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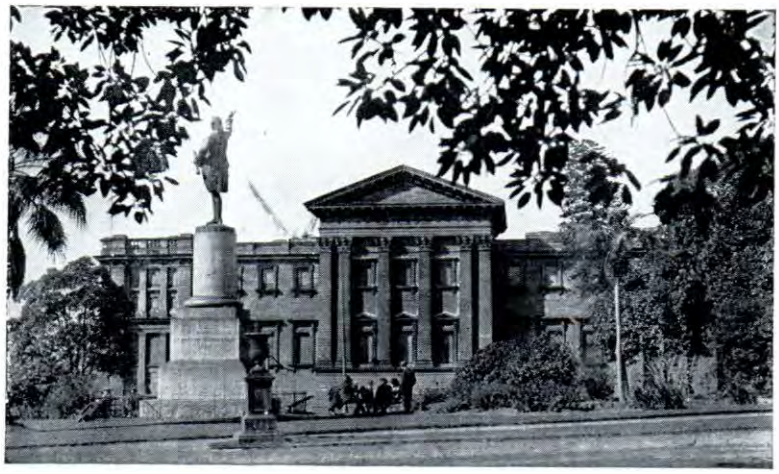

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● **FRONT COVER: The Common Wombat, *Vombatus hirsutus*, found in New South Wales, Victoria and eastern South Australia. This photo shows the Common Wombat's coarse fur, short ears and bare snout, compared with the fine and silky fur, long ears and hairy snout of the Hairy-nosed Wombats (*Lasiorhinus*), which occur on the inland plains of South Australia and Queensland and which are illustrated in the article on wombats on pages 65-69. The cover photo (by H. Burrell) shows clearly the powerful foreclaws with which wombats dig their burrows.**

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WOMBATS

By B. J. MARLOW

THE marsupials or pouched mammals show a markedly discontinuous distribution, since living members of this group are found only in the Australasian region and the New World. Each of these areas possesses three main groups of marsupials, the true opossums, opossum-rats and the extinct borhyaenids in America and the carnivorous dasyurids, bandicoots and phalangeroids in Australia. It has been customary in the past to group this great assembly of extremely diverse marsupials into one order, the Marsupialia, but many modern workers have advocated their separation into different orders since they show comparable diversity with the placental mammals.

In a recent revised classification of marsupials, Ride has erected four orders which more adequately balance the two infraclasses Metatheria and Eutheria which comprise the marsupials and placental mammals respectively. The true American opossums or didelphids, the extinct American borhyaenids and the Australian dasyurids are all included in the order Marsupicarnivora, while the American opossum-rats or caenolestids and related forms are placed in the order Paucituberculata. The bandicoots are placed alone in the order Peramelina and all the remaining marsupials, which are Australasian, comprise the order Diprotodonta.

The Diprotodonta are characterized by the possession of long procumbent lower incisors and embrace the phalangers or possums, the large extinct diprotodonts, kangaroos and wombats.

The Classification And Distribution Of Wombats

When compared with other families in the Diprotodonta, the wombats show very little diversity since there are only three genera, one of which, *Phascolonus*, is extinct. Of the living genera, *Vombatus* comprises two living and about six extinct species, while *Lasiorhinus* contains two living and two extinct species. Wombats in the genus *Vombatus* are known popularly as Common Wombats, while those in the genus *Lasiorhinus* are the Hairy-nosed Wombats.

Hairy-nosed Wombats, *Lasiorhinus latifrons*. The long ears and white hairy muzzle can be readily distinguished. [From a painting by John Gould.]

Common Wombats are confined to the eucalypt forests of eastern Australia and the islands of Bass Strait. The mainland species, *Vombatus hirsutus*, extends from northern New South Wales, south through southern Victoria to the eastern part of South Australia. The smaller Island Wombat, *V. ursinus*, is now confined to Tasmania and Flinders Island, although it formerly occurred on several other islands in this area.

The Hairy-nosed Wombats are found in the inland plains. The Southern Hairy-nosed Wombat, *Lasiorhinus latifrons*, extends from the western bank of the Murray River in South Australia across the Nullarbor Plain to the border of Western Australia. This animal shows a remarkable discontinuity of distribution, since the subspecies, *L. l. barnardi*, occurs in central Queensland at Clermont. The second species of Hairy-nosed Wombat, *L. gillespiei*, is confined to Queensland in the plains country between St. George and Clermont. This latter species has been placed in a separate genus, *Wombatula*, by some mammalogists, since the frontal bones of the skull are greatly reduced, but in its external appearance and in other anatomical features it is closely related to *Lasiorhinus* and does not merit generic separation.

