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PALAEONTOLOGY, BIOLOGY, ANTHROPOLOGY

A RECENT BONE DEPOSIT AT MARBLE ARCH, N.S.W.

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ABSTRACT

Preliminary investigations of a recent bone deposit at Marble Arch, N.S.W. revealed the presence of twenty three species of small mammals, several of which are now extinct and others which are not found in the area. The deposit is the result of an accumulation of a large number of regurgitated pellets, believed to be from Masked Owls, *Tyto novaehollandiae*. Changes in food selection or availability for the owls are shown and some comments on the possible age of the deposit are made. A key for identification of the dentaries of small mammals in south-eastern Australia is presented.

I. INTRODUCTION

Marble Arch is a naturally occurring cave located 40 km south of Braidwood on Reedy Creek, a tributary of Moodong Creek which flows into the Deua River (Figure 1). The cave is approximately 60 m long and is extremely complicated in nature, there being at least seven separate entrances (see article by Nicoll, Spate and Brush, Section 1).

The bone deposit is located on top of a large block of limestone which is approximately 3.5 m high and is located near the down-stream entrances to the cave. The block is triangular in plan view and moderately flat on top. The bone deposit covers approximately 8 sq. m and is of varying but shallow depth. There are several other bone deposits located on inaccessible ledges in other areas of Marble Arch Cave.

Several partly decomposed, but still intact, regurgitated owl pellets were found on the deposit. It is assumed that the bone deposit is a result of a large accumulation of these owl pellets and that the limestone block has served as a roosting site for owls over a long period of time.

The pellets represent indigestible food items which have been prevented from passing down the birds alimentary canal by the gizzard. Generally speaking the pellet is composed of hard materials such as bones, claws, chitin, fur and cellulose, rolled into an elongated form and regurgitated by mouth (Welty, 1968). Frequently the pellets contain dentaries (jaw bones), skulls and long bones which are sufficient to determine the food species of the owl. Most owls produce two pellets a day, one of which is usually regurgitated while the bird is at its diurnal roost (Glue, 1970). Quite often some of the small mammal species preyed upon by owls are particularly difficult to trap or find and the analysis of owl pellets has been used in this way in several fauna surveys (Papp, 1970; Glue, 1970).

This report outlines the collection of a sample from the Marble Arch deposit and the identification and development of a key for the small mammals present in the material. An analysis of the deposit is made with regards to the fauna of the bone material and the knowledge of the present small mammal fauna of the area.

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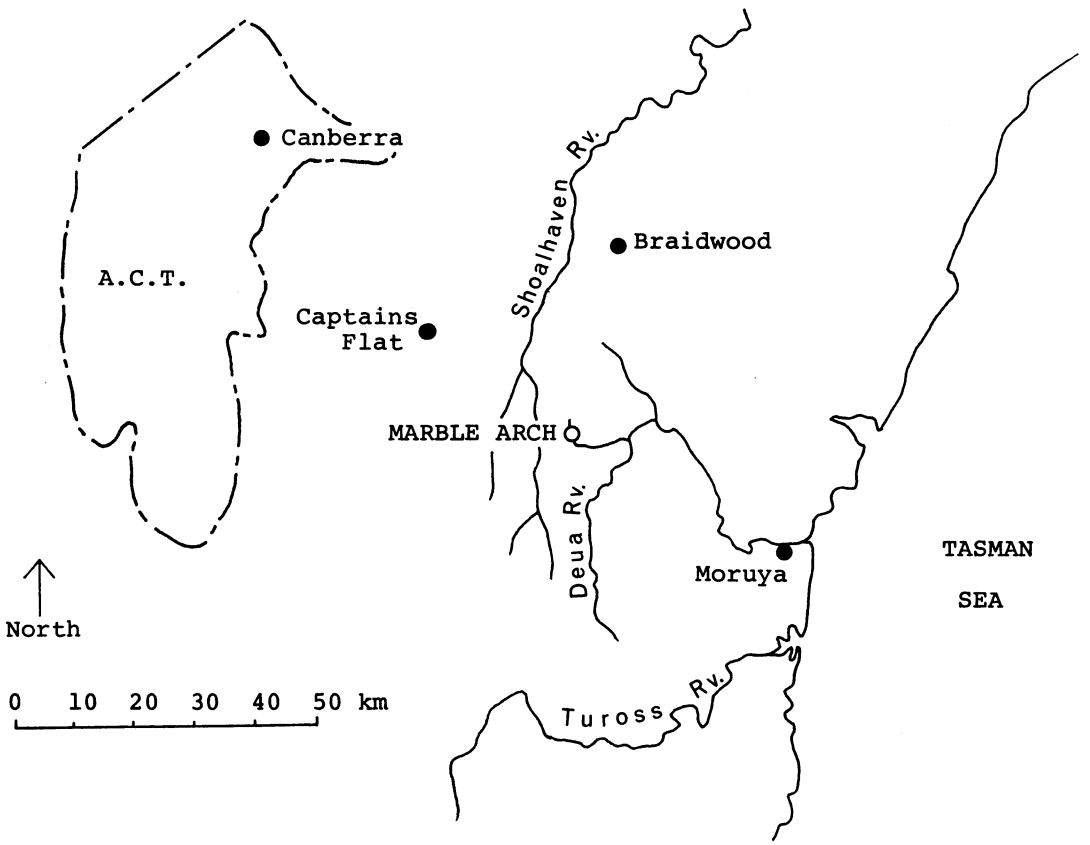
Figure 1. Location of Marble Arch.



II. METHODS

A. Collecting the sample:

After the deposit was mapped and photographed (Plates 1a and b), the deepest part of the deposit was located by probing amongst the bone material with a piece of wire. On the deepest area a 0.5 x 1.0 m rectangle was marked with cloth tape. A 25 cm steel cementing trowel and a stiff 5 cm paint brush were then used to remove a 1 cm layer of the deposit at a time. The deposit was 11 cm deep (Plate 2), and the eleven layers were each placed in a plastic bag and labelled. Long bones, particularly tibias, provided some difficulties when located in a vertical position between several layers. These bones were removed and placed in the sample from the highest layer in which the bone was located.

