 1907). There can be little doubt that the tracks and other impressions were made by kangaroos, not by human beings.

About 45 years ago C. C. Brittlebank, Government Plant Pathologist, while making geological observations, found a stone implement in a bed of gravelly clay 1 ft. 6 in. thick resting on Permo-Carboniferous glacial strata and underlying Newer Volcanic lava flows near the junction of Myrniong Creek and the Werribee River, about six miles north-west of Bacchus Marsh,

FIG. 5.
Site where the first sub-basaltic Artefact was found (X).
Sketch from a photograph by C. C. Brittlebank.

Victoria (Plate I). He presented the specimen to the National Museum, but did not publish any record of it. The implement is a wedge-shaped slab of hard slaty rock measuring about 7 inches by 6 inches, the narrowest part (4 inches) being at the thicker end. One face, somewhat roughened by weathering, is slightly concave, and near its centre are indentations made by pounding with another stone; the opposite face is slightly convex, rougher, and shows no signs of usage. Flakes have been struck off the edges of one side and of the thinner end, as if to make a crude chopper.

The other side is straight and smooth, apparently a natural cleavage surface, and the smaller end is bounded by two fractures. Weathering has dulled sharp edges. A few years later Brittlebank found two more artefacts in the same sub-basaltic gravel; one of these is the axe illustrated in Plate III, figs. 3 and 4. One-third of this axe protruded from the outcrop and the rest was embedded in tough sandy red clay which had to be picked away to free it. The other specimen, though less deeply embedded, was also firmly fixed in the clay. Both were found within a few yards of where the first was discovered. His letters to the Museum record that Brittlebank found the first artefact in an excavation made for the purpose of observing the effect produced by heat from the lava on the underlying gravelly clay. At about 1 ft. 8 in. or 2 ft. from the outcrop of this bed he found the implement in tough gravelly clay and almost in contact with the base of the lava flow. Since it differed in shape and size from the surrounding quartz pebbles, he examined it closely and, observing the chipped edge, he took it to water and washed away the adhering red sandy clay and small pebbles. He then saw that it was an implement made of hard slate. He was convinced that it could not have fallen through a fracture in the basalt to the position where he found it, nor have been placed there in post-basaltic times. Brittlebank being an experienced and accurate scientific observer and a sound geologist, his evidence must carry great weight. It has been suggested that the first-found implement may have been buried in recent times by surface material sliding down the slope of the hill (Mahony and others, 1933), but these authors did not know that Brittlebank found two other artefacts in the same gravel. Since the basalt was extruded, valleys several hundred feet deep have been cut through it into the underlying rocks, and the basalt where the artefact was found forms a small isolated plateau, locally known as The Island, since it is almost surrounded by the deep valleys of the Werribee River and Myrniong Creek. The area is close to the eastern margin of the Ballarat Plateau. The Island is about 1,200 ft. above sea level, and the adjoining Bacchus Marsh basin, through which the Werribee River flows, is nearly 900 ft. lower and is only 5 miles distant as the crow flies. Brittlebank made a geological map and section of the locality and marked on it the site where he found the first sub-basaltic implement (Plate II): his manuscript map is in the National Museum of Victoria.

The Werribee River is a puny stream. At Bacchus Marsh its drainage area is 115 sq. miles and its average discharge 250 gallons of water per second; in summer it usually ceases to flow. Between

Ballan and the Bacchus Marsh basin, a distance of eight miles as the crow flies or eleven along the course of the river, its bed falls 95 ft. per mile[10] and the river flows through a gorge ranging from 400 ft. to 600 ft. in depth. Possibly in its early development, when the stream was cutting its valley into the Newer Volcanic lava, it flowed over a waterfall into the Bacchus Marsh basin, and owing to erosion the ledge over which it fell retreated upstream and finally disappeared, leaving a steeply inclined river bed. Rainfall may formerly have been greater than it is now.

