

ANALYSIS OF AN ABORIGINAL SKELETON AND A PIERCED TOOTH NECKLACE FROM LAKE NITCHIE, AUSTRALIA

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The circumstances of the discovery, on a deflation surface of a lunette 11th December 1969, and of the excavation 14th January 1970, of this unique Australian burial have been published (Macintosh et al 1970), as has also a description of the stratigraphy of the burial site (Bowler 1970b), each as a preliminary and tentative report, recognising that much more work needed to be done on the material from the burial and on the site.

The Lake Nitchie site is 870 km in a direct line almost due west of Sydney; but the drive to it by road from Sydney involves a semi-circular route of 1170 km. Lake Nitchie, 3 km by 2 km, is one of a group of basins which are mostly dry save after floods, east of the Anabranch of the Darling River, and is 85 km north of where the Darling River joins the Murray River.

Most dry lake basins in south western New South Wales have a crescentic lunette or dune on their eastern margins. It is only in the last two years that some proof has emerged (Bowler 1970) that the "lake-full" phase of these basins came to an end by 15,000 B. P., and that the stratigraphic sequences in these lunettes relate hydrologic and climatic history and that they are apparently rich in relics of ancient human and faunal activities.

The grave was cut by unknown means and unknown tools into a brick hard calcareous paleosol considered by Bowler (1970b) to be the equivalent of his Golgol Unit of the Willandra Lakes, dated there at more than 40,000 B. P. Overlying the lower unit of the lunette is an upper unit which Bowler equates with that on Willandra Lakes Zanci unit, dated between 17,000 and 15,000 B. P.

If the burial occurred before the Upper Unit was deposited, the skeleton is more than 15,000 B. P. If the burial was after deposition and then erosion of the Upper Unit, the skeleton assessed solely on that evidence could be as little as 1000 B. P.

Bowler (1970b) has discussed the details of evidence for and against antiquity as deduced from the stratigraphic sequence and erosional history, soil evidence, preservation of bone and teeth, and on the deflation surface a stone artifact assemblage which does not include representatives of the Continent wide technological change which occurred approximately 6000 B. P., and finally implications about faunal extinction.

The burial position was supine recumbent on sacrum and lumbar spine with knees fully flexed, and with a niche cut at floor level in the left side wall for the feet; head, neck, and upper thorax were hyperflexed and dislocated by force to compress the body into the too-small and unyielding grave. This position, like the grave itself, is unique for Australia.

The central maxillary incisors of the skeleton are absent as a result of ritual avulsion. No other fossil or mineralised specimen of proven or suspected antiquity so far recovered in Australia has shown this condition, so that irrespective of whether it has high or low antiquity, it will be the earliest example of this practice.

The remains of another skeleton in this same geological lower unit 5 m away, consist only of the upper and lower dental arcades and a full representation of 32 teeth, so that ritual avulsion had not occurred in that individual.

A detailed description of burial position, problems of excavation, interpretation of burial technique, the grave-wall shape, consistency and in-fill, identification of the skeleton's sex, racial characters, personal age at death, stature by direct measurement, together with some forensic comments appear in the paper already published, Macintosh et al. (1970). Mention is there also made of an enormous necklace of root pierced canine teeth of *Sarcophilus sp.*, apparently extinct on the Australian Mainland since about 3000 B. P., which adorned the skeleton. Brief survey was made of pierced teeth reported from Palaeolithic Europe and elsewhere and a preliminary comment on the apparent technique of tooth piercing.

This present paper reports progress on three aspects which have yet to be dealt with: Radiocarbon dating, a description of the skeleton, and a fuller description and identification of the pierced tooth necklace.

RADIO-CARBON DATING

A small ritual localised hearth had been located in the grave, 15 cm below surface level, in front of the left first rib; it made a striking contrast to the red sandy infill which was otherwise uniform throughout the grave, and was scooped as a block into a polythene bag. Subsequently the charcoal

was separated from the sand by a needle under low power microscopy; five different concentrations of charcoal in the sand, ranging from 95 % to 4 % were weighed and the amount of charcoal available calculated as 5.1 gm. Such a small sample may not afford a meticulously exact date, but being so intimately related to the skeleton, it provides an invaluable check on the validity of the bone dating. The problem of dating burials if charcoal is not too intimately associated with the bones, is a particularly difficult one in Australia; grave goods are extremely rare, and radio-carbon dating of bone carbonate and of carbonate crust on bone is accompanied by contamination problems which are not yet fully explored, while bone collagen appears to have an Australian upper limit of survival of only six or seven thousand years.

A few examples will indicate this problem. At the Green Gully site near Keilor in southern Victoria a date of $17,300 \pm 700$ B. P. is associated with a flake industry continuing to 8990 ± 150 B. P. The Green Gully bones, a delayed burial strangely combining parts of a male and a female, although no bone in the assemblage is duplicated, were assigned an age of about 9000 years on the basis of charcoal nearby. The bone collagen subsequently showed 6460 ± 190 B. P. and the bone carbonate 1781 ± 115 B. P. In other words the bones were not contemporary with the charcoal, but had been buried into such relationship.

Dating of the Keilor cranium is even more confused. The crust from the outside of the cranium has given a date of 7360 ± 105 B. P. Various dates from very small samples of charcoal at considerable distances from the cranium locus, but claimed to be from identified and related strata, range up to $15,000 \pm 1500$ B. P.

The Mossgiel skeleton, a sitting burial into an extraordinarily hard claypan, is heavily encrusted with carbonate. It is considered on geomorphological considerations to have been buried before this consolidation and hardening of the clay and so assumed to have appreciable antiquity. But the bone carbonate reads 6010 ± 125 B. P. and insufficient carbon was recovered from the organic portions of the bone to obtain a significant collagen result.

The Talgai cranium was found in 1886; it has taken the last seven years to identify the locus from which it came. Radio-carbon dating of carbonate nodules from that stratum reads $11,650 \pm 100$ while organic material in the soil reads $12,400 \pm 300$. From comparison with C 13 analysis these dates are thought to be reliable. Neutron activation analysis and comparison between soil from the interstices of the cranial bones and soil at the site when completed should check the validity of the locus. But the cranium will still only be minimally dated, because the lapse of time between when the individual died and when the cranium rolled to the locus of its discovery and there became silted up and encrusted is quite unknown.

These examples indicate how fortunate is the

presence of the ritual fire in the Lake Nitchie grave.

Before submitting a bone sample it was necessary to try to assemble the full skeleton; one did not want to sacrifice any fragments or chips of bone which might subsequently have been identified in reassembly of the skeleton.

This has now been done, as shown in Plate 1 which indicates good representation for most parts; indeed only about 100 gm of bone chips failed to be identified, and this amount is too small for adequate radiometry. No part of the sternum has survived, nor the bodies of the lumbar and lower thoracic vertebrae. A decision then had to be made as to which bone to sacrifice to provide an additional adequate amount for testing. The right femur was selected; it was moulded and cast, a quick setting mould being used to avoid contamination penetration of the bone cortex. The total bone sample is 536 gm, which should be sufficient for C 14 tests of the bone carbonate, collagen and perhaps apatite.

There is no trace of crust on the bones. The compact bone is brittle and at least somewhat mineralised; but the cancellous bone does not appear to be mineralised at all. From these observations and from comparison of the appearance of the Nitchie bones with known dated bone from Australia, I estimate that the Nitchie Skeleton has an antiquity of about 5000 years and a good collagen test should be possible. (As will be referred to later, I think the morphology of the skull would be appropriate to an antiquity of 5000 years also).

As the bones and the charcoal come from one undisturbed, small, environmental locus, protected by encasing walls except for erosion of its upper 3 cm, this grave may offer the most reliable chance so far available in Australia of checking the mutual relationship of bone carbonate, collagen, apatite, charcoal and the encasing carbonate of the grave wall. These samples are at present in the hands of Dr. T. Athol Rafter, Director of the Institute of Nuclear Sciences in Wellington, New Zealand. It is hoped the date on the charcoal may be available as a footnote for this paper.

The skeleton: The published preliminary report, Macintosh, 1970, stated that the reassembly of the bones was practically completed, by which I meant as much as could be done. That statement was too pessimistic. Only the left ilium of the pelvis had been put together and it seemed unlikely that any further matching of fragments would occur but Plate 1 shows the pelvis is now fairly complete. Similarly small intervening pieces of bone between the femoral condyles and shaft had not been identified and reconstruction with soft dental wax had been attempted. Subsequently these fragments were identified and substituted for the wax, which incidentally resulted in a different alignment from that envisaged in the reconstruction. As a result of that salutary lesson, reconstruction as contrasted with reassembly has been minimal and restricted to strengthening the alignment of cancellous fitting fragments which have lost their compact covering.

On the debit side, the bodies of most of the thoracic vertebrae have disintegrated. These, as originally examined, presented eroded upper and lower peripheral margins, so that vertical anterior and posterior measurements to assess spinal curvature could not be made. But measurement between mid points of their upper and lower surfaces were recorded. The vertebrae were then mounted on a rod, covered with adhesive and passing through the vertebral foramina. It had been recognised that the bone was brittle, but its friability had been underestimated; we should have processed at least the vertebrae in a hardening medium as we did with the Green Gully bones (Macintosh, 1967). It can be seen from Plate 1 that the arches and transverse processes have survived and the spines which cannot be seen in Plate 1 have also survived. The measurements made earlier have been retained.

The present description aims to test the preliminary opinion from measurements on individual bones that skeletal status is 187.7 cm, that the sex is male, identified on large size and rugosity of the bones and on skull characters, that personal age at death was 37 ± 4 and that racial characters are Aboriginal Australian. It is therefore not intended to make a total description in detail. The left side of the skeleton is almost uniformly in a better state of preservation than the right. The long axis of the grave cut into the hard palaeosol lies transversely to the downward sloping axis of the eroding lunette, the left margin uphill, the right margin downhill. The right side of the grave wall therefore represents a catchment for water drainage and soakage; although this is an arid region, it is a reasonable assumption that, over a few thousand years, the right side of the skeleton has been more affected than the left.

Vertebral column (all measurements in mm).

Atlas: Measurements on the Lake Nitchie atlas are followed in brackets by measurements on an atlas from a small, complete and markedly female Aboriginal skeleton excavated at Gynea Bay, New South Wales, which has a personal age of 27 ± 5 and a C 14 antiquity of between 1000 and 1300 B. P.

	Lake Nitchie	Gynea Bay
Total transverse diam.	83	(63.5)
Ant.-post. diam.	48	(36.5)
Index of body	57.83	(57.48)
Max. trans. vertebral foramen	29	(23)
Ant.-post. vertebral foramen	29.5	(28)
Baudoin's sex index	65.06	(63.78)

It is clear that for the Aboriginal atlas, index of body is not influenced by stature differences, and Baudoin's index does not discriminate sex.