B. Processing the sample:

The samples were weighed and double sieved; first through a 0.63 cm wire mesh and then through a 0.35 cm wire mesh. Bones separated by the meshes were stored separately and the remaining material was returned to the plastic bag.

Bone samples from each layer were sorted into dentaries, skull fragments, long bones and other bones by using a large illuminated magnifying glass ("Maggi lamp"). The dentaries were labelled with an individual number and sorted into approximate groups according to size and obvious features.

C. Development of the key:

To develop the identification key it was necessary to use dentaries of known specimens from the CSIRO Division of Wildlife Research's Museum. Where possible specimens that had been collected in south-eastern N.S.W. were selected. Comparative material was not available for all species, and when this occurred, key features were taken from the work of Wakefield (1960a, 1960b and 1969).

The key was developed by identifying features of the dentary particular to a species (Figures 2a, b, c and d). This involved observations on the number, position, relative size and shape of teeth, the shape of the dentary and its associated features, and the location of these features. The presence or absence of these features was also used, and it was found useful to compare the dentaries of similar species or species with close taxonomic relationships. In the murids, the length of the molar tooth row, molar and incisor width were also used.

The key was then applied to the top two layers (1 and 2) and the bottom two layers (10 and 11) of the sample. Considerable time was needed to become familiar with the key and the material and hence processing of the other layers has not yet been done.

III. RESULTS

A. Identification of the owl species:

During the collecting of the sample, two primary wing feathers of the Boobook Owl *Ninox novaeseelandae* were found in the material. Calaby (1969) states that the food of the Boobook Owl consists almost entirely of insects and only occasionally is a house mouse or small bird added to the diet. He also mentions that they will rest in caves during the day. As there did not appear to be any invertebrate remains it is deduced that Boobook Owls visit Marble Arch Cave to roost but played little or no part in the building up of the bone deposit.

Several partly decomposed pellets which were found on the deposit showed signs of having a "dried skin" type of coating (Plate 3), indicating that they were produced by an owl of the genus *Tyto* (Wakefield, 1960b; Fleay, 1968). This, coupled with the large size of the pellets (average length 8.0 cm), suggests that they should have been produced by a Masked Owl, *Tyto novaehollandiae*.

When considering the body size of some of the mammal species contained in the bone deposit, it is obvious that the predator must have been a large owl (Table 1).

Table 1. Size of those mammals whose dentaries were found in the Marble Arch deposit.

Species	Head and Body length
Potoroo *Potorous tridactylus*	42 cm
Bandicoot *Perameles nasuta*	40 cm
Ringtail Possum *Pseudocheirus peregrinus*	40 cm

Apart from the Masked Owl the only other owl capable of killing the species in Table 1 is the Powerful Owl, *Ninox strenua* (Fleay, 1968). However, the Powerful Owl must be discounted because its pellets have a felty external appearance (Wakefield, 1960b), and as Fleay (1944) points out, the Powerful Owl does not normally roost in caves, nor does it hunt terrestrial mammals for food.

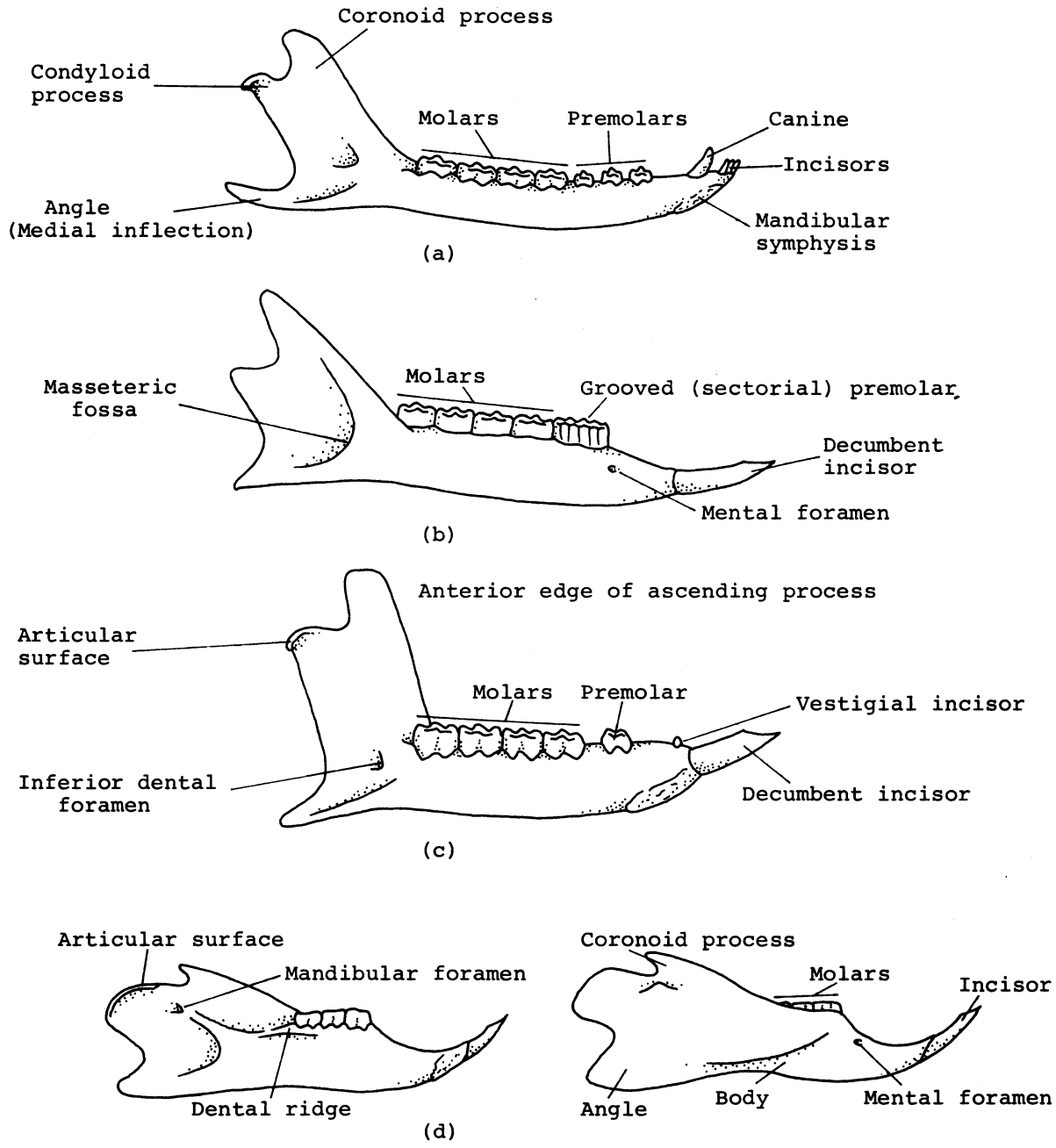


Figure 2. Features of Marsupial and Murid dentaries (not to scale).