For a period of five years Brittlebank (1900) conducted experiments at numerous points to determine the rate of erosion of the bed of the gorge, and his results work out at 0·58 inch per century. The period of experiment was probably too short and his methods not sufficiently accurate to give a figure other than an approximation to the right order of magnitude. No data are available for similar streams elsewhere. The average rate of degradation of the Mississippi basin is estimated at 0·34 inch per century, and Niagara Falls are retreating upstream at an average rate of 4 ft. 6 in. per annum (Chamberlin and Salisbury, 1905), but the general fall per mile of the Mississippi is low and the rate of retreat of Niagara Falls is exceptionally rapid, so these figures are of little value in an enquiry into the rate of formation of the Werribee gorge, but they indicate that a waterfall causes rapid erosion.

If we assume that the rate of erosion of Werribee gorge during its whole development was very high and averaged 20 times the amount that Brittlebank's figure indicates for the present time, say 12 inches per century, the excavation of the gorge would take 60,000 years. Though this figure is hypothetical and probably too small, it indicates that the sub-basaltic gravel bed at Myrniong in which the implements were found is Pleistocene in age.

In the Great Buninyong Estate mine, near Ballarat, Victoria, fragments of bones of extinct marsupials were found 240 ft. from the surface in black pyritic clay underlying a basaltic lava flow; the bones were near the base of the lava. The clay is a swamp deposit and the basalt is a lava flow from Mount Buninyong, a scoria cone in the vicinity (Hart, 1899). The bones, which are mineralized and impregnated with pyrites, were identified by De Vis (1899) as those of *Diprotodon* and an extinct kangaroo, *Macropus faunus*. One fragment, probably part of a *Diprotodon* rib, is about 6 inches long, irregular at one end and terminated at the other by two cuts from opposite sides which do not meet

10. Figures for drainage area, discharge and fall of river bed were supplied by the Victorian State Rivers and Water Supply Commission: river gaugings at Bacchus Marsh were taken over a period of 15 years.

but are separated by an irregular broken surface (Plate III, figs. 5 and 6). The cuts were considered by De Vis to have been made by a sharp implement, not by teeth of carnivores, and in his opinion the specimen is an artefact. Gregory (1904) rejected this suggestion, and held that the cuts were made accidentally by the shovel of the miner who unearthed the bone. The surface of each cut, however, is not flat as would be expected if made with a shovel; one, especially, looks like the result of several short strokes of a pocket knife used as in cutting plug tobacco. Possibly the miner who found it tested its hardness in this way. The shape of the fragment and the relative positions of the cuts do not suggest an artefact. A. S. Kenyon, who examined the specimen at about the same time as Gregory, recorded that the cuts had crushed the pyrites in the bone, and were therefore made after the bone had been fossilized (Mahony and others, 1933). Many years ago the specimen was covered with size to prevent oxidation of the pyrites; no pyrites can now be seen and it is therefore difficult to determine the appearance of the cuts when the bone was found. A face cut for experimental purposes in 1934 on one of the other Buninyong bones has exactly the same appearance as those on the supposed artefact. De Vis identified one of the other fragments as probably the head of the same rib from which supposed artefact was made; if this is correct, it seems more reasonable to suppose that the bone was broken by the jaws of a carnivore than that a man would make an implement out of one part of the rib and then discard it close to the rejected portion. The specimen was formerly in the Ballarat School of Mines but is now in the National Museum of Victoria, Melbourne.

Cuts and scratches on bones of extinct marsupials from the Darling Downs, Queensland, and several localities in Victoria, considered by some observers to have been made by human agency, have been attributed to tooth marks of the marsupial lion, *Thylacoleo*, by De Vis (1884) and by Spencer and Walcott (1912). J. E. Tenison Woods (1883, 1886) noticed scars on the bone of a large struthious bird associated with midden material near Penola, South Australia, and suggested that they were made by aborigines; he considered that the bird is the extinct *Dromornis*.[11]

A small quartzite upper mill stone (Plate III, figs. 1 and 2) was found in 1908 by A. J. Merry of Terang while making an excavation for the foundations of a concrete culvert over Pejark Swamp drainage channel where it crosses the road from Terang to Noorat, Victoria. One side has been rubbed flat, and a depression ("husking hole") has been made on the other (Plate III, figs. 5 and 6);