Axis: Vertical height from antero-inferior lip of the body to tip of the odontoid process is 37.3 mm. With axis and atlas fitted together, vertical height from antero-inferior lip of axis body, to level of mid point of concavities of the superior

articular surfaces of the atlas is also 37.3 mm. Vertebral vertical dimensions made subject to the limiting conditions described above are as follows:

C2 measured	37.3	
C3 measured	13.5	
C4 measured	12.7	
C5 measured	12.0	
C6 measured	13.0	
C7 measured	14.0	102.5
T1 measured	17.5	
T2 measured	22.1	
T3 measured	19.0	
T4 measured	21.0	
T5 measured	22.2	
T6 measured	22.0	
T7 measured	22.2	
T8 calculd.	21.5	
from arches		
T9 from arches	22.8	
T10 from arches	23.7	
T11 from arches	22.7	
T12 from arches	24.0	260.7
L1 from arches	27.0	
L2 from arches	28.3	
L3 from arches	28.3	
L4 from arches	26.4	
L5 from arches	30.9	140.9
		504.1

Practically all standard text books of Anatomy agree that the vertebral discs constitute about one-fourth of the length of the vertebral column. The vertebral column, in that case, is 672.1 mm.

Sacrum

Has lost the anterior margin of its promontory by erosion. The plane of the surface of the promontory was projected forwards to an estimated position for mid-point of its anterior border.

- (a) Mid ventral straight - ? 105
- (b) Mid ventral curved - ? 125
- (c) Maximum straight breadth - 110

Sacral index $\frac{c}{a} \times 100$ - 104.7 (Subplatyhiere)

Sacral index $\frac{c}{b} \times 100$ - 88

The alae fit perfectly with the articular areas of the ilia, and there is no trace of arthritic changes.

Pelvis

Length of pubis - 72

Length of ischium - 89

Thieme & Schull index - 41.2 (Values under 54 are male)

Vertical height from mid-point superior surface promontory to summit of articular surface of acetabular cavity - 100

Sciatic notch: greatest width - 46

Sciatic notch: greatest depth - 29

Pubic symphysis: The oval outline is approximately complete; the symphyseal face is smooth generally; the extremities are fairly clearly defined; there is a pronounced bony outgrowth for the gracilis tendon; the ventral margin is defined and there is a commencing lip; there is no ridge on the dorsal

margin. Comparing this with Krogman's age grades (1962) the Lake Nitchie individual was between 35 and 44 years old.

Femur

Thieme and Schull say that the greatest femoral head diameter is the best single discriminant measurement for sex.

Davivongs found no significant sex differences between the angle of the neck and the angle of torsion.

The Lake Nitchie femur has the highest transverse condylar breadth on aboriginal record, equals Davivongs' maximum for the greatest head diameter, and is high but inside the maximum of range for all other observations.

Femur

Lake Nitchie		Davivongs' male ranges.
Max. length	488	405-502
Trochanteric length	461	385-478
Oblique or Physiological length	487	405-498
Subtrochanteric		
A - P diam.	28	18- 29
Tran. diam.	28.5	24- 34
Platymeric index	98.2	eurymeric 62.1-100
Mid Shaft		
A - P diam.	32	21- 37
Tran. diam.	28	21- 29
Pilastric Index	114.3	84.6-134.6
Shaft robusticity index	12.3	10.1- 13.4
Greatest head diam.	50	39- 50
Trans. condylar breadth	89.5	60- 84
Collo-diaphy. angle	138°	117°-142°

Tibia

Length from centre articular surface medial condyle to centre articular talar surface 392

Nutrient foramen level	
A - P diam.	40
Tran. diam	26.2
Platycnemic index	65.5 mesocnemic

Of the six cross section outlines illustrated by Quarry Wood, the Lake Nitchie tibia is nearest his type 2.

There is no retroflexion; retroversion cannot be measured objectively because there is an insufficient articular surface to establish the plane, but subjectively there appears to be at least medium retroversion.

A marked lateral articular facet is present on the anterior border of the distal epiphysis, which Wood (1920) said is almost constantly present in Australian tibiae; there is moderate exhibition of Klaatsch's praefibular process.

Because of non-survival of lateral condyle and medial malleolus, comparisons are limited.

Tarsus

The articular surfaces of the talus, calcaneum and navicular fit together very accurately. The first cuneiform can be measured for length, but is in-

complete transversely. The base of the proximal phalanx has not survived. Joining these bones with adhesive, there appears to be a well preserved medial arch, and distance between mid point of superior articular surface of talus, and ground level is 69. (Probably this should be increased by 2 or 3 mm. to compensate for first cuneiform and proximal phalanx deficiencies.)

Patella

Maximum height 44, breadth 48, thickness 24. Its articular surface shows a well defined lateral facet. The adjacent blunt ridge presents two vertical areas of which the medial is the larger; the medial facet is relatively small; there are no additional facet subdivisions.

Length of foot (mainly by estimation) probably about 128.

Clavicle

Comparison is made with Ray's (1959) analysis of 292 Aboriginal clavicles. In the Nitchie clavicles, the sternal surface is triangular; two nutrient foramina are present on the posterior aspect of each; the rhomboid impression is large and well marked, as is the conoid tubercle, but the subclavian groove is shallow although very wide.

The Nitchie clavicles conform with Ray's finding that the maximum length of the left exceeds the right, but the caliber index is greater on the right. They are large, but well inside Ray's maximum ranges.

Length: Right	152	109-160 (139.5)
Left	155	114-158 (140.7)
Circumference at mid point		
Right	40	30-48 (38.5)
Left*	40	30-46 (37.1)
Caliber index		
Right	26.3	21-39 (27.7)
Left	25.8	21-32 (26.4)

Humerus

Mid shaft		
A - P diam.	Right 25.0	Left 20.5
Tran. diam.	Right 24.0	Left 20.0

Radius

Physiological length	Right 261	Left 261
Maximum length	Right 276	

Ulna

Physiological length	Left 263
Maximum length	Right 292
Left scapula glenoid fossa	Max. tran. diam. 27, vert. 41.

Stature

Occipital condyles to vertex	150
Spinal column	672
Sacral promontory to summit acetabulum	100
Physiological femur length	487
Physiological tibia length	392
Physiological talus to ground level	69
Allowance articular cartilages at hip, knee, ankle.	5

1875

This is only 2 mm less than reported in the preliminary paper, and confirms that the Nitchie skeleton was that of a very large male by Aboriginal Australian standards, but within all maximum sizes on record, except for the transverse femoral condylar diameter. All indices are within characteristic Australian ranges and there is absolutely no evidence of pathology, including trauma, which is an interesting point, because in practically every other fossil specimen from Australia there is evidence of trauma, some being of severe grade.

Cranium

Length	197
Breadth	146
Cranial Index	74.1
Bimastoid breadth taken at tips	113
Height to bregma	124
Height to vertex	124.5
Basion to bregma	144
Basion to prosthion	107
Basion to nasion	111
Flower's Gnathic Index	96.4 (Orthognathic under 97.9)
Maximum supraorbital width	122
Minimum post orbital width on fronto sphenoidal suture	101
Frontal curvature index	24.2 (subtense 29.5; chord 122)
Postorbital constriction	21
Maxillo-alveolar length	60
Maxillo-alveolar breadth	75
Maxillo-alveolar index	125.0 (brachyuranic)
Least frontal breadth (on temporal lines)	106
Maximum frontal breadth (on coronal suture)	131
Maximum byzygomatic breadth	151
Nasion to prosthion	71
Nasal length	58.5
Nasal width	31
Nasal index	52 (chamaerrhine 51-58)

Orbital breadth: left 49; right 50? (taken from maxillo frontale).

Orbital height: left 33; right 34.

Interorbital breadth 23 (between maxillo frontale on one side to the corresponding point on the other side)

Orbito-alveolar height 44 (least distance between the lower border of the orbit and the alveolar border)

Depth of infraorbital fossa: left 4; right 3. Slight (Range for New South Wales males 2-13, classed as slight up to 5.9)

Depth of glenoid fossa 8 (mean N.S.W. males 6.8; range 3 to 9).

Depth of palate 9 (mean N.S.W. males 12.8 range 8 to 17.5).

Mandible

Height at symphysis	37
Minimum width at ramus	36
Maximum width at ramus	45
Ht. of ramus	80
Bicondylar width	143
Total length (Symphysis to condyle)	110

Sexing the Nitchie cranium

An examination of the Lake Nitchie skull showed its glabella conformed to Martin's modification of Broca's scale 3 and thus was slight (1), the superciliary ridges were strong (3) and the zygomatic

trigone was also strong (3). The occipital muscle markings showed moderate relief (2) while the remaining characters used for sex diagnosis in Australian crania were large. These included the malar tuberosity (3), the mastoid process (3) and the size of the palate (3). The value of each character is given in parenthesis, thus showing a sex score of 18 and being unequivocally male. With this method crania with scores of 11 or less are classed as females while all those with scores above 11 are classed as males. (Larnach & Macintosh 1966)

Australian Race Diagnostic Characters

By a similar technique, such values are given to each of the 20 characters which we have found most distinctive for Australian skulls. Highest scores are found in the most distinctively Australian skulls, lowest in non-Australian crania. Maximum score is 60. The following indicate values for the Nitchie skull:

Cephalic index		3 (less than 75)
Glabella		1 (slight)
Superciliary ridges		3 (marked)
Zygomatic trigone		3 (marked)
Phaenozgy		3 (present)
Gabbling of vault		3 (present)
Frontal curvature index	(24.2)	2 (medium)
Occipital torus		3 (present)
Palatine torus		3 (present)
Rounded border of malar		3 (present)
Subnasal prognathism		1 (slight)
Anterior nasal spine		2 (Broca scale 3)
Maximum supraorbital breadth	(122)	3 (marked)
Size of palate		3 (large)
Naso-frontal articulation		3 (wide)
Median frontal ridge		3 (present)
External occipital protuberance		3 (absent)
Parietal bosses		2 (medium)
Lower narial margins		3 (non-anthropine)
Post-orbital constriction	(21)	2 (marked)
	Score	52

The non metrical morphological characters observed in the Nitchie skull are extremely interesting. Larnach & Macintosh (1966) analysed the morphology of Aboriginal skulls from coastal New South Wales; the same authors have now analysed a series of Queensland skulls (Monograph No 15 in press) the results from which are very similar to those of the N.S.W. series.

The object was to have a standard of modern Aboriginal skulls with which to compare the pre-historic skulls.