(a) Marsupial, Polyprotodont (Peramelidae) - Medial aspect
(b) " , Diprotodont (Potoroinae) - Lateral aspect
(c) " , " (Phalangeridae) - Medial aspect
(d) Murid dentary - Medial and lateral aspects

Available evidence leaves little doubt that the predator was of the genus *Tyto*, and it suggests strongly that the species was the Masked Owl, *T.novaehollandiae*.

B. Analysis of the sample:

The key developed for the identification of dentaries of the mammal species present in the sample appears as Appendix A.

The key initially requires a person to sort the dentaries into approximate groups, according to size, shape and then obvious features. Then by using the photographs (Plates 4, 5 and 6) and the diagrams (Figures 2a, b, c and d) in conjunction with the key, it is possible to identify all the dentaries of the species so far found in levels 1, 2, 10 and 11 of the Marble Arch deposit.

(i) Identification and number of species in the two surface levels:

A total of 75 dentaries were found in level 1, and 70 in level 2. This represented 18 species of mammals. The maximum number of left or right dentaries of a species was taken as the number of individuals present in a level. This totalled 44 individuals for level 1 and 46 individuals for level 2. The samples are not regarded as having enough material to make a valid comparison, so they have been combined. Table 2 shows the identification information from levels 1 and 2.

Table 2. Species and Number of Mammals Identified in Levels 1 and 2

Species	Level 1	Level 2	Combined
Isoodon obesulus	0	2	2
Perameles nasuta	2	2	4
Potorous tridactylus	0	2	2
Antechinus stuartii	7	9	16
Antechinus swainsonii	1	0	1
Antechinus flavipes	0	1	1
Sminthopsis murina	1	0	1
Sminthopsis leucopus	0	1	1
Pseudocheirus peregrinus	2	0	2
Schoinobates volans	6	3	9
Petaurus breviceps	5	6	11
Rattus fuscipes	8	7	15
Rattus lutreolus	1	1	2
Mastacomys fuscus	2	1	3
Pseudomys oralis	6	8	14
Pseudomys fumeus	1	0	1
Oryctolagus cuniculus	1	1	2
Rattus rattus	1	2	3
Species total	44	46	90
Total of dentaries in deposit	75	70	145

Antechinus stuartii, *Rattus fuscipes* and *Pseudomys oralis* make up the majority of dentaries, followed by *Petaurus breviceps* and *Schoinobates volans*. The other 13 species are represented by 25 dentaries.

(ii) Identification and number of species in the two bottom levels:

In levels 10 and 11 there were 95 dentaries representing 16 species. There were 49 individuals in level 10 and 45 in level 11. These levels have also been combined and the results are shown in Table 3.

Table 3. Species and Number of Mammals Identified in Levels 10 and 11

Species	Level 10	Level 11	Combined
Perameles nasuta	3	1	4
Antechinus stuartii	6	9	15
Antechinus swainsonii	1	1	2
Antechinus flavipes	0	1	1
Sminthopsis leucopus	1	0	1
Pseudocheirus peregrinus	3	0	3
Schoinobates volans	2	0	2
Gymnobelideus leadbeateri	1	3	4
Petaurus breviceps	7	6	13
Petaurus norfolcensis	1	0	1
Rattus fuscipes	6	9	15
Rattus lutreolus	4	5	9
Mastacomys fuscus	1	1	2
Conilurus albipes	0	1	1
Pseudomys oralis	13	7	20
Pseudomys novaehollandiae	0	1	1
Species total	49	45	95
Total of dentaries in deposit	93	78	171

Pseudomys oralis has the greatest number of dentaries followed by *Antechinus stuartii, Rattus fuscipes, Petaurus breviceps* and *Rattus lutreolus*. The remaining 11 species are represented by 22 dentaries.

(iii) Comparison of levels 1 and 2 with levels 10 and 11:

Table 4 compares the two surface layers with the two bottom layers. The combined species numbers are given and the percentage composition shown by each family or group is shown.

Some of the major features are:

(a) *Isoodon obesulus, Potorous tridactylus, Sminthopsis murina, Pseudomys fumeus, Oryctolagus cuniculus* and *Rattus rattus* are all present in the surface levels but absent from the bottom levels of the deposit.

(b) *Gymnobelideus leadbeateri, Petaurus norfolcensis, Conilurus albipes* and *Pseudomys novaehollandiae* are present in the lower levels but absent from the surface levels.

(c) The presence of the following species has remained relatively constant - *Perameles nasuta, Antechinus stuartii, Petaurus breviceps, Rattus fuscipes*. The following may also be included in this group, though figures for them are too small to be really significant - *Antechinus flavipes, Sminthopsis leucopsis, Pseudocheirus peregrinus* and *Mastacomys fuscus*.

(d) There is more *Schoinobates volans* material in the surface levels than in the lowest levels, and the reverse case applies to *Rattus lutreolus* and *Pseudomys oralis*.

(e) Over half of the lower levels' species are Murids (52%), with the Petauridae (24%) and Dasyuridae (20%) making up most of the rest. In the surface layers the percentages for the Petauridae and Dasyuridae remain much the same as in the lower level, but the Murids drop to 39%. The rest is made up by Peramelidae (7%), introduced mammals (6%), and Macropodidae (2%).

(f) The dentaries from the lowest levels were usually a dark brown colour which contrasted with the light "bone" colour of the surface level material. Dentaries

from the lower levels were often extremely fragile.