11. See also Etheridge (1890).

similar implements are commonly found on the surface in Victoria. He gave the specimen to the National Museum and supplied the following information. The excavation, which is 10 ft. deep, passed through soil 3 ft., bedded volcanic tuff 2 ft., black clay 3 ft., and yellow clay 2 ft. The yellow clay and the base of the black clay contained numerous fragments of marsupial bones. The millstone was embedded in the yellow clay 2 ft. below the level of the bed of the drainage channel and 3 ft. distant from it. Merry, while digging in the yellow clay, felt his shovel strike against a solid object and, thinking it might be a large fragment of bone, he dug it out carefully. Shortly afterwards he showed it to Dr. Beaton, a local medical practitioner, and after the adhering yellow clay had been washed off, both of them recognized it as a stone implement. Merry found another stone implement in clay thrown out of the excavation, but could not be certain which part of the hole it came from. He added that R. Harvie, who had been employed in excavating the drainage channel in 1893, told him that he had dug up a grindstone from similar yellow clay 4 ft. below the bedded tuff layer at a site about one chain west of the culvert, and that a petrified human skull had also been found 5 ft. below the tuff about 100 yards west of the culvert, but the skull was broken up and thrown away by the workman who found it. Sir Baldwin Spencer and R. H. Walcott, in December, 1908, made excavations alongside the drainage channel near the culvert but found nothing except fragments of marsupial bones. Spencer and Walcott (1911) recorded the implement without giving full details since their paper concerned scars and scratches on fossil marsupial bones from this and other localities. Further excavations should be made at this site.

Stone implements are said to have been found under tuff near Mount Schank, South Australia, but no particulars are available.

In 1854 a basalt axe-head was found by A. C. Swinton at a depth of 4 ft. in alluvial wash in which he was sinking a shaft that bottomed on bedrock at 5 ft. (Howitt, 1898); the wash was cemented gravel with three false bottoms and was situated in a small tributary valley of the main lead near Maryborough, Victoria. About 40 years later, Swinton, at the request of Howitt, marked on a plan the position of this shaft, and Stanley Hunter, an officer of the Geological Survey, examined the locality. Hunter found that the tributary referred to by Swinton is one of the heads of the Bet Bet sub-basaltic lead (buried river valley) and he considered that the lower deposits of wash in the tributary may be of the same age as the sub-basaltic wash of the Bet Bet lead. At a later date Hunter told Gregory that he did not attach much

importance to the discovery of the artefact since it might have fallen into a wombat hole or a natural hollow in the ground (Gregory, 1904); it seems unlikely, however, that wombats would burrow in consolidated gravel or that prospectors would sink a shaft where there was a natural hollow.

In Dicker's *Mining Record*, 1864, p. 120, a figure is given of a basalt axe-like implement with a hafting groove found in undisturbed gravelly clay at 22 inches below the surface at Ballarat. It was 8 inches long, weighed 5 lb., and was patinated. The implement (fig. 6) is similar to a type commonly found on the surface in the Western District of Victoria.

Voisey (1934) recorded kitchen middens of oyster and other shells along the base of low cliffs that mark an old coast line extending from Grassy Head to Collombatti, about 10 miles inland, in the Kempsey district, New South Wales. The old strandline

FIG. 6.
The Ballarat Implement.
(Reproduced from Dicker's *Mining Record*, 1864.)

is about 10 ft. above present high-tide level. McCarthy (1943), who described these middens and the contained implements, quotes Professor L. A. Cotton's opinion that they were formed between 5,000 and 11,000 years ago. Near the mouth of the Burdekin River, Queensland, is another locality where oyster-shell middens containing stone artefacts are associated with an old shoreline 4 miles inland and about 20 ft. above high-tide level (Jardine, 1928). Since primitive people do not carry large quantities of shellfish to camps several miles inland, the inference is that these middens were formed before the sea retreated to the present shoreline. W. Anderson (1890 b) made a similar suggestion in regard to middens 30 ft. above sea level near Pambula and Noorooma, N.S.W.