Although wombats are widely distributed in southern and eastern Australia, this is the only living family of the Diprotodonta which is absent from New Guinea.

The Morphology Of Wombats

Wombats are heavy thickset bear-like animals with a vestigial tail. Adult animals may measure about 4 feet in total length and weigh up to 60 pounds. The head is short and blunt with rather small eyes. The limbs are short and thick and each foot bears five digits. In the forelimb each digit has a stout claw, while in the hind foot all the digits except the big toe bear claws. The second and third toes of the hind foot are joined as in the other Diprotodonta and bandicoots, but to a lesser degree.

The hair of Common Wombats (*Vombatus*) is very dark brown or black and extremely coarse and thick, while in Hairy-

Above: Typical habitat of Common Wombats, *Vombatus hirsutus*, in dry eucalyptus forest in the Great Dividing Range of New South Wales. Below: Habitat of Hairy-nosed Wombats, *Lasiorhinus latifrons*, in the limestone plains on the west bank of the Murray River at Blanchetown, South Australia. [Photos: Author.]

nosed Wombats (*Lasiorhinus*) it is mottled grey and very fine and silky. The ears of the latter genus are much longer than those of Common Wombats. The snout of Common Wombats is covered with naked granulated skin, while in the Hairy-nosed Wombats the snout is covered with short velvety hairs.

In the skull, the nasal bones of *Vombatus* are relatively long, while those of *Lasiorhinus* are short and very broad. In addition, a postorbital process is present in *Lasiorhinus*, which is completely lacking in *Vombatus*.

The teeth of wombats present many interesting peculiarities when compared with those of other marsupials. The majority of marsupials have a different number of incisor teeth in the upper and lower jaws, but in the wombats these teeth are reduced to a single pair in each jaw. Moreover, wombats are the only marsupials in which all the teeth have persistent pulps which allow them to grow continuously throughout the life of the animal.

Like the majority of marsupials, Hairy-nosed Wombats have 13 pairs of ribs; in

the Common Wombats, however, the number of ribs is increased to 15 pairs.

Ecology And Behaviour Of Wombats

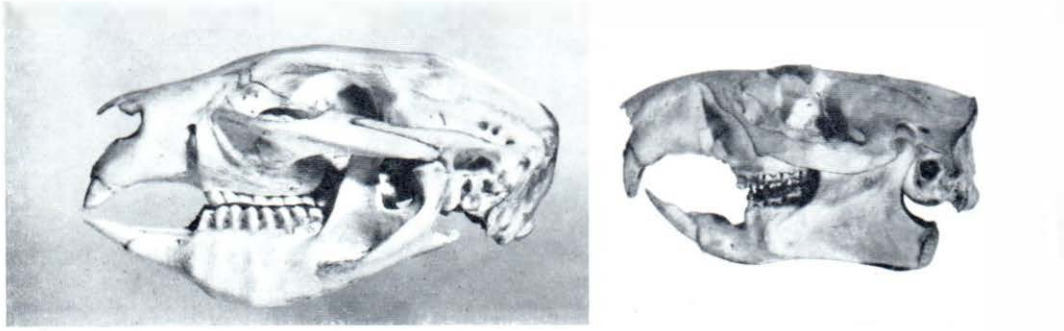
Wombats are nocturnal herbivorous marsupials which are well adapted for digging. During the night, they feed on grasses, roots and other vegetable matter and during the day they retire to a system of burrows which they dig with their powerful foreclaws. The burrow systems of Common Wombats are far more simple than those of the hairy-nosed forms, since they normally consist of a burrow with a single entrance about 18 inches in diameter, situated at the base of a tree or rock in the mountainous eucalyptus forests where these animals live. In contrast, Hairy-nosed Wombats appear to construct large communal warrens on the flat limestone plains. Each warren may have about 20 burrows which interconnect and whose entrances are situated below a limestone ledge at the bottom of a crater about 10 feet in diameter. Well worn pathways radiate from the burrows to the feeding grounds in both groups. Wombats normally move with a fast shuffling ambling gait, but if hard-pressed can break into a clumsy gallop in which they can only be overtaken on foot with difficulty, especially over rough ground.

Unfortunately, little is known about their reproduction, but it would appear that they give birth, in the late autumn, to a single young which is independent by the following summer.