Table 4. Comparison of Species and Numbers Between Levels 1 and 2 and Levels 10 and 11

Species	Levels 1 and 2 Number	Levels 1 and 2 Percentage	Levels 10 and 11 Number	Levels 10 and 11 Percentage
Peramelidae				
Isoodon obesulus	2	7	0	4
Perameles nasuta	4		4	
Macropodidae				
Potorous tridactylus	2	2	0	0
Dasyuridae				
Antechinus stuartii	16		15	
Antechinus swainsonii	1		2	
Antechinus flavipes	1	22	1	20
Sminthopsis murina	1		0	
Sminthopsis leucopus	1		1	
Petauridae				
Pseudocheirus peregrinus	2		3	
Schoinobates volans	9		2	
Gymnobelideus leadbeateri	0	24	4	24
Petaurus breviceps	11		13	
Petaurus norfolcensis	0		1	
Murids				
Rattus fuscipes	15		15	
Rattus lutreolus	2		9	
Mastacomys fuscus	3		2	
Conilurus albipes	0	39	1	52
Pseudomys oralis	14		20	
Pseudomys fumeus	1		0	
Pseudomys novaehollandiae	0		1	
Introduced mammals				
Oryctolagus cuniculus	2	6	0	0
Rattus rattus	3		0	

IV. DISCUSSION

Published information on the identification of skeletal parts of Australian mammals is mainly restricted to the works of Wakefield (1960a and b, 1969), Tidemann (1968) and Smith (1971, 1972). Specialised work, such as that on the taxonomy of *Antechinus*, (Wakefield and Warneke, 1963 and 1967) and *Rattus*, (Taylor and Horner, 1973) supply sufficient information to identify the dentaries of those species.

The development of a key for the Marble Arch area required information on which species were extant in the area and on comparative museum material.

The key, while only partly a dichotomous type, is functional and similar to several developed overseas for owl pellet analysis (Corbet, 1964). Because a certain number of the key features are derived from Wakefield's work, especially those features for rare or extinct species, the key resembles the one he developed for the deposit in Pyramid Cave at Buchan, Victoria (Wakefield, 1969).

Throughout this study, identifications of species from the Marble Arch deposit were made according to observed similarities and absence of major dissimilarities between the sample material and museum specimens of known identity, together with a consideration of known geographic distributions. It is also recognised that such identifications, made with no knowledge of plastic characters of the mammalian dentary, are more or less hypothetical, but must be accepted if there is to be any identification of species in the sample.

The technique described for sampling the deposit appears to be reasonable. The number of dentaries removed from each layer (75, 70, 93 and 78) shows that the technique is relatively consistent provided the layers represent equal periods of time and pellet deposition.

It is possible however, that the smallest sieve size (0.35 cm) may be too large to retain the very small dentaries of *Cercatetus*, *Acrobates* and members of the family *Chiroptera*. None of these were found in the Marble Arch deposit, but were frequently found in the Pyramid Cave deposit at Buchan, Victoria (Wakefield, 1969).

As regards the Marsupials, the fauna in the surface levels at Marble Arch is essentially that of the modern marsupial fauna of the area. *Antechinus stuartii*, *Pseudocheirus peregrinus*, *Schoinobates volans* and *Petaurus breviceps* were all seen in the area during the study. A surprising omission from the surface material is *Petaurus australis* which is present in the area. It is interesting to note the presence of *Perameles nasuta*, *Isoodon obesulus* and *Potorous tridactylus*, three marsupials which are regarded as being restricted to coastal areas in south-eastern N.S.W. (Marlow, 1958, Ride, 1970).

It is known that *Antechinus swainsonii* and *A.flavipes* occur in the general area along with *Sminthopsis murina* and *S.leucopsis* (Wakefield and Warneke, 1963 and 1967; Marlow, 1958; Ride, 1970, and Tidemann, pers. comm.).

Distributionwise, there does not appear to be any reason why *Petaurus norfolcensis* is not present in the bone material (Marlow, 1958).

Of the Murids in the surface levels at Marble Arch, *Rattus fuscipes* is common in the area and *R.lutreolus* is known from the general area (Taylor and Horner, 1973).

Pseudomys fumeus, once regarded as being confined to western Victoria (Ride, 1970), and *P. oralis*, thought to be in coastal northern N.S.W. (Ride, 1970), have been recently caught in east Gippsland and south eastern Queensland, respectively. It is possible that the former could also be found in the Marble Arch area. The distribution of *Mastacomys fuscus* was detailed by Calaby and Wimbush (1964). In New South Wales it is restricted to areas with an elevation greater than 1,500 m. This would exclude the Marble Arch area, but it is felt that trapping in suitable areas will reveal the presence of *M.fuscus*.

The presence of *Oryctolagus cuniculus* and *Rattus rattus* in the surface levels shows that introduced mammals are now included in the owl's diet.

The marsupial fauna of the bottom levels of the Marble Arch deposit is interesting in that it contained the dentaries of *Gymnobelideus leadbeateri*, a small possum now only known from southern Gippsland in Victoria (Ride, 1970). The rest of the marsupials, *Perameles nasuta*, *Antechinus stuartii*, *A.swainsonii*, *A.flavipes*, *Sminthopsis leucopsis*, *Pseudocheirus peregrinus*, *Schoinobates volans*, *Petaurus breviceps* and *P.norfolcensis* could be reasonably expected to occur in the area (Marlow, 1958; Ride, 1970). The absence of *Isoodon obesulus* is interesting as Wakefield (1969) also records the absence of this species from the bottom level of the deposit in Pyramid Cave, Buchan, Victoria.

The Murids found in the bottom levels of the deposit are essentially the same as those found in the surface levels with the exception of the presence of *Conilurus albipes* and *Pseudomys novaehollandiae*. *C.albipes* has not been seen

alive this century (Ride, 1970), and *P.novaehollandiae* has only been recently "re-discovered" in central coastal N.S.W. (Keith and Calaby, 1968).

Mastacomys fuscus has been found in several cave deposits in south-eastern Australia (Calaby and Wimbush, 1964), indicating that it once had a wider distribution than its present one.