Macintosh (1967) referring to the very small series (only six being of any significance at that time), noted that these appeared to fall into two groups: a group exhibiting archaic looking contours and another group apparently exhibiting advanced or modern looking contours. Subjectively, the two groups create an impression of significant difference. Also the former group was regarded as "reminiscent" of *H. erectus* and Solo Man. The latter group subjectively and objectively recalling the appearance of Wadjak Man (see also Jacob, 1967).

This type of observation was originally put forward by Weidenreich.

As opposed to this when we applied the analytical formulae used on the modern skulls, we found both groups fitted within a normal distribution of modern skulls, indubitably Aboriginal Australian. The archaic looking group tended towards the higher index range; the more advanced looking, tended towards the lower index range.

It was noted that by using vectors specifically derived from *H. erectus* and Solo Man traits, each fell outside the maximum coastal Aboriginal values, Solo Man even further than *H. erectus*.

We thought we were faced with two alternative interpretations. Either two groups of related people, but possessing different concentrations of similar gene pools, had arrived separately in the Continent and subsequently hybridised; or that selection of different concentrations from a common pool had permitted emergence of two different looking groups.

We began a search for frequency of archaic traits specific to *H. erectus* and Solo Man in modern aboriginal series.

Some non-metrical morphological characters are not only present in all *H. erectus* skulls but they form a constant pattern of the greatest diagnostic importance. They include:

1. An undivided supraorbital torus.
2. A prominent lateral wing of this torus (old supraorbitalis lateralis) which is not only uniquely characteristic of *H. erectus*, but is not seen elsewhere in hominids.
3. A wide mound-shaped occipital torus without the presence of an external occipital protuberance.
4. A small mastoid process.
5. A wide somewhat shallow digastric fossa bounded medially by an occipito-mastoid ridge at the suture, but without a juxtamastoid ridge.
6. Postorbital constriction.
7. A sharp angling of the upper occipital contour to that of the nuchal plane.
8. The squamo-tympanic suture is transverse.
9. The petrous part of the petro-tympanic axis is angled forwards and medially at the carotid foramen.
10. There is a giant-size suprameatal zygomatic root forming a tegmen. (This feature is not so constant)

This pattern has disintegrated in all Neanderthal, Solo, Rhodesian and modern skulls. Individual characters may be present, but the pattern as such has disappeared.

Mandible

The diagnostically relevant features of the mandible are found at the symphysis:

1. The absence or slight development of a trigonum mentale.
2. The absence or slight development of an anterior mandibular incurvature.

3. The presence of a definite planum alveolare.
4. The presence of a genial pit.

The sporadic appearance of some of these individual characters can be recognised in a good series of modern Australian skulls and this might lead to the expectation of such characters occurring more often in fossil Australian skulls.

In this we were relatively disappointed, while recognising that the diagnostic bone areas of the occiput and base are missing in Cohuna, the base is missing from Mossgiel, the diagnostic base areas are completely obscured by crust in Keilor, and not yet determinable in the fragmented Talgai which we are slowly restoring.

Although Weidenreich placed Solo Man in the direct line of ancestry between *H. erectus* and the modern Australian Aboriginal nevertheless Solo Man has separately developed characters unique to himself. His foramen ovale is situated in a deep pit in which there is also a supplementary foramen ovale. His glenoid fossa also displays unique features. There is no postglenoid tubercle present with the consequence that the squamo-tympanic suture runs along the floor of the fossa alongside the tympanic plate. The tympanic plate thus forms the entire posterior border to the glenoid fossa. On the other hand the persistence in Solo Man of a giant-size suprameatal zygomatic root (Weidenreich's tegmen) is apparently the only instance known outside of *H. erectus* skulls.

We have therefore concluded that on present evidence, Solo Man cannot be ancestral to Aboriginal Australians.

Since arriving at that assessment, and state of progress, some 18 fossil skulls or skeletons have been found in the last twelve months and have not helped so far to elucidate our problem, although the majority have the archaic contour appearance.

At that stage, the Lake Nitchie skeleton was excavated. Almost six months have been occupied by identification and reassembly, and there has been the simultaneous study of the *Sarcophilus* teeth necklace, so the analysis of the Nitchie skull is still immature; but the following characters have been observed.

Cranium. There is an entirely undivided and heavy supraorbital torus, but there is no lateral supraorbital wing of the characteristic *H. erectus* type. Compared with *H. erectus*, there is comparable post orbital constriction. There is a wide mound-shaped occipital torus, with no external occipital protuberance, continuing into angular torus and mastoid ridge. But the mastoid process is large, not minimal in size as in *H. erectus*, and the digastric fossa has a defined juxtamastoid ridge. The angle of upper occipital plane to nuchal plane is 110° but its position is far lower than that of the characteristic, if not unique, high posterior position of the angle of 105° in *H. erectus*. The squamo-tympanic suture in the Nitchie skull is only very slightly oblique, but postglenoid tubercles are present. There is angling of the petrous part of the petro-tympanic axis, opposite the carotid foramen,

to the tympanic part. There is no giant size supra-orbital root of zygoma (the tegmen of Weidenreich). The squamous part of the temporo-parietal suture is low and only moderately arched. In the mandible, there is a moderate planum alveolare, but no genial pit. There is only the slightest trigonum mentale, but distinct anterior mandibular incurvature. There is a marked submental notch, bounded by pronounced anterior marginal tubercles.

This appears, at our present stage of study, to present the most numerous collection of archaic traits occurring in any Aboriginal skull in our experience, while remembering that each of these archaic traits does occur singly in frequencies up to 50% in modern aboriginal skulls.

More study is indicated, but meanwhile so many characters (some modified) out of the *H. erectus* pattern, occurring in this large orthognathic skull, high vaulted and with a frontal curvature index of 24.2 (compared with Cohuna's 13.8 and Mossgiel and Sinanthropus III each recording 18.6) are at least provocative.

Finally a recent paper by Day (1969) quotes for thickness of bone in Omo II at angular torus of parietal near asterion 13.0 mm right and 13.5 left, and at bregma 9.0 mm. In the Lake Nitchie skull the respective measurements are 15.5, 16.0, 12.0 mm.

The pierced tooth necklace, Plate 2. Not a single example of a pierced tooth has ever been reported before from Australia. This necklace of 178 pierced teeth of an extinct mainland animal is therefore as dramatic as it is unexpected, and merits as detailed study as possible. The nearest places to Australia from which tooth piercing is reported are neolithic and present day New Guinea and the Gilbert Islands, Mesolithic Java, and Upper Palaeolithic Choukoutien near Peking in China.

The preliminary report (Macintosh et al 1970) identified 162 teeth, plus 126 fragments. Approximately 40 of those identified teeth had been reassembled by edge matching of fragments, usually 2, but in some cases 5 or even 7 fragments to reconstitute a tooth. Since then another 8 have been reassembled from 28 of these fragments. Re-sieving of the matrix has collected an additional 23 bits, about 4 × 3 mm in size, but these have not helped further reassembly. There are now 121 fragments, 55 small, 45 medium and 21 larger sized; it is likely that most of these are derived from fractured parts of the identified teeth, but they cannot be fitted because intermediate slivers are missing. Among the larger fragments an additional 8 teeth are represented, because 4 show broken root apex and 4 show broken crown remnant, each continuous with longitudinally split body; these cannot be parts of the identified teeth.

The collection therefore consists of Maxillary right 39, left 37, Mandibular right 44, left 47, subtotal 167; 8 fragmentary, 3 published (1970, Plate 1C) to illustrate the drill holes and now on exhibition and not shown in Plate 2; total 178. In Tables A & B, only the subtotal of 167 has been analysed for colour, condition, etc.

Superficial examination is sufficient to note that every tooth in the necklace represents a right or left, maxillary or mandibular, carnivorous canine tooth. The only placental carnivore on the Continent before European contact was *Canis familiaris dingo* Meyer. The marsupial carnivora in addition to *Thylacinus* and *Sarcophilus*, include *Dasyurus quoll* and *Perameles* but their canines are so very much smaller as not to enter comparison. Spencer and Kershaw (1910, Pl. 8) reported from King Island, Bass Strait, sub-fossil remains of *Dasyurus bowlingi* in which the canines are much more slender and recurved and shorter; and *Dasyurus maculatus* in which the canines, although longer and thicker, are not as large as *Sarcophilus harrisi* and have a different longitudinal curvature.

Specimens of *Sarcophilus harrisi* (the Tasmanian Devil) used for comparison with the necklace were collected by S. L. Larnach of our Department thirty-five years ago on the rugged, densely vegetated west coast of Tasmania. He recalls that having collected these representative samples required for the study-project of that time, *Sarcophili* subsequently found every day in the trap cages were released again, except for two or three which were killed and cooked for food, and which he compared in taste to wallaby. That considerable population of *Sarcophilus* 35 years ago, is now reduced to an occasional sighting; such drastic reduction in such a short time cannot be taken as an index of how *Sarcophilus* came to extinction on the Mainland some 3,000 years ago. The reduction in Tasmania was due to the collective destructiveness of European influences, ranging from conversion of natural bush refuge for farmland, mining and timber-mills, to wanton hunting; whereas the Aboriginal only killed for food and, as we now know from the evidence of the present necklace, for adornment which was most probably totemically significant.

Wakefield (1964) identified 588 representatives of 31 faunal species from the eleven Levels of Shelter 2, Fromm's Landing excavation on the lower Murray River. Only two representatives of *Sarcophilus harrisi* are identified out of this collection; one is from Level 7, dated between 1806 ± 85 B.C. and 1931 ± 85 B.C., and a "second fragment" from Level 5 dated between 1290 ± 80 B.C. and 1806 ± 85 B.C. Such frequency can only be classified as rare. *Sarcophilus* is similarly rare in the Devon Downs Shelter also in South Australia, and Tindale (1957) quotes 2300 ± 180 B.C. as dating Level 9 of the Hale & Tindale 1930 excavation.

A single specimen identified by Calaby as the anterior half of a mandible of *Sarcophilus harrisi* was found by Carmel White near Oenpelli in the Northern Territory. It was in a shallow cave deposit near the lowest level for which she quotes 3120 ± 100 B.P., Calaby & White (1967). Those authors (1967, p. 474) say "Remains of Recent *Sarcophilus harrisi* are abundant (italics mine) in caves and other deposits, including Aboriginal occupational sites in western Victoria" and they quote "Gill, 1953; Wakefield, 1964". They then refer to two papers by Lundelius and three by Cook noting

finds of *Sarcophilus harrisi* in Western Australia of which the most recent for three occurrences is 3750 ± 240 B. P.; Calaby mentions his own find of a fragment of a right 1st molar on a cave floor at Kangaroo Island. A further extension of geographical range is their mention of Longman's 1925 and 1945 finds of *Sarcophilus laniarius* in eastern Queensland; but those two finds consist only of a few teeth and bone fragments.