Many marsupials show the phenomenon of convergence towards placental mammals, where members of these unrelated groups may come to resemble each other very closely, both in appearance and behaviour, since they occupy similar ecological niches. This convergent evolution is brought about through the selection by the environment of similar mutations which arise spontaneously in each group. Wombats show a remarkable convergence towards certain large, burrowing, ground squirrels called marmots which are found in mountainous regions of northern Asia and North America. Although they are not closely related, wombats and marmots resemble each other not only in their external form but also in their internal anatomy. If a comparison is made of their skulls, it will be seen that both animals have a single pair of incisors in each jaw, which have enamel only on the anterior face. As these are worn away, they provide a sharp chisel shaped cutting edge which is well adapted for gnawing or cutting through roots. In both animals, there is a large gap between the incisors and molar teeth at the rear of the jaws, and all the teeth have persistent pulps and grow continuously throughout life.

Status And Conservation

Wombats have the dubious distinction of being the only marsupials which are not protected in Australia. Furthermore, in some areas, a bounty is paid on their scalps since they may undermine rabbit-proof



A comparison of the skulls of a wombat (left) and a marmot (right). The large gnawing incisors and the cheek teeth, which grow continuously, are similar in each species. A large gap or diastema is present between the incisors and cheek teeth in each skull. [Photo: C. V. Turner.]

fences with their burrows. In spite of this, Common Wombats are plentiful in suitable localities in eastern Australia and Tasmania, while Hairy-nosed Wombats exist in large numbers in South Australia. Common Wombats have declined in numbers in the islands of Bass Strait where they were formerly plentiful. Hairy-nosed Wombats are also extremely rare or possibly extinct in certain parts of their former range, particularly in the Riverina of New South Wales and in central Queensland.

The Relationships Of Wombats

The relationship of wombats to other Diprotodonta remains obscure since no fossils have been discovered, so far, which are earlier than the Pleistocene, but it is probable that they form an offshoot from the main phalanger stem which gave rise to the other families. Several workers have suggested that wombats are closely related to the koala, and that the phalangeroid features of the latter are due more to convergence than true phyletic relationship. This suggestion is supported by the fact that the chromosomes of the koala are very different from those of the phalangers. The placentae of the koala and wombats also show considerable similarity, since the allantois is apposed to the chorion, although the vessels do not become vascularized to form a true allantoic placenta as they do in the bandicoots. Only the koala and wombats share this type of placenta.

Because of our lack of good series of fossils which might indicate the true relationships of these marsupials, it is better, at the present state of our knowledge, to retain the wombats and koala in separate families which have probably arisen independently from the basic phalanger stem.

There is still much to be learnt about other aspects of the biology of wombats, particularly in the fields of ecology and behaviour. Although wombats form an important element in the marsupial fauna of Australia, they have received little attention in comparison with other species. An intensive study of all aspects of the biology of this isolated family of marsupials would be both stimulating and profitable.

LAND HERMIT-CRAB OF THE CORAL SEA REPORTED FROM THE BARRIER REEF

The bright-red land hermit-crab *Coenobita perlatus* is a conspicuous and relatively abundant scavenger on the cays of the Coral Sea, as described in the article "Collecting in the Coral Sea", by D. F. McMichael and J. C. Yaldwyn, in the last issue of *Australian Natural History* (Vol. 15, No. 2, June, 1965, pages 33-38). Though found on many tropical shores throughout the Indo-West Pacific area from the Red Sea to Samoa, this species has seldom been seen on the cays of the Great Barrier Reef. It has been recorded, however, from Lady Elliott Island, Lady Musgrave Island in the Bunker Group, One Tree Island in the Capricorn Group and from cays in the Swain Reefs, all from the extreme southern end of the Barrier Reef. This specimen in a Tonna shell was photographed on One Tree Island by Keith Gillett in December, 1961.—J.C.Y.

A shell disc belt, ornamented with animal teeth and seeds, from Bougainville, Solomon Islands. Strings of these discs were used as currency in many Melanesian and Micronesian islands. [Photo: Howard Hughes.]

THE USES OF SHELLS BY PRIMITIVE MAN

By FREDERICK D. McCARTHY
Australian Institute of Aboriginal Studies, Canberra, A.C.T.

THE structure of molluscs, consisting of a fleshy animal and a hard protective shell, incorporates many characteristics of very great use to man, primitive and civilized. Molluscs such as the cockle, whelk, oyster and others which occur in vast numbers on mud-flats, rocky shores and sandy beaches formed a staple part of the diet of coastal peoples in many parts of the world and constitute the bulk of the species in Australian kitchen middens. Inland the mussel was a valued native food. The women brought in to camp baskets and bags full of molluscs from their daily foraging, and these were either eaten fresh, baked in ashes or roasted in the fire. Ninety-three species were recorded in Queensland shell middens.