The absence of *Oryctolagus cuniculus* and *Rattus rattus* from the lowest levels, suggests that the lower part of the deposit pre-dates the introduction of these two mammals. For *O.cuniculus* this would be in the late 1800's, but there is no reliable information on *R.rattus*.

These differences in faunal composition, the obvious visual differences in colour of dentaries from the surface and bottom levels, and the associated super-positioning of the levels in the Marble Arch deposit suggest that the bottom levels are considerably older than the surface levels.

It is likely that the roost has been occupied by only one or two owls at a time, or a family group at the most (Smith et al, 1974). With the production of only one pellet per bird per day (Glue, 1970), the deposit represents a long period of use by the owls.

The decline in the number of Murids, and in particular the absence of *Conilurus albipes* shown in the deposit, appears to be part of the recent general decline in numbers and species of Murids in south-eastern Australia reported by Ride (1968) and Wakefield (1969). It could, however, indicate that in the Marble Arch area, owls have changed their feeding habits and now rely more on introduced mammals.

Wakefield (1969) used the differences between levels in Pyramid Cave to speculate on past climatic conditions and the effect European man and introduced mammals have had on the native fauna. The fauna of Pyramid Cave was not unlike that of Marble Arch Cave, but the vegetational changes around the Pyramid Cave have been much greater than around Marble Arch. The land surrounding Marble Arch does not appear to have been altered by man to any extent and offers considerable variation in habitat types. Hence speculation on past climatic conditions, as indicated by faunal assemblages in different levels of the bone deposit, were not attempted.

V. CONCLUSION

This report has outlined a method of removing and identifying a sample of bones from a deposit in Marble Arch Cave. The technique involved the removal of material in 1 cm layers and separation of bones from other material by double sieving. Dentaries were removed from the bone material and identified by using a key developed for the Marble Arch area (Appendix A).

Using the method sufficient material was obtained and identified to permit a preliminary analysis of the deposit. The fauna from different levels of the deposit were compared and discussed in relation to the present knowledge of the existing fauna of the Marble Arch area.

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APPENDIX A

Key recognition features of dentaries of species of small mammals found in the Marble Arch deposit.

1.	Dentary angle medially inflected	2 (Marsupials)
	Dentary angle not inflected	5 (Eutherian)
2.	Dentary narrow with many teeth. 3 incisors, canine, 3 premolars and 4 molars	3 (Polyprotodonts)
	Dentary with one large decumbent incisor, also occasional vestigial incisor, canine absent, 1-3 premolars, 3-4 molars	4 (Diprotodonts)

The key now relates to various dentary features and is not necessarily dichotomous. Figure 2a, b, c and d, Plates 4, 5 and 6, should be used in conjunction with the key.

3. POLYPROTODONT MARSUPIALS

PERAMELIDAE: M_{1-3} > 10 mm

Perameles nasuta - Immediately posterior to M_4 the upper edge of the dentary is angled at approximately 130° to the line of the alveoli, after which the anterior edge of the coronoid process rises at approximately 100° to the line of the alveoli.

Isoodon obesulus - Immediately posterior to M_4 the upper edge of the dentary is angled at approximately 110° to the line of the alveoli, and the anterior edge of the coronoid process continues at the same angle to the alveoli.

DASYURIDAE: M_{1-3} < 9.5 mm

Sminthopsis and *Antechinus* M_{1-3} < 7 mm.
Sminthopsis: P_4 larger than P_3 (this can be also deduced from the size of the alveoli). Mental foramen anterior to centre of M_1.
Sminthopsis murina - M_{1-3} < 4.8 mm, coronoid process only slightly curved.
Sminthopsis leucopus - M_{1-3} > 5.0 mm, coronoid process strongly curved.
Antechinus: P_4 smaller than P_3. Mental foramen posterior to centre of M_1.
Antechinus swainsonii - Premolars spaced slightly apart; P_{1-4} > 3.5 mm.
Antechinus stuartii - Premolars tightly crowded together; P_{1-4} < 3.2 mm, M_{1-3} < 5.2 mm.
Antechinus flavipes - Premolars tightly crowded together; M_{1-3} > 5.3 mm.

4. DIPROTODONT MARSUPIALS

MACROPODIDAE: Large masseteric canal present; two deciduous premolars are replaced by permanent P_4; no tooth present between large incisor and permanent P_4.

Potorous tridactylus - M_{1-3} < 15 mm; cusps of molars blunt. The deciduous P_3 with 2-3 grooves and the permanent P_4 with 3-4 grooves.

PETAURIDAE: Large masseteric canal not present, one or more teeth present between large incisor and P_4.

Pseudocheirus and *Schoinobates*: Anterior edge of ascending process angled at approximately 90° - 100° to line of alveoli. Cusps of molars are sharp, crescentric. Molars 4.
Schoinobates: Angle strongly inflected, the inner margin of the angle flattened; the inferior dental foramen recessed behind the anterior margin of the angle.

Schoinobates volans - M_{1-3} ⟨ 11.0 mm
Pseudocheirus: Angle not greatly inflexed, the inner margin of the angle curved; the inferior dental foramen not recessed behind the anterior margin of the angle.
Pseudocheirus peregrinus - M_{1-3} ⟩ 11.2 mm
Petaurus and *Gymnobelideus*: Molars 4, M_{1-3} between 4.5 and 6.0 mm
Petaurus: Decumbent incisor curved, angle only slightly inflexed, molar row inflexed posteriorly.
Petaurus breviceps - M_{1-3} ⟩ 5.0 mm
Petaurus norfolcensis - M_{1-3} between 6.7 and 7.3 mm
Gymnobelideus: Decumbent incisor straight, angle strongly inflected, molar tooth row almost straight.
Gymnobelideus leadbeateri - M_{1-3} ⟨ 4.0 mm

5. EUTHERIAN

MURIDAE: Molars 3. Premolars and canine absent. Incisor of continuous growth.