Bowler (1970) discusses some of those same papers and also refers to conflicting dates on Gill's reports, so these need not be pursued further here, excepting to say that Calaby's use of the word "abundant" may have influenced Bowler's suggestion that the former wide distribution argues a wide tolerance of ecological conditions. That presumably might deny my suggestion that the large population of *Sarcophili* necessary to provide the necklace demands an antiquity back to 6000 or even 9000 B.P. Allowing that predators are always fewer than their prey, the very low frequency of *Sarcophilus* relative to other fauna at all the scattered sites which "cluster around 3000 B.P.", to use Bowler's phrase, appears to me to suggest near extinction and a failure to adapt to ecological conditions simultaneously across the Continent. It should be noted too, that the finds extend from 3000 to 4300 B. P., which further thins the archaeological recoveries of any one time level.

A stratified site rich in faunal remains has been excavated recently by P. W. Thompson at Madura in Western Australia, 120 miles from the South Australian border; similar frequency of *Sarcophilus* involving similar time level seems to be indicated, but no publication is available. That work is also being promoted and financed by the Australian Institute of Aboriginal Studies.

I agree with Calaby that as no study of individual variation has been made in *Sarcophilus harrisi*, nor a statistical study between *Sarcophilus harrisi* and *Sarcophilus laniarius*, the latter may be only a larger Pleistocene form of the Recent species.

A similar possibility was met with, when Macintosh and Mahoney (1964) identified a 4000 years old permanent upper left 1st molar as *Thylacinus sp.* which statistically on size is significantly below the range of modern Tasmania *T. cynocephalus*. In seeking comparative material, it was noted that *T. spelaeus*, claimed to be a more robust Pleistocene form from the Wellington Caves, New South Wales, was morphologically similar to *T. cynocephalus* and within or slightly overlapping the range size of the latter, although exhibiting a larger mean size. Lydekker (1894) said *S. laniarius* (Owen 1838) is "distinguished from the existing *S. ursinus* in much the same manner as *Thylacinus spelaeus* differs from *T. cynocephalus*, although the disparity between the size of the extinct and living forms is rather less marked than in the case of the latter."

The simplest published comparison of upper canine teeth of Dingo, *Thylacinus* and *Sarcophilus* is Etheridge's Plate XII with captions and brief text

(1916, pp. 53-4), but he does not illustrate the mandibular teeth.

Etheridge noted for maxillary canines that:

The root in *Thylacinus* and *Sarcophilus* shows longitudinal striae and grooves, that of the dog is smooth; dog crown and root are laterally compressed ovals in cross section, whereas the marsupial tooth body is inflated; the cemento-enamel junction in dog is much better defined and marked by a "collar"; the dog crown has a posterior carina; crown enamel of dog occupies one third to one half total tooth length, but only one third to one quarter in *Thylacinus* and *Sarcophilus*.

The first four can be agreed with as an approximate guide, although *Sarcophilus* has a slight carina, but the fifth is not so for *Sarcophilus*. Etheridge does not define his method of measurement. In *Sarcophilus*, the enamel extends furthest on the labial aspect. I have measured from crown extremity to that level in Larnach's collection of *S. harrisi*. It includes one male and one female which show such marked attrition as to truncate the crown tip; one male and one female show minimal attrition, and the teeth of the fifth specimen which are in a complete head, show slight attrition. No attempt was made to estimate correction for attritional wear. Crown length to maximum length measured as chords gave a range of 47.0% in the case of least attritional wear to 39.2% in that showing greatest attrition, with a mean of 42.4%. Twenty dingo maxillary canines taken random from our collection of some 150 skulls, gave a mean crown length of 21.0, a mean maximum length of 43.0, and a mean index of 48.8%. There is thus appreciable overlap of index range, although the mean length of dingo maxillary canine is about 28% greater than in *S. harrisi*. More reliable is the index of labio-lingual to mesio-distal maximum diameters, in dingo it is 54.4%, in *S. harrisi* 91.5%.

A skull of *Thylacinus cynocephalus* which we (Macintosh & Mahoney 1964) regarded as the mean of our series, has a maxillary canine crown length of 17 and a maximum tooth length of 53, index about 32.1%. Its labio-lingual to mesio-distal index is 8 to 13 or 61.5%.

In the light of these brief comparisons, it is obviously unwise to regard measurements as convincing criteria for identification. Instead, non-metrical, morphological characters should be used. The pattern of the cemento-enamel junction of *Sarcophilus* is completely diagnostic; for teeth whose crowns have been broken off, and more particularly for small fragments, fuller criteria are necessary, and these are as follows:

Morphological traits of *S. harrisi*.

Upper canine: The crown is almost conical, convex labial and mesial, concave lingual and distal. The enamel cap is thin, tapering to a sharp tip incisally, cemento-enamel margin is undulant. Disto-labially the enamel is grooved by the lower first premolar, bounded distally by a slight ridge which separates labial from lingual enamel surfaces, and lingual to the ridge is another slight groove. The

mesial border is blunt, almost straight and abraded by the distal margin of the lower canine.

The cemento-enamel junction is markedly convex and extends furthest apically on the lingual surface: proximally this curve is reversed and is more deeply concave mesially than distally; on the mesial portion of the lingual surface, a short spur of enamel passes apically onto the root. There is a very slight cingulum where the enamel terminates, a little more marked disto-lingually.

The root is ovoid, being slightly compressed labio-lingually, the lingual surface being almost flat and presenting a shallow fossa with some 8 faint vertical ridges, while the labial surface is distinctly bulbous. This bulbous cross section tapers rather abruptly into a blunt apex.

The greatest mesio-distal and labio-lingual diameters occur half way along the long axis of the tooth.

Transition from crown to root is mesially and distally a smooth continuous curve. The tip of the crown deviates from the long axis, very slightly lingually as well as distally.

Faint stains indicating original position of gingival and alveolar margins can be seen on all aspects, gingival more or less parallel to cemento-enamel junction, alveolar more uniform encircling the root.

Lower canine: Whereas the upper tooth is most stable lying on its flatter lingual surface and with the crown tip touching the table, the reverse applies to the lower which is most stable lying on its labial surface, the crown tip touching the table.

The cemento-enamel junction is markedly more undulant in the lower canine. It is markedly convex towards the apex labially; but mesio-lingually the enamel retreats incisally to the extent of half the crown length. The line connecting the labial and lingual margins is sigmoid on mesial and distal aspects.

As in the upper, the enamel is thin, only slightly inrolled gingivally, and when it is shed, slight constriction of the root indicates the original position of the cemento-enamel junction.

The long axis of the tooth seen from lingual and labial aspects is decidedly more strongly curved than the upper.

The lingual surface has a more pronounced fossa and more prominent strial ridges than the upper.

The root is more strongly curved distally than the relatively straight upper root and is decidedly more compressed labio-lingually than the upper. The apex of the root is blunt but not so bulbous as in the upper root.

Viewed mesially, the long axis of the lower crown diverges labially, whereas in the upper, the axes of root and crown are relatively coincident.

The whole of the lower crown is more uniformly conical than the upper, although its enamel has a more pronounced distal ridge which is interrupted by attrition from the mesial border of the upper canine.

By applying these criteria, every tooth and portion of tooth in the Lake Nitchie burial necklace is

identified as *Sarcophilus*; there is no representation of *Thylacinus* or dingo, which is puzzling for a number of reasons. First the canine teeth of *Thylacinus* and of dingo being each flatter ovals in cross section, ought to offer easier media for the technique of root piercing.

Thylacinus is coincident in time span with *Sarcophilus*, Continent wide in distribution, and recovered from archaeological excavations in approximately similar frequency. The youngest recovered archaeologically, 4000 B.P., was the single tooth described by Macintosh & Mahoney (1964); but more recently two carcasses, each air mummified were found in Western Australian caves and dated at 3300 B.P. & 4500 B.P. At the present time it is said to be contemporary with *Sarcophilus* in Tasmania. It has not been seen alive for almost 40 years, but claims have been made that its tracks have been seen since. Sighting a live specimen would be the only satisfactory evidence of survival.

The earliest fully attested complete dingo skeleton is that recovered by Mulvaney from Fromm's Landing in South Australia and dated at 3000 B.P. (Macintosh 1964); dingo remains have been claimed occurring between 8600 ± 300 and 7450 ± 270 B.P. at Mt. Burr, South Australia. It has been pointed out that the dingo could not have entered Australia before 11000 years ago, when Bass Strait was flooded (Macintosh 1967). In other words the dingo is Recent in Australia, whereas *Sarcophilus* and *Thylacinus* are *Pleistocene* and presumably *Pre-Pleistocene*.

It therefore might be speculatively argued that the necklace was made before the thinning out and approaching extinction of *Sarcophilus* and before the build up in population of the Recently introduced dingo, which I think must indicate some 8000 years ago.

There is indirect evidence to suggest that a whole series of innovations in Aboriginal Australia may have been linked items in a new cultural complex. Of these, the rapid diffusion of a revolution in stone technology is the only item objectively identified by stratigraphy and radiocarbon dating as having its beginning perhaps as early as 7000 years ago and certainly by 5000 years ago.

I make the suggestion now, which I have not read or heard suggested previously, that a similar period saw the inclusion of the dingo into Aboriginal mythology, introduction of pecking technique in rock engraving, the introduction of subincision as an addition to circumcision, ritual tooth avulsion as a possible alternative to ritual subincision, cult heroes replacing sky gods, and *pari passu* with innovations, a phasing out of more archaic items such as mythology and ritual related to *Sarcophilus*.

The last is the only logical explanation that occurs to me for the interment of this unique necklace, and in chronology it ought to coincide with a dwindling *Sarcophilus* population. There is no surviving record of *Sarcophilus* in totemic significance, but the necklace argues for such a former role. Study of the necklace is therefore taken further than the comments in the preliminary paper. (1970)

In the technique of piercing these teeth, the first step was to reduce the labio-lingual diameter of the root by grinding or by grooving those surfaces. In some cases one to five mm of the root apex appear to have been reduced in this process. There are two examples where the first pierced hole broke through to the apex, and a second hole was made incisalward from the first. The length and the labio-lingual diameter of the tooth is thus altered.