Research by archaeologists on these middens has revealed important information about the climate, environment and ecology of the people who left them as camp debris. In Europe, south-east Asia and Indonesia the middens have produced stone implements of the Middle Stone Age, the Mesolithic, back to some 10,000 years ago. In the south island of New Zealand the early Maori hunters extinguished the various kinds of moas and were forced to become shellfish eaters, as at Paunowea after 1450 A.D. In Australia shell middens excavated by archaeologists in northern and eastern Australia have yielded radio-carbon dates back to 4070 B.C. Shells have not survived in the oldest occupational deposits left by man, even in Australia.

Utensils

Many large shells, such as the baler, helmet, clam and conch, make perfect natural containers. The Aborigines who lived along the tropical coasts of Australia used them for carrying water, seeds, yams, roots, fruit and berries, and the baler as a cooking vessel. Smaller shells were used as drinking cups in the Pacific area. The edges of oysters and other shells formed excellent knives for cutting meat and soft seeds like the Macrozamia, for carving and incising designs on wood, shaping spear barbs and for shaving. Shell blades were used on garden hoes in western Papua, a variety of adze blades were fashioned out of clam shell in Micronesia and Melanesia, and drill points in New Guinea and along the east coast of Australia. Shells were commonly used as fish hooks and barbs, and their attractive nacre patterns formed the lure to catch bonito and other fast swimming surface fish.

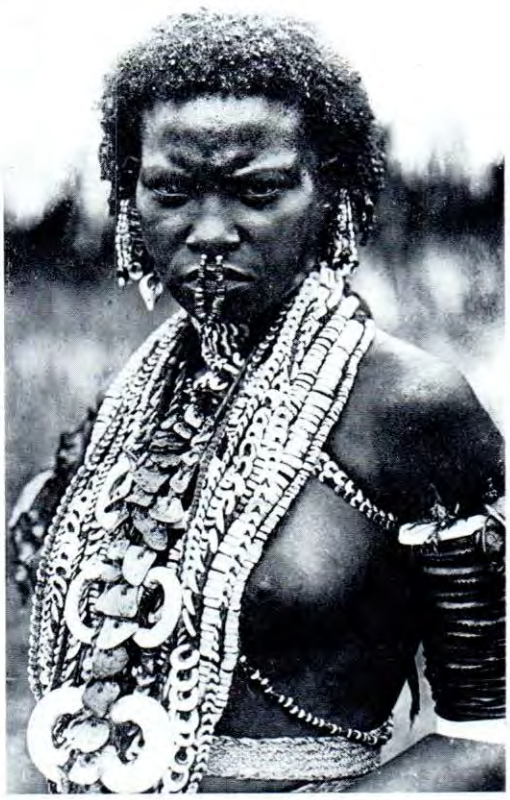
Ornaments

The shells fashioned most commonly into ornaments by Australian and Pacific natives are not the attractively coloured ones. Part or whole pearl shells are favoured, as are white shells like the clam and baler. Equally popular are small species such as the cowry and nassa and fragments of other shells suitable for stringing into necklets and ornaments. The Australian Aborigines made necklets and forehead bands out of neatly shaped discs of pearl shell on the coasts and of mussel shell inland. In Polynesia a variety of small shells were strung into necklets, but shells were not used as ornaments very lavishly by these people.

The Melanesians, however, covered themselves with a remarkable array of shell forehead bands, necklets and breast pendants, armlets, belts and pubic covers. In coastal New Guinea the men and women in festival attire almost obscured the upper parts of their bodies with these ornaments, but in the southern groups—New Caledonia, New Hebrides and the Solomons—there was a more restrained use of shell decoration of the human body.

Trade And Gift Exchange

Cowry, clam and gold-lip pearl shells



Papuan girl from Ambasi Village, Ipi River, wearing elaborate shell ornaments. [Photo: Frank Hurley.]

and shell ornaments were traded from the north and south coasts into the central highlands of New Guinea where they are still of considerable value, and serve as a currency for paying bride dowries, purchasing pigs and other important transactions. Pearl and baler shell ovals mounted in a red binding, were laid out in long rows, in the great ceremonial gift exchanges, hundreds being displayed and exchanged at a single festival attended by many thousands of natives.

A similar long-distance trade took place with two types of shell ornaments in Australia. The men of the Garadieri tribe on the north-west coast cleaned the outer surface of a large pearl shell and decorated the lustrous inner surface with incised designs, painted red, of linear patterns, and human and animal figures often combined with plants. They were worn dangling from