Rattus: M_1 with four roots. Coronoid process long, falcate.
Rattus lutreolus - Incisor ⟩ 3 mm wide, M_1 W ⟩ 2.15 mm
Rattus fuscipes - Incisor ⟨ 1.25 mm, M_1 W ⟨ 2.14 mm
**Rattus rattus* - Incisor ⟨ 1.15 mm, M_1 W ⟨ 2.0 mm
Pseudomyinae: M_1 with 2 or 3 roots, normally with 2 large roots only but occasionally with also a small medial root.
Conilurus albipes - Teeth large, M_{1-3} ⟩ 8 mm, M_1 W ⟩ 2.2 mm. Coronoid process absent. Dentary shallow beneath M_1.
Mastacomys fuscus - Teeth large, M_{1-3} ⟩ 7 mm, M_1 W ⟩ 2.4 mm. Coronoid process present. Dentary comparatively deep beneath M_1.
Pseudomys: Dentary comparatively shallow beneath M_1. No medial root present on M_1, except rarely in *P.oralis*.
Pseudomys novaehollandiae - M_{1-3} ⟨ 4.2 mm
Pseudomys fumeus - M_{1-3}, 4.4-5.5 mm; M_1 W, 1.2-1.4 mm
Pseudomys oralis - M_{1-3}, 6.2-7.0 mm; M_1 W, 1.6-2.0 mm. Coronoid process poorly developed.
**Mus musculus* - M_{1-3}, 2.7-3.2 mm, total length of dentary approximately 13 mm.

LEPORIDAE: Molars 3, 1 grooved premolar, incisor of continuous growth.

**Oryctolagus cuniculus* - PM with 2 deep grooves, M_{1-3} ⟩ 10 mm. Ramus deep.

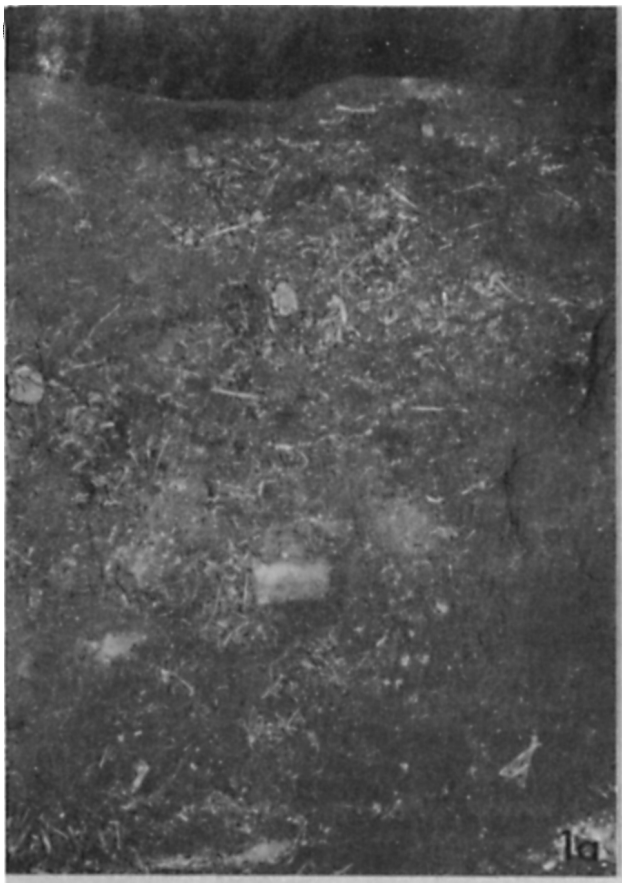
* Introduced mammal.

PLATE 1. a) General view of the Marble Arch bone deposit.

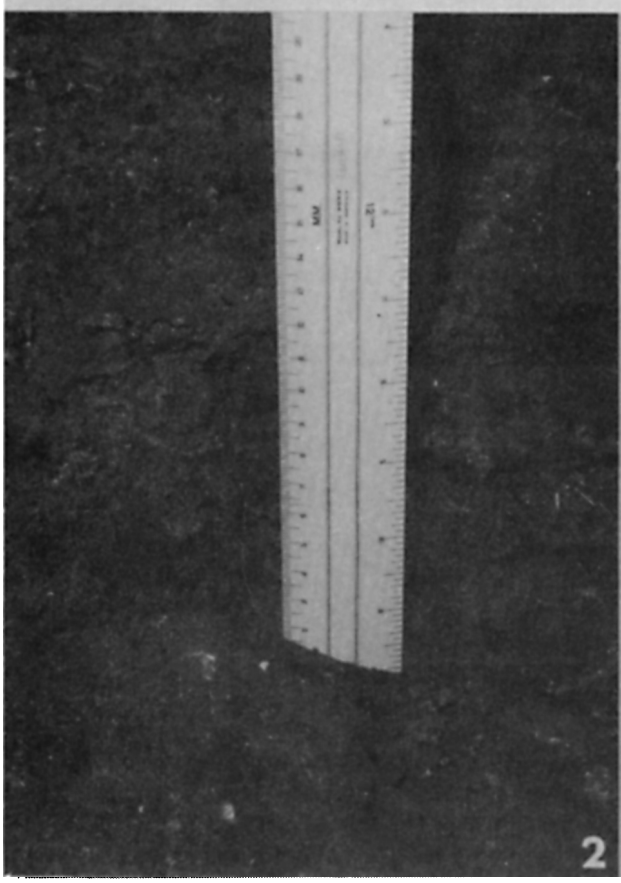
b) Close up of the bone deposit showing individual bones.

PLATE 2. Profile of bone deposit at sampling site

PLATE 3. Partly decomposed pellet showing "skin" type coating.