The tooth needs to be held by its crown while work is being done on the root. Because of its bulbous root and tapering crown, it is much more difficult to manage than a canine of *Thylacinus* or

dingo. The tighter the finger and thumb grip the crown, the more the tooth tends to escape the grasp by sliding and projecting itself, rather like a squeezed orange seed. A large proportion of the crowns have partly or completely broken off at the cemento-enamel junction which apparently is the weakest part of the tooth. This weakness has almost certainly been accentuated by stress on the crown, being held while the root was being worked.

I have already said that measurements are less satisfactory than morphological characters for identification and I have referred to attritional loss of crown tip, to individual variability, and to overlap

TAB. A
Pooled sex, and pooled young and old adults

Lake Nitchie Teeth.		Canines from 5 skulls of <i>S. harrisi</i> (Larnach's collection)		
Maxillary	(Right 39, left 37, total 76)			
Max. Length				
No., Range, Mean	21, 27—37, 31.72	10	33—37	35.03
Crown Length				
No., Range, Mean	21, 9.0—14.6, 11.57	10	13—16	14.87
Index crown to Max..	36.46		42.4	
Mesio-distal diam.				
No., Range, Mean	64, 6.8—10.0, 8.22 (S.D. 0.7070)	10	8.5—10.1 (S.D. 0.5481)	9.16
Labio-lingual diam.				
No., Range, Mean	64, 5.6—8.2, 6.96	10	8.0—9.0	8.38
Index labio-lingual to mesio distal	84.67		91.48	
Mandibular	(Right 44, left 47, total 91)			
Max. Length				
No., Range, Mean	37, 25—28, 30.64	10	31—34	32.09
Crown Length				
No., Range, Mean	37, 9.0—15.5, 11.84	10	11.1—16.3	14.81
Index crown to Max..	38.61		46.1	
Mesio-distal diam.				
No., Range, Mean	79, 6.1—9, 5, 8.08 (S.D. 0.8208)	10	8.7—10.0 (S.D. 0.3771)	9.10
Labio-lingual				
No., Range, Mean	79, 4.2—7.2, 5.87	10	7.0—8.5	7.94
Index labio-lingual to mesio distal	72.65		87.25	

TAB. B

Maxillary Teeth	7.5YR 4/4 Dark Brown		7.5YR 5/6 Strong Brown		10YR 5/6 Yellowish Brown		10YR 7/8 Yellow		10YR 7/4 Very pale Brown		10YR 8/2 White	
	R	L	R	L	R	L	R	L	R	L	R	L
Number of teeth	1	0	8	8	14	10	8	9	7	9	1	1
Manganese stain	1	0	4	3	3	6	1	2	1	2	0	0
Crown gross damage	1	0	5	7	7	10	5	2	7	7	1	1
Root apex gross damage	0	0	4	8	8	7	7	2	3	3	1	1
Intact body i.e. no longit fracture					3				1			
Mandibular Teeth												
Number of teeth	1	1	3	4	19	16	11	14	10	12	0	0
Manganese stain	1	0	1	0	5	3	5	4	1	2	0	0
Crown gross damage	1	1	2	2	9	4	3	3	4	5		
Root apex gross damage	1	1	3	2	11	11	7	5	2	4		
Intact body i.e. no longit. fracture					3		3	2	4	5		

The human teeth in the Lake Nitchie skeleton are 10 YR 8/2 (white) for crowns, and their roots 10 YR 6/4 (light yellowish brown), the bones being 10 YR 5/6 (yellowish brown).

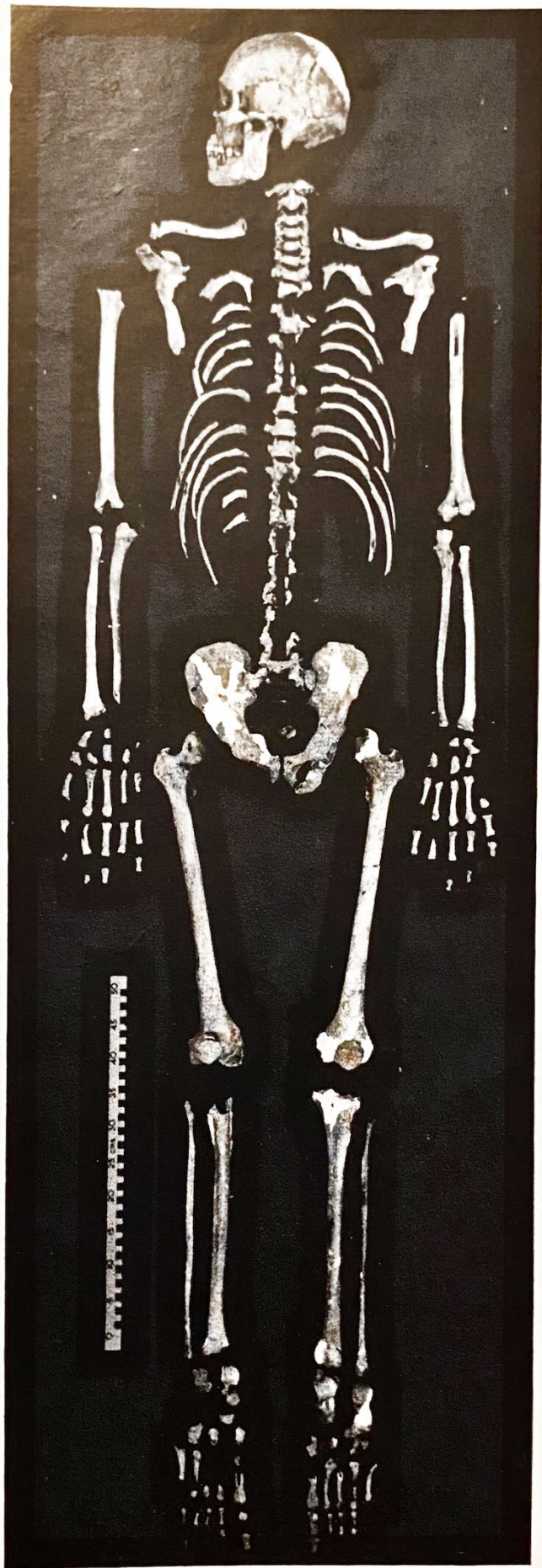


PLATE 1.

Aboriginal Australian male skeleton, stature 187.5 cm excavated 14 Jan. 1970. Identification and adhesive reassembly of the bone fragments took 6 months study and work. The photo shows that only minimal reconstruction with plaster has been made and the skeleton is in a fairly good state of preservation and completeness.
The right femur is cast, the original is being radio-carbon dated.

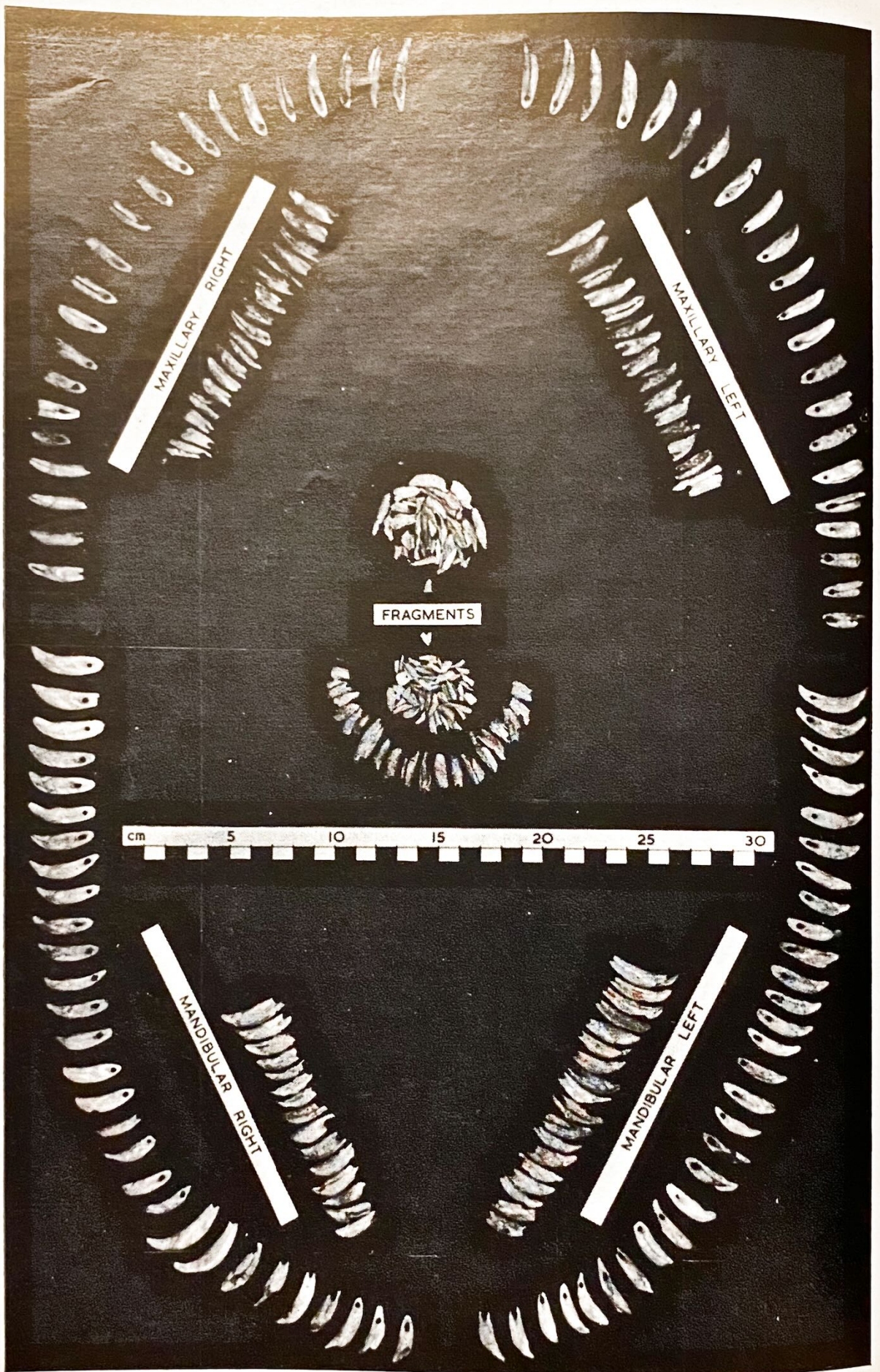


PLATE 2.

Necklace worn by the skeleton in Plate 1. It extended from neck to pelvis and comprised 178 canine teeth of *Sarcophilus harrisi* extinct on Mainland Australia since approximately 3000 B. P. By Munsell color analysis they can be separated into 5 groups of apparently increasing antiquity; also their state of preservation is not as good as that of the skeleton and its teeth, so they are deduced to be of greater antiquity than the skeleton.