South of the Embley River on the western side of Cape York Peninsula and about three-quarters of a mile inland from the coast

there are large shell middens forming a series of heaps and mounds from 20 to 30 ft. high which extend for several hundred yards (Jackson, 1902).

Middens several acres in extent and up to 10 ft. thick composed of oyster and other shells have long been known in Tasmania. Noetling (1910) calculated that the time required for them to accumulate is 5,000 to 7,000 years. His calculations are based on assumptions, which may or may not be approximately correct, concerning the number of natives formerly inhabiting Tasmania, and shellfish consumed per head per day. David (1923) thought that a considerably longer time is indicated.

At the Reedbeds, Fulham, near Adelaide (White, 1919; Howchin, 1919), and at Shea's Creek, near Sydney (Etheridge and others, 1896), artefacts have been found near the coast in swamp deposits or estuarine beds a few feet below sea level.[12] Both deposits are considered to be geologically recent.

The only records of implements in river terraces are those of Ferguson (1894), who found some in terraces a little above the level of the present streams in the valleys of the Hopkins and Wannon Rivers, near Wickliff, Victoria, and the artefact found near the Keilor skulls.

Large areas of Central Australia are covered with "gibber," that is, with wind-worn fragments of hard rock derived from strata disintegrated by subaerial denudation. Among the gibber stones Howchin (1921) found flaked pieces of siliceous rock with patinated surfaces; he regarded them as ancient artefacts of an earlier cultural phase than that of modern aborigines. Wood Jones and Campbell (1925) and Tindale (1932) have furnished sound reasons for believing that the flaking was fortuitously caused by natural agencies.

Bennett (1867) recorded that sandstone with grooves similar to those made on grindstones or outcrops of sandstone by aborigines when sharpening their stone axes was found in the Hunter River valley, New South Wales, under 30 ft. or more of alluvium. In this locality alluvium accumulates rapidly and instances are cited of some flats having been buried under 4 ft. of silt during a single flood (MacPherson, 1886).

During the construction in 1913 of the Sugarloaf Dam near the junction of the Goulburn and Delatite Rivers, R. B. Comer, engineer, State Rivers and Water Supply Commission, collected hundreds of stone implements for the National Museum of Victoria. Among them was an axe fashioned from a pebble found more than 20 ft. below the surface, and four others from 28 ft.;

12. See also David (1923 a) and Tindale (1937 b).

the latter came from an excavation at the head of a gully near Mount Tinnigar, Devil's River.

At Hasemer's brick pit, Forbes, New South Wales, Andrews (1901) recorded middens and bones of *Diprotodon* in alluvium at a depth of 18 ft. from the surface. There is no available evidence as to whether alluvium is now accumulating at this site. Andrews has informed me that he saw the pit only after complete removal of these objects, but that he considers that Hasemer's statement concerning them was an honest one; he cannot, however, vouch for the association of the midden with the bones.

A stone tomahawk was unearthed at a depth of 2 ft. in 1870 by miners digging a water-race in shingly alluvium at the side of the valley of the Upper Dargo River, Victoria (Howitt, 1898). Howitt, who visited the locality soon afterwards, did not consider that there is evidence of geological antiquity.

Wilkinson (1887) recorded a stone axe found at 14 ft. below the surface at Bodalla, near the coast of New South Wales, about 80 miles north of the boundary of Victoria.

At West Maitland, New South Wales, a primitive stone axe with a ground edge was found in ferruginous clay at 11 ft. below the surface during the sinking of a mine shaft (Enright, 1923). Immediately below the surface is a bed of reddish clay 8 ft. thick and below this is ferruginous clay 7 ft. 6 in. thick in which the specimen was found. Surface topography suggests that the clay beds were not recently deposited.

Near Cape Otway, Victoria, artefacts were recorded in a mixture of beach material, pebbles, humus and broken shells resting on Permo-Carboniferous sandstone and apparently intermediate between it and dunes 200 ft. high (Etheridge, 1876). David and Etheridge (1890) considered that the deposit, since it underlies a dune of this size, must be ancient, but Gregory (1904) held that the implements were buried by the advancing dune, or that the shelly material was a surface layer resting on the dune and extending beyond its edge.