1a


1b


2


3

PLATE 4. I - *Perameles nasuta* (X2)

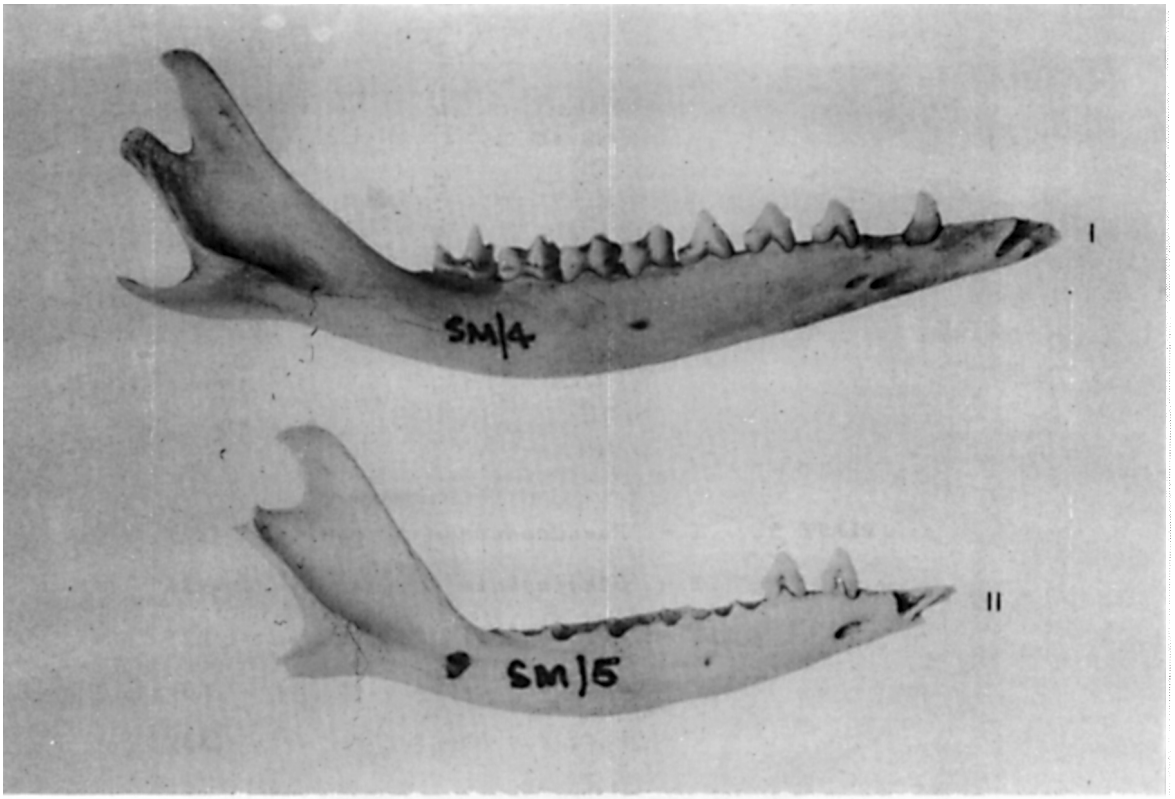
II - *Isoodon obesulus* (X2)

III - *Antechinus swainsonii* (X3)

IV - *Antechinus stuartii* (X3)

V - *Sminthopsis murina* (X3)

(N.B. Owing to the similarity of the dentaries of *Antechinus stuartii* and *Antechinus flavipes*, only the former is shown.)