Pierced shells, bones and stone have been reported from Australia, but not a single pierced tooth.

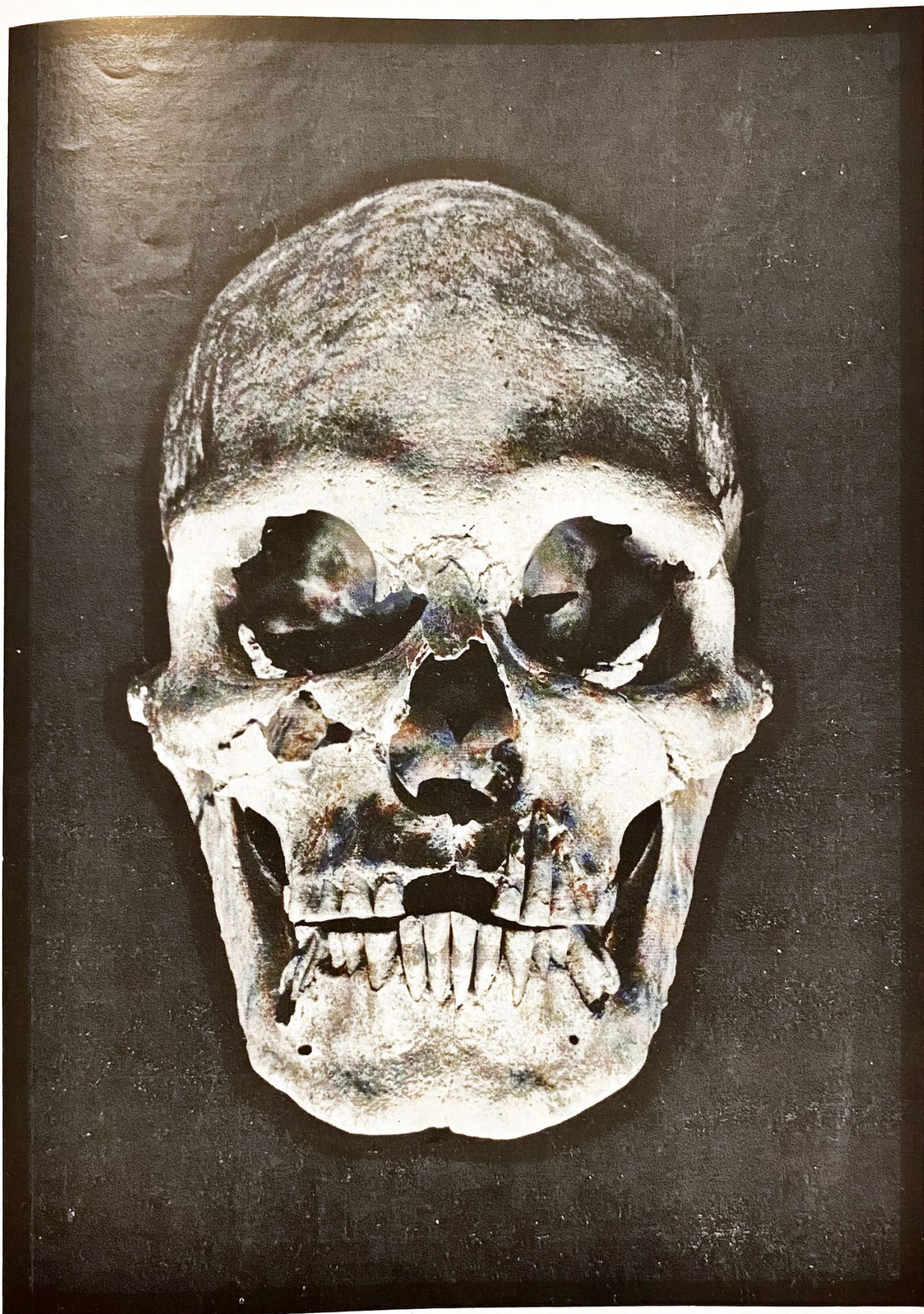


PLATE 3

„Normae frontalis, occipitalis, verticalis, basalis, left lateralis, showing mixture of archaic and modern characters described in the text; also, in norma frontalis note the ritual avulsion of the upper central incisors and the compensatory extrusion of the lower incisors; this is the earliest known recording of this practice in Australia.“

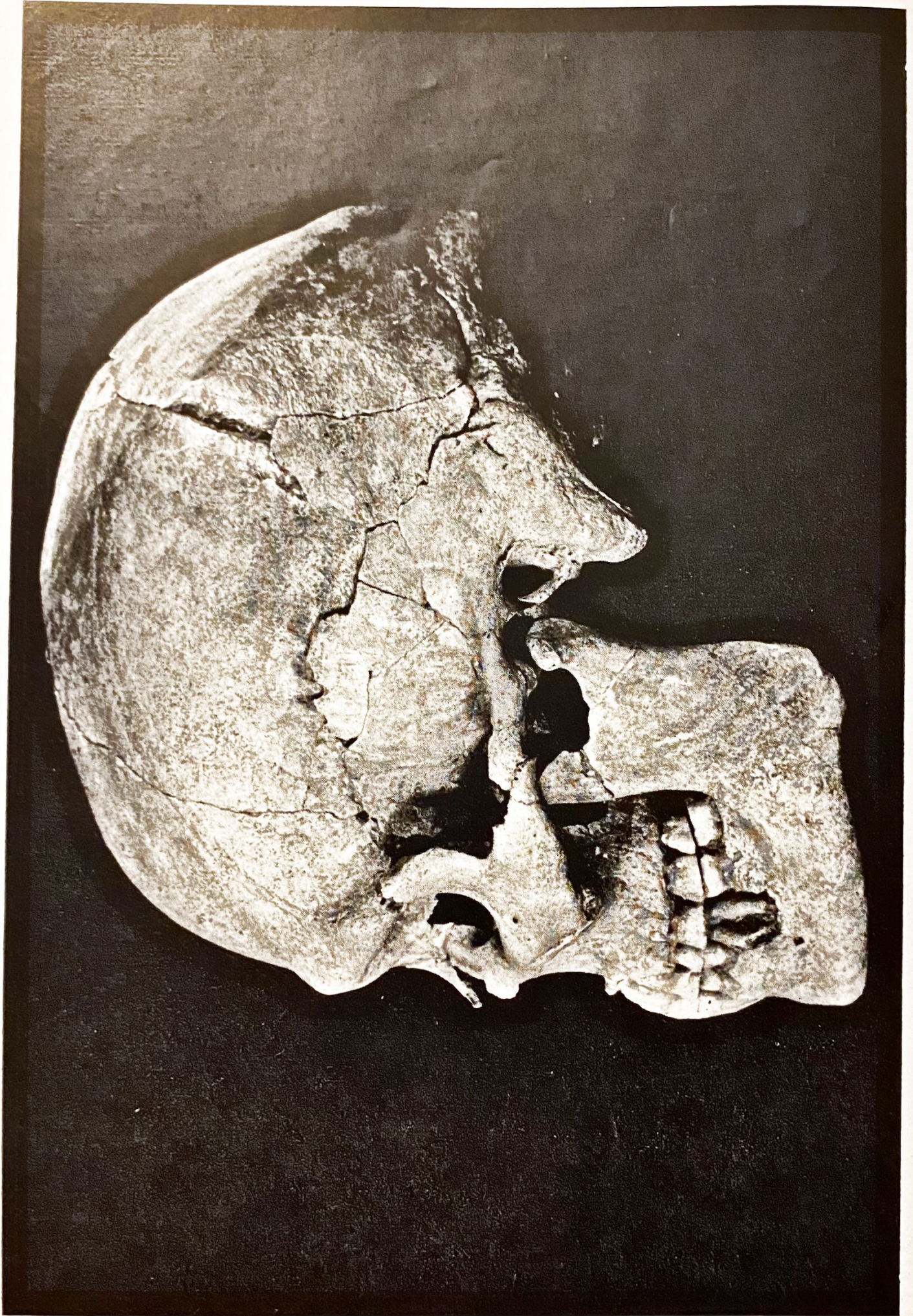


PLATE 4
Lake Nitchie skull — Norma lateralis.

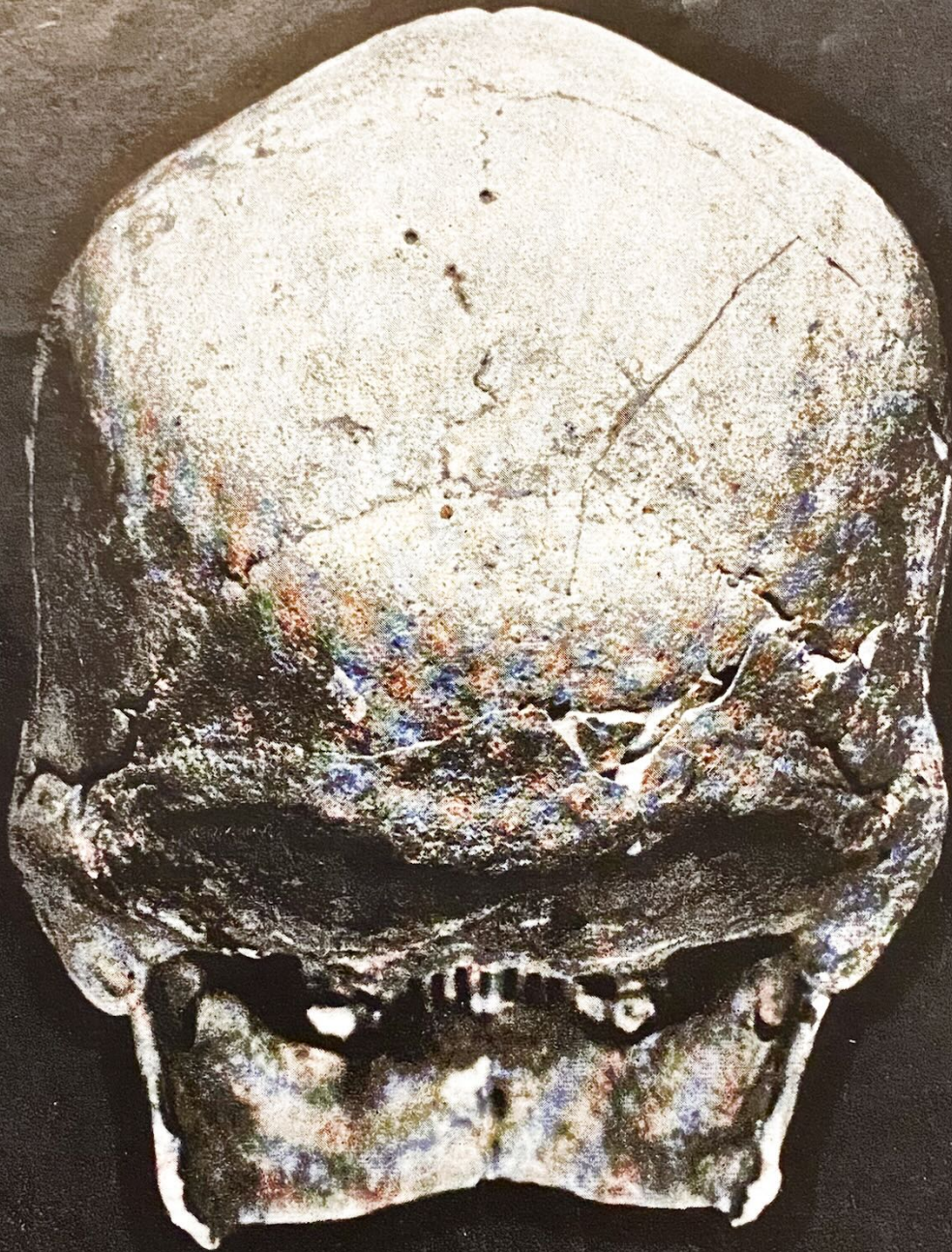


PLATE 5
Lake Nitche skull — Norma occipitalis.