Certain rock carvings in the Flinders Range, South Australia, are patinated, and Basedow (1914) claimed that they are ancient. The evidence has been discussed by Mountford (1929 a), who thought that some of the carvings are of considerable age, and by Ward and others (1933), who do not believe that any claim to antiquity can be substantiated.

Mountford (1926 b) described a rock-carving from Panaramitte, South Australia, which he believes depicts the head of a crocodile, a reptile long extinct in South Australia and now represented there only by fossils.

Typography of certain stone implements found in Australia may furnish evidence of antiquity. Crude flint implements deeply patinated are fairly abundant in the south-east corner of South Australia, and McCarthy (1940) holds that both typography and patination indicate their antiquity, and he compares them with products of the Hoabinhien cultural phase of the Far East. Tindale (1937 a) considered that Tasmanian implements show typological evolution and that certain artefacts found on Kangaroo Island and elsewhere in South Australia are primitive and ancient. Hale and Tindale (1928) recorded six successive cultural stages in implements found at Tartanga and Devon Downs, South Australia. Throughout Australia are found implements the uses of which are apparently unknown to modern aborigines; among them are microliths which recall those of Azilian age in Europe resembling small Gravette points and Chatelperron points (Casey, 1934, 1936; Campbell and Noone, 1943).

Australian aborigines use both highly specialized and very crude stone implements and even unflaked stones with natural sharp edges (Mountford, 1940). In basing inferences on typography, this fact must be borne in mind. Little is known about length of time required for patination to occur, but it evidently varies both with rock type and with atmospheric conditions; deep patination therefore cannot always be assumed to indicate antiquity.

Summary

Evidence set out above indicates that mankind migrated into Australia at a period that is certainly ancient in the historical and almost certainly in the geological sense, as is shown by the geological investigations of R. A. Keble and Miss Hope Macpherson and by the Myrniong implements.

The evidence also strongly suggests that the earliest migrants belonged to a Tasmanoid (Negrito) race that had no domestic dog, and that this race occupied the mainland and found its way to Tasmania. At a later date came a wave of Australoid (Dravidian) immigrants with their domestic dog, the dingo; on the mainland they dispossessed the Tasmanoids and absorbed some part of them, but they did not cross Bass Strait to Tasmania, except in small numbers during modern times.

Tasmanian and Australian, especially West Australian, skulls have certain characteristics in common. Anatomical studies of the Keilor skull by Dr. J. Wunderly and Dr. Wm. Adam indicate that this arises from racial intermixture rather than from close kinship between the original Tasmanoid and Australoid races.

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Appendix

In a scrapbook purchased by the Melbourne Public Library in 1889 is an engraving (Fig. 7) of a human head carved in wood and accompanying manuscript notes which are quoted below. The carving is said to have been found 60 feet below the surface at Creswick in 1851. It is evidently the specimen mentioned by Smythe (1869, p. 150), who considered it a forgery; he said that an engraving of it, together with letters and documents testifying to its authenticity, had been

FIG. 7.
The Creswick Carving.

published. The artist S.T.G. is doubtless S. T. Gill, a number of whose sketches of scenes in Victoria, including three of Creswick, were published in 1855 by J. J. Blundell & Co., to whom F. J. Bury's letter (see below) is addressed.

The craftsmanship is unlike that of primitive man either ancient or modern, and the features are European in appearance. In my opinion no claim for its antiquity can be taken seriously. Perhaps, as a practical joke, the head was carved by one of the miners from a piece of semi-fossil wood and buried at a spot where Smith and his friends would find it.

I have been unable to discover if the carving still exists or where the woodcut and documents relating to it were published.

The manuscript notes are as follows:

Copy of Declaration.

True Copy (W.S.).

We, James Smith, Robert Tapley, and John Mackie, do solemnly and sincerely declare, that the Carving of the Human Head, now produced, was found by us on Wednesday, the 21st day of February, 1855, in a Hole on the Black Lead, Creswick, at a depth of 60 feet 6 inches from the surface. The Head was found at the bottom of a drift, which drift formed a superstratum to the clay. The Head is at present in precisely the same state as when found by us.