SM/4
I
SM/5
II

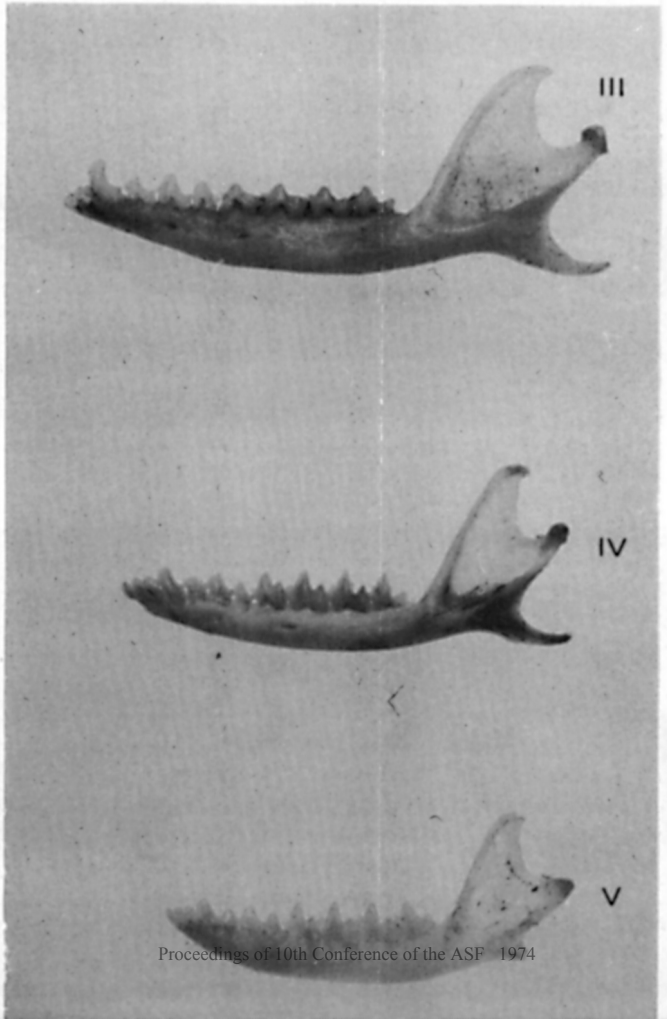

III
IV
V

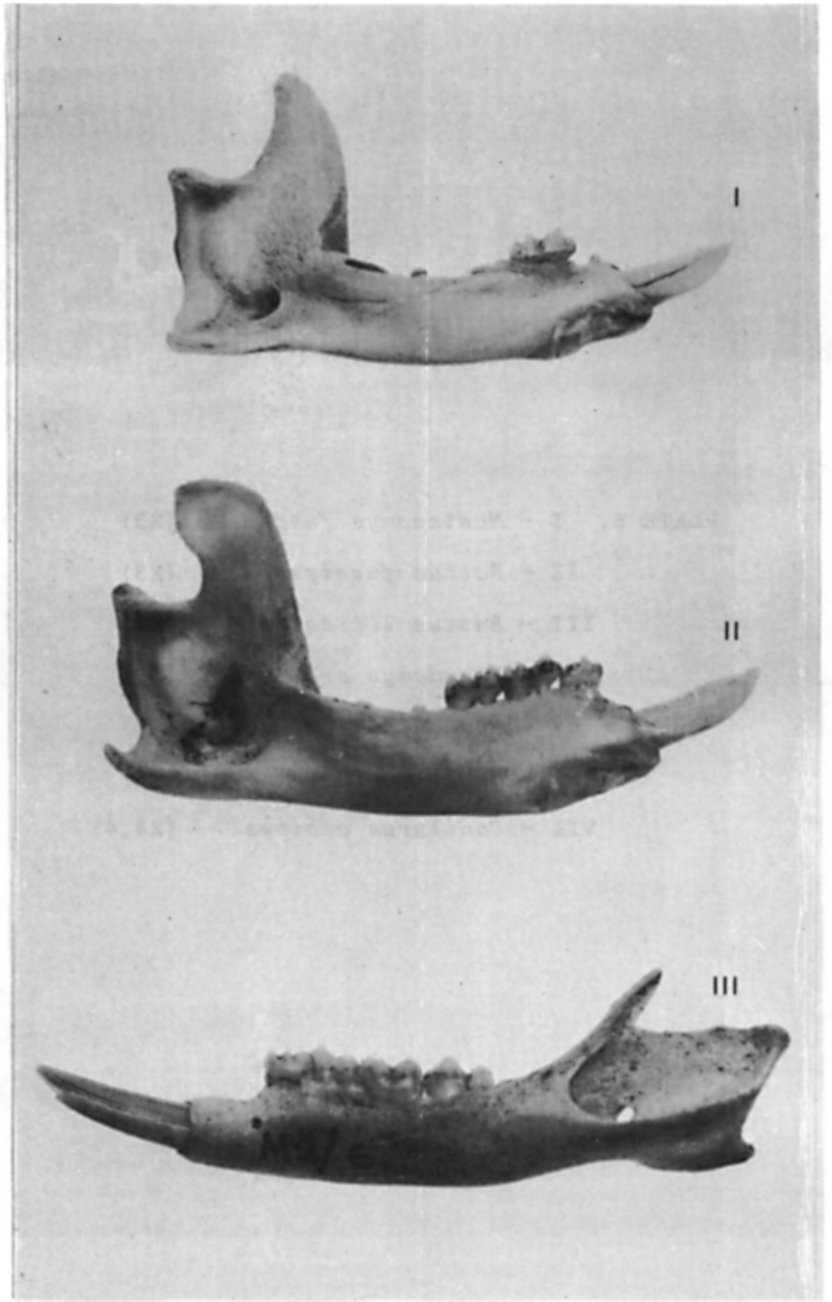
PLATE 5. I - *Pseudocheirus peregrinus* (X2)

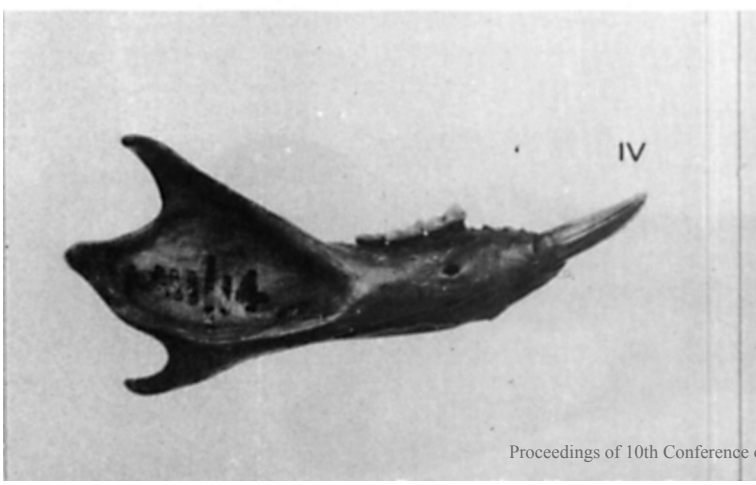
II - *Schoinobates volans* (X2)

III - *Potorous tridactylus* (X2)

IV - *Gymnobelideus leadbeateri* (X3)

V - *Petaurus breviceps* (X3)


I
II
III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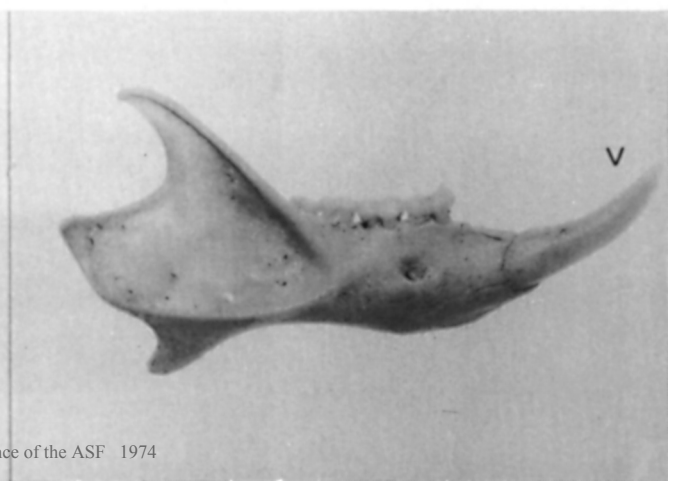

V

PLATE 6. I - *Mastacomys fuscus* (X3)

II - *Rattus fuscipes* (X3)

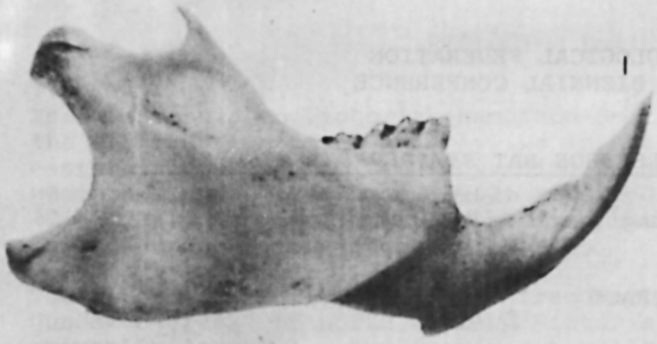
III - *Rattus lutreolus* (X3)

IV - *Pseudomys oralis* (X3)

V - *Pseudomys fumeus* (X3)

VI - *Mus musculus* (X3)

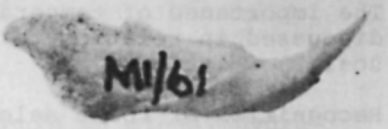
VII - *Conilurus albipes* (X4.4)



I

IV

II



V

III

VI

VII