PLATE 6
Lake Nitchie skull — Norma verticalis.



PLATE 7
Lake Nitchie skull — *Norma basalis*.

in size ranges between related species and unrelated genera.

Hence measurements on the necklace teeth for the purpose of statistically identifying specific relationship i.e. with *Sarcophilus lanarius*, or of matching left and right, upper and lower, to identify individual animals would be misleading rather than enlightening. There is also the problem of unknown proportions of male and female in such a pooled series. Nevertheless, an elementary statistical table (restricted to range and mean) has led to a different sort of information (see Table A).

The mesio-distal maximum diameter is the only measurement not altered by the tooth piercing work, and the mean of this diameter in the Nitchie collection is lower than in the small pooled *Sarcophilus harrisi* collection by 10.3% in the maxillary, 10.2% in the mandibular teeth, but there is a considerable overlap in ranges; so even without statistical elaboration of standard deviations and so on, it is clear that there is no reason to separate the Nitchie animals from *Sarcophilus harrisi*.

The labio-lingual diameter has a mean which is smaller in the Nitchie teeth than in the *Sarcophilus harrisi* collection by about 17% maxillary and 26% mandibular. This is a very clear indication of the considerable amount of tooth surface removed in the piercing operation, i.e. about 7% maxillary, 16% mandibular.

The explanation of why twice as much is removed from the mandibular as from the maxillary is probably because the mandibular is the more manageable tooth, having a less bulbous body and root, and so lending itself to more complete preliminary preparation for the ultimate piercing. In only 27.6% of the maxillary teeth has crown, body and root apex survived in continuity, making possible a total tooth length measurement; whereas 40.6% of the mandibulars have so survived in the grave. There is no reason to suppose the mandibular teeth are inherently stronger, indeed the maxillary are the more robust teeth.

In Table B the teeth have been classified for hue, value and chroma, using Munsell Color Charts 1954 edition; and crown, body and root damage has been recorded for the six colour classifications arrived at. Colour subdivisions could be, and indeed were recorded, under 11 colour classifications. These were re-assessed and the mean colour of three or two slightly different but adjacent identifications was nominated as the colour for that group. In other words there is minor variation of colour within each group.

The maxillary crowns show lower survival than the root apices in spite of the apical drill holes; the reverse applies to the mandibular teeth, where crowns have survived better than root apices. Whatever the condition of the crowns may have been, all the teeth must have had at least intact drill holes when the aboriginal was buried wearing the necklace. The distribution of the teeth seen at excavation, i.e., around the back and sides of the neck, over the left and right chest wall down to the left and right iliac bones, proves that this was a continuous

string of teeth, not handfulls thrown randomly into the grave. Some degree of damage or disintegration is now present in practically every tooth irrespective of colour classification.

The *Sarcophilus* teeth obviously have not survived as well as the human skeleton has, and teeth survive far better than bone does. This suggests very strongly that the *Sarcophilus* necklace has greater antiquity than the wearer of the necklace. Compared with the teeth of the 3000 year old dingo from Fromm's Landing and other sub-fossil dingo teeth referred to in that same paper (1964), these *Sarcophilus* teeth give me a subjective impression, based on colour and on fissure or frank fracture, of having two to threefold greater antiquity, i.e. 6000 to 9000 B.P. Of course, different grave environment and individual variability in genetic susceptibility to enamel cracking and staining can compromise such subjective observations.

The distribution by Munsell comparison is certainly interesting. The two teeth classified as white can be ignored, being quite obviously bleached by exposure like the calotte of the human skeleton.

Modern *Sarcophilus harrisi* teeth have very pale brown 10 YR 8/3 roots and 10 YR 7/4 crowns, and light yellowish brown 10 YR 6/4 cement near the junction. Teeth, like ivory, darken with age and sustain progressive fissuring, longitudinally in canines.

The maxillary distribution, i.e. 15, 17, 24, 16 through four colour classifications of very pale brown, yellow, yellowish brown, strong brown, suggests four time periods of increasing antiquity and I see confirmation of this in the presence of one dark brown representative which I think indicates still greater antiquity. The mandibular distribution, i.e., 22, 25, 35, 7 is reasonably similar, and there are 2 dark brown representatives.

Tooth piercing: In the preliminary paper (1970), I stated that four basic technical steps, 1. grinding, 2. shallow followed by 3. deep chiselling, and 4. piercing, applied to all the teeth. Following the present more complete examination, I have to alter that opinion, and substitute the following list of 13 technical variations; distribution frequency is indicated by 4 numbers for Right Maxillary, Left Maxillary, Right Mandibular, Left Mandibular respectively.

TECHNICAL VARIATIONS OF TOOTH PIERCING

Deep concave ground basin bilateral, hole	9	7	9	13
Shallow wide ground basin bilateral, hole	6	2	0	7
Shallow wide ground basin bilateral, groove, hole	3	2	1	0
Flat ground bilateral, groove, deeper groove, hole	2	3	7	12
Flat ground bilateral, basin, deeper basin, hole	2	3	6	0
Flat ground bilateral, steep, steep grooves, hole	2	0	0	0
Flat ground unilateral, deep basin, hole	1	4	0	0

Not ground, gouged basin, hole	7.	4.	4.	3.
Not ground, gouged groove, hole	1.	5.	11.	8.
Not ground, hole	0.	0.	5.	0.

Combinations:

Ground on one side, groove				
Not ground other side, groove, basin hole	1.	1.	0.	0.
Ground one side, deep basin				
Ground other side, reverse groove hole	1.	2.	0.	0.
Indeterminate	4.	4.	11.	4.

In a left maxillary there is a unique example of a not ground, but bilaterally gouged gutter, with a single pierced hole in one gutter and two in the opposite gutter. In a right mandibular, the hole near the apex fractured, and a second hole was pierced nearer to the crown. The majority of the pierced holes are circular, but a considerable minority are oval, the long axis of the oval being variously oblique to the long axis of the tooth, and 3 are irregular in outline.

It is possible to further subdivide the 13 techniques listed, but no purpose would be served, because these 13 differing techniques could scarcely appear to be the product of one craftsman or even one school of craftsmen; further subdivision of technical performance would only emphasize individuality of craftsmanship. These techniques are scattered in random fashion through the different colour classifications.

These findings appear to me to support the proposition that the necklace represents an ongoing concern in replacement and, or, additions over multiple generations.

Necklaces, particularly if worn frequently, do not have high survival rates. The sustaining thread wears the pierced holes, and itself. In Aboriginal society, a long single string necklace would not survive one day of hunting or even one day of animated ceremonial dancing. The only logical conclusion seems to be that this necklace was analogous to churingas (sacred totemic engraved stones) which were (and still are) hidden for most of the year, and only brought out for ritual re-enactments and ceremonies.

It is also impossible to identify how many animals have contributed to this necklace. The minimal number is 47. Although mandibular exceed maxillary by 91 to 76, Table B shows reasonable similarity of frequency between left and right in each of the colour groups, and also a similarity (although less marked) between maxillary and mandibular numbers in each of the colour groups. This applies also to the distribution of manganese staining. That argues for the minimal number of animals being contributors. But as I am unable positively to match maxillary or mandibular pairs let alone sets of four teeth, even with the help of colour identification and manganese staining, it seems highly probable that teeth were progressively replaced and added to in this necklace over a period encompassing many human generations of craftsmen. It is at least poss-

ible that the 178 teeth are derived from 178 animals, and indeed they may all be replacements of earlier animal contributors.

This could only occur if the *Sarcophilus* population was large enough in the region, not just of the dry lake, but of the adjacent Darling River and its Anabranche, to permit adequate replacement allowing for waste when the piercing technique was unsuccessful. Failure rate was probably very high, by analogy with the enormous disproportion between waste stone flakes and finished stone implement products evidenced in all Aboriginal work sites, whether surface or stratified.

With the decline in *Sarcophilus* population it must have been increasingly difficult to obtain tooth replacement for the necklace and *pari passu*, the totemic significance of *Sarcophilus* in Aboriginal spiritual and economic life would have declined. The archaeological evidence from strata between 3000-4500 B.P. most certainly does not indicate a sufficient *Sarcophilus* population. For the required *Sarcophilus* frequency a minimal antiquity of 7000 B.P. is suggested.

Burial of this necklace may well be analogous with the burial in sacred water-holes of totemic poles at the termination of Maraian ceremonies in present day Arnhem Land; those poles are resurrected annually. The terminal nature of the burial of the Nitchie necklace is almost certainly an index of the incipient extinction of *Sarcophilus*, the last "head man" of the *Sarcophilus* totem having the no longer functionally significant necklace buried with him.

From the various deductive reasons given I think the necklace at the time of its burial had an antiquity of 7000 years, some of the teeth being older than others, and therefore indicating a history in continuity of replacement before that back to 8000 B.P.

Conflicting with this is my deduced opinion, already stated, that the human skeleton is unlikely to be much older than 5000 B.P. The two deductions are not entirely irreconcilable. A sacred or traditional heirloom might well survive for centuries or even millennia particularly with replacements, and if stored away in a secret place, and brought out only at rare intervals by initiates of high degree.