And we make this solemn Declaration conscientiously believing the same to be true, and by virtue of the provisions of an Act, made and passed in the 9th Year of the Reign of Her present Majesty, intituled, An Act for the more effectual abolition of Oaths and Affirmations taken and made in various departments of the Government of New South Wales, and to Substitute Declarations in lieu thereof, and for the suppression of voluntary and extra judicial Oaths and Affidavits.

(Signed) James Smith, Robert Tapley, John Mackie.

Made and signed before us at Creswick, this 24th day of March, 1855,

(Signed) F. J. Bury, J.P., Bernard Smith, J.P., James Green Taylor, J.P.

Extracts from Letters from Thomas Burr, Esq., District Surveyor.

I was present at the time this affirmation was made, and have cogent reasons for believing that this is no imposition, from the circumstance of having, in connexion with mineralogy, for many years been accustomed to study the fracture of different substances, it has led me to examine minutely the surface of any matter put into my hands; and the entire surface of this Head presents a homogeneous appearance, which indicates that, at whatever time it was carved, the whole was done at the same time, and that the mass had been exposed to the same circumstances subsequently, except one or two small abrasures, which were evidently recent, and were known to have been made since the time that this specimen was brought to the surface. The wood appears to be the root of one of the Eucalyptus tribe, but the substance has been so changed either by heat, or by pressure, or these combined, as to be converted into Graphite.

It may be as well to observe, that, in connexion with the Carved Head here shown, there was a large quantity of Wood, similarly altered in appearance or substance. This Wood belongs to Genera and Species identical with that at present growing in this part of the Continent of New Holland, namely, Eucalyptus, Casuarinae and Banksia; the cones of the latter, more especially, being met with in profusion, and beautifully preserved.

(Signed) Thomas Burr.

Ballarat 29th Sepr. 1855.

F. J. Bury to J. J. Blundell & Co.

Gentlemen.—In reply to your letter of the 20th instant, on the subject of the Carving in Wood found at Creswick on the 21st February last.—I beg to state that the carving in question was brought to me by James Smith and party within a few hours after its discovery and remained for some time in my possession. The strata in which the carving was found was Black Clay, and the ground was first opened and worked by Smith's party; in the same hole, and in several adjacent ones, large portions of Wood and honeysuckle cones were, at various times, found at depths varying from fifty to eighty feet.

The Declaration, subsequently signed before me, was made in consequence of reports having been circulated that the carving had been executed by Smith's party.

I am, Gentlemen,
Your most obedient servant,
(Signed) F. J. Bury.

To Messrs. J. J. Blundell & Co., Melbourne.

Explanation of Plates

Plate I.

The Keilor skull before removal of incrustation.

Plate II.

C. C. Brittlebank's geological map and section of the area near the junction of Myrniong Creek with the Werribee River where he found stone implements in sub-basaltic river gravel. Heights are shown relative to his house, "Dunbar," which is about 1200 ft. above sea level.

Plate III.

Figs. 1 and 2. The Pejark implement. Top and base.
Figs. 3 and 4. One of the Myrniong implements: a crude axe or chopper made by flaking both sides of one end of a flat quartzite pebble. Aspect from each side.
Figs. 5 and 6. The Buninyong bone. Aspect from each side.

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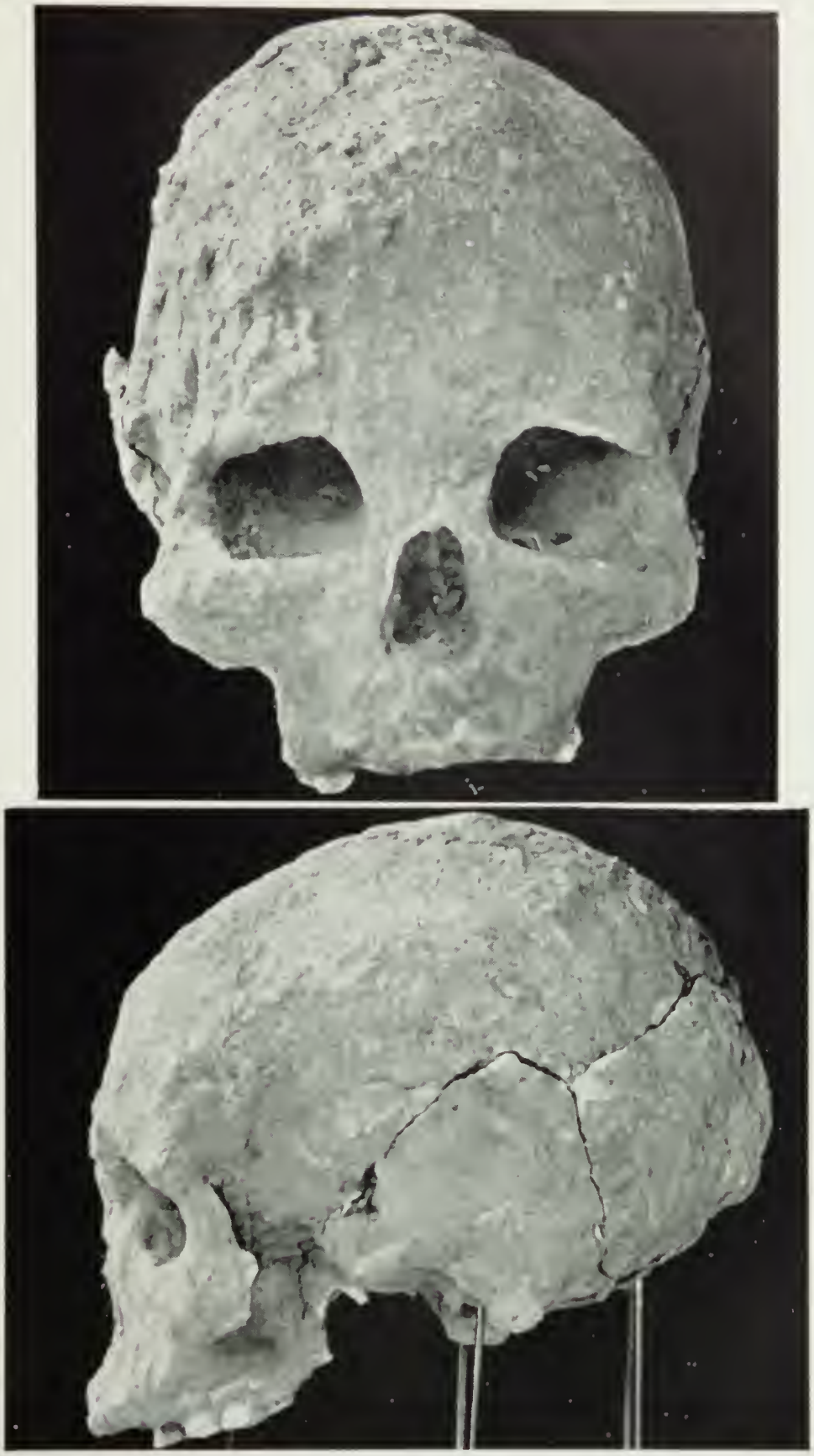

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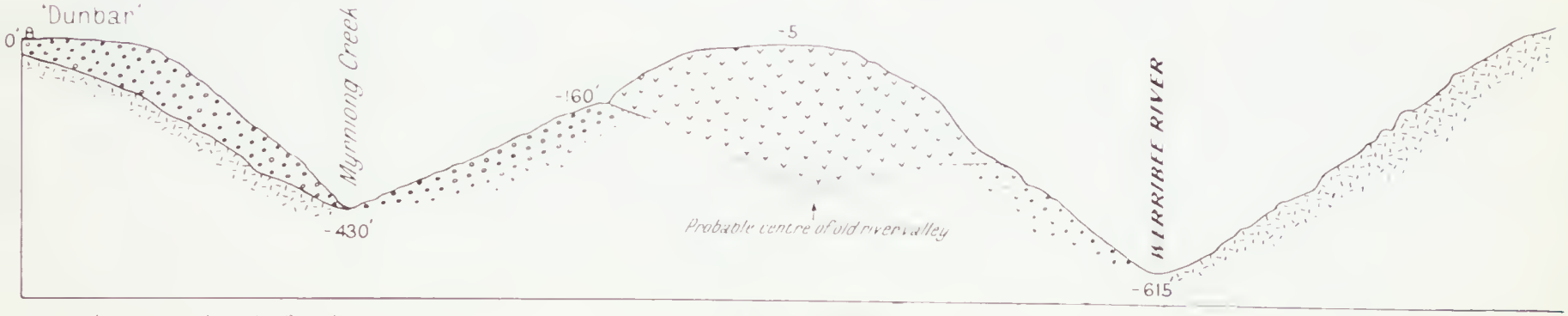
— PLAN —

SCALE, 40 Chs. to one inch



Horizontal scale, 6 inches to one mile

— SECTION —

Vertical scale, 400 feet to one inch

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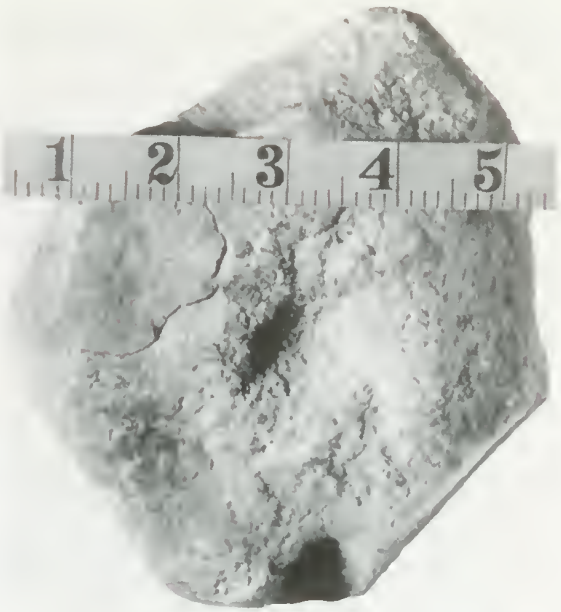

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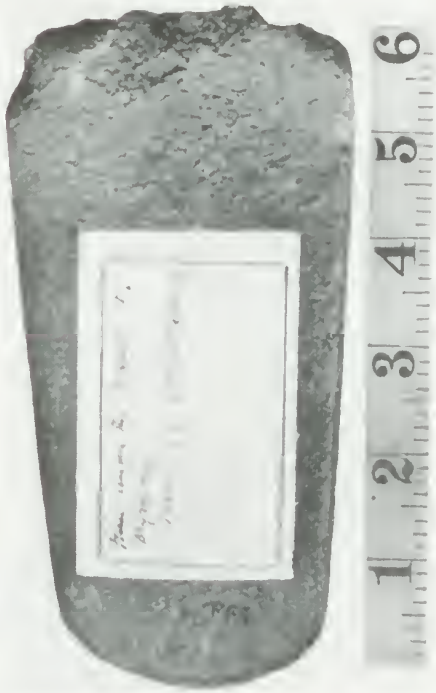

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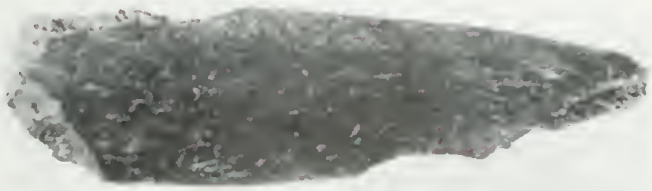

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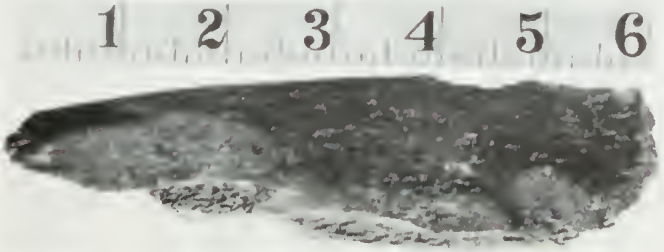

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