Aboriginal society has been extremely conservative in some directions, illustrated by traditional chants, still sung today, but couched in archaic words. Churingas of both stone and wood of unknown age, but so old that the designs are barely decipherable as a result of finger stroking once or twice a year over untold centuries, are still produced for ceremony. Unfortunately social or traditional anthropologists have elicited no absolute and scarcely any relative historical chronology from their studies of present day iteration of legends, chants, ceremonies. Those studies having no identified time depth, are therefore largely sterile for the archaeologist or anatomist.

Before this find there was no evidence on which any writer could say that *Sarcophilus* had ever been anything but a very rare animal, and there was no

evidence that Aborigines pierced any teeth for any purpose whatever, nor that tooth avulsion was practised more than a few centuries ago.

So an entirely original vista of knowledge stems from this one burial. Irrespective of what the radiocarbon results may indicate for the burial, there would appear to be no way of testing my deduction that the necklace is older than the human skeleton. Fluorine comparisons would not help, because the necklace and its wearer were simultaneously interred.

SUMMARY & CONCLUSIONS

An appreciable frequency of Modern Aboriginal Australian skulls show individual archaic traits but not to the collective extent of the Nitchie skull; it is unusual in its mixture of modern and archaic traits, which is more marked than in other Australian skulls whether modern or fossil. Its temporal and frontal fullness (frontal curve index 24.2), slight phaenozgy, considerable vertical height, relative orthognathism, modern digastric fossa with juxtamastoid ridge, postglenoid tubercle, angulated mandibular incurvature, no genial pit, all indicate modernity.

Its uninterrupted frontal and mound-like occipital tori, the latter without external occipital protuberance and continuing into angular torus and mastoid ridge, angulated petro-tympanic axis opposite carotid foramen, relatively transverse squamo-tympanic suture, low flattish temporo-parietal suture, angle of occipital plane to nuchal plane of only 110°, although not in the high posterior position of the cranium as in the 105° of *H. erectus*, rather well defined mandibular planum alveolare, very slight (if present at all) trigonum mentale, and marked submental notch all indicate archaic characteristics and represent the most numerous collection of these simultaneously in any Australian skull recorded.

In general appearance, essentially of contours, it looks far more modern than the Cohuna or Talgai crania or even the Keilor cranium, but those crania show only one or two or three of the archaic traits compared with nine or perhaps ten in the Lake Nitchie skull.

The general appearance created by the Lake Nitchie skull, particularly its contouring, combined with the completeness and relatively good preservation of the skeleton, absence of any encrustation, non mineralisation of the cancellous bone, lead me to assess its antiquity as approximately 5000 years.

It would be quite wrong to say that any example of definitive *H. erectus* has so far come out of Australia or that any fossil Australian skull, (if found in Javanese Trinil geological context), could be mistaken for *H. erectus*. Indeed it would be differentiated instantly by the lateral trigone and the location of the occipital torus; nevertheless the exhibition of archaic traits, particularly some of those of *H. erectus*, occurs in ancient and modern Australian skulls in varying frequencies, and probably in greater frequency than in any other modern races; it would be interesting to compare these Australian

manifestations with the Omo crania published by Day (1969). One particularly interesting point is Day's reference to a deeply incised digastric groove which in Australian analysis would be regarded as very modern.

A description of the detailed morphological characters of *S. harrisi* canines has been put on record, and such detail is not to be found elsewhere in the literature.

Although the mean of mesio-distal diameter of the Lake Nitchie teeth is about 10% smaller than in a compared series of *S. harrisi*, there is very considerable overlap in range, and there is no reason to separate the Nitchie animals from *S. harrisi*.

Munsell color analysis of the Nitchie canine teeth quite distinctly divides them into 5 groups, which is considered to indicate different levels of antiquity and by comparison with other Australian teeth which have been radiocarbon dated, suggests an 8000-7000 B.P. time range for the necklace teeth.

No tooth has survived totally free from some disintegration and less than 35% have relatively intact crown, body and root. They are not as well preserved as the teeth or even the bones of the human skeleton. Also, analysis of tooth piercing in this necklace shows at least 13 different techniques. So, it is probable that the teeth have been replaced and added to in the necklace by multiple craftsmen over multiple generations.

While the minimum number of animals represented cannot be less than 47, it is possible that every tooth is a replacement or an addition in the necklace, hence the animal contributors over the history of the necklace may run into hundreds. Such frequency of *Sarcophilus* population also suggests minimal antiquity of 7000 B.P. on Mainland Australia.

Discrepancy between the estimated antiquity of 5000 years for the skeleton and 7000 ranging to 8000 for the necklace is rationalised by a semi-speculative assumption, based on analogy with known Aboriginal customs, that the necklace was a sacred totemic emblem passed on to successive generations.

ADDENDUM

The results of radiocarbon dating were completed by Dr. T. Athol Rafter, Director of the Institute of Nuclear Sciences, Department of Scientific and Industrial Research, Lower Hutt, New Zealand, on 15th August 1970. I had then already left Australia and received these results on 3rd September in Prague.

Charcoal from the small ritual fire	5,230 ± 715y B.P.
Bone carbonate of the right femur	3,290 ± 85y B.P.
Collagen of the right femur	6,820 ± 200y B.P.

The report states that the very small sample of charcoal from the ritual fire produced only 0.615 litres of CO₂ and counting was done after a large dilution of 90.9%; that the bone carbonate has

been contaminated definitely; that the collagen gives an excellent result.

The problems of radiocarbon dating of Australian materials were described in the opening section of this paper; those observations are reinforced by these results.

I suggested in the text that a new cultural pattern occurred in Aboriginal Australian C 7000y B.P. involving a series of innovations combined with a phasing out of more archaic items such as mythology and ritual related to *Sarcophilus*.

The skeleton now dated at 6820 ± 200 y B.P., is almost 2000 years older than my conservative deductive estimation of 5000 years, and strongly supports my suggestion that the interment of the unique *Sarcophilus* necklace indicates a terminal phase of its functional significance coincident with a dwindling *Sarcophilus* population. There remains the problem of testing my hypothesis that the necklace has appreciably greater antiquity than the skeleton. By a fortunate coincidence I have just received a note from Dr. Kenneth Oakley of the British Museum requesting 2.0 gm. of dentine from the *Sarcophilus* teeth for comparison with 2.0 gm. of compact bone from the skeleton for analysis of fluorine, phosphate, carbonate, uranium and nitrogen. Simultaneous interment of necklace and skeleton had seemed to me to militate against fluorine differentiation of the two items, but perhaps the combined analysis will resolve the problem.

REFERENCES

- BOWLER, J. M. 1970a: Pleistocene salinities and climatic change: evidence from lakes and lunettes in southeastern Australia. In *Aboriginal Man and Environment in Australia*. Ed. Mulvaney & Golson. A.N.U. (in press).
- BOWLER, J. M. 1970b: Lake Nitchie Skeleton — Stratigraphy of the burial site. *Arch & Phys. Anthr. Oceania* 5, 2 : 102—113.
- BOWLER, J. M., JONES, R., ALLEN, H., and THORNE, A. G. 1970: Pleistocene human remains from Australia: a living site and human cremation from L. Mungo, western N.S.W. *World Archaeology*. (in press)
- CALABY, J. H. and WHITE, C. 1967: The Tasmanian Devil (*Sarcophilus harrisi*) in Northern Australia in Recent Times. *Aust. J. Sci.* 29, 12 : 473—5.
- DAVIVONGS, V. 1963: The femur of the Australian Aborigine. *Am. J. Phys. Anthropol.*, 21, 4 : 457—68.
- DAY, M. H. 1969: Omo human skeletal remains. *Nature*, 222 : 1135—8.
- ETHERIDGE, R. 1916: The Warrigal, or "Dingo", introduced or indigenous? *Mem. Geol. Survey N.S.W. Ethnol. S.* 2, 43—54.
- JACOB, T. 1967: The Racial History of the Indonesian Region: 1—162. Utrecht.
- KROGMAN, W. M. 1962: The Human Skeleton in Forensic Medicine. c.c. Thomas. U.S.A.
- LARNACH, S. L. & MACINTOSH, N. W. G. 1966: The craniology of the Aborigines of coastal New South Wales. *Oceania monograph No. 13*.
- LYDEKKER, R. 1894: A Handbook to Marsupialia and Monotremata. Allen & Co. London.
- MACINTOSH, N. W. G. 1964: A 3,000 years old dingo from Shelter 6. *Proc. Roy. Soc. Vict.*, 77, 2, 498—507.
- MACINTOSH, N. W. G. and MAHONEY, J. A. 1964: A 4,000 years old Thylacine tooth (Dasyuridae) from Shelter 2. *Proc. Roy. Soc. Vict.*, 77, 2, 507—514.
- MACINTOSH, N. W. G. 1965: The physical aspect of man in Australia. Ch. 2 in *Aboriginal Man in Australia*. (Berndt, R & C., Eds.). Sydney.
- MACINTOSH, N. W. G., 1967: Fossil Man in Australia. *Aust. J. Sci.* 30, 3 : 86—98.
- MACINTOSH, N. W. G., SMITH, K. N. and BAILEY, A. B. 1970: Lake Nitchie Skeleton — Unique Aboriginal burial. *Arch. & Phys. Anthr. Oceania*. 5, 2 : 85—101.
- MACINTOSH, N. W. G. 1970: Fossil Man in Australia. IX *Internat. Congress Anatomists, Leningrad. Abstr.*: 82—3, Aug. 17—22. Ed. D.A. Jdanov et alii.
- MULVANEY, D. J. 1964: Archaeological Excavation of Rock Shelter No. 6 Fromm's Landing, South Australia. *Proc. Roy. Soc. Vict.*, 77, 2, 479—516.
- SPENGER, B. and KERSHAW, J. A. 1910: A collection of sub-fossil bird and marsupial remains from King Island, Bass Strait. *Mem. Nat. Mus. Melbourne*. 3 : 5—33.
- THIEME, E. P. & SCHULL, W. J. 1957: Sex determination from the skeleton. *Human Biol.* 29 : 242—273.
- TINDALE, N. B. 1955: Archaeological site at Lake Menindee, N. S. W. *Rec. S. Aust. Mus.*, 11 : 269—98.
- TINDALE, N. B. 1957: Culture succession in south-eastern Australia from Late Pleistocene to the present. *Rec. S. Aust. Mus.*, 13 : 1—49.
- WAKEFIELD, N. A. 1964: Mammal remains. *Proc. Roy. Soc. Vict.*, 77, 2, 494—498.
- WOOD, W. Q. 1920: The tibia of the Australian Aborigine. *J. Anat.* 54 : 232—257.
- YAMAGUCHI, B. 1967: A comparative osteological study of the Ainu and the Australian Aborigines. *Occ. Paps. No. 10, Aust. Instit. Aboriginal Studies*: 1—73.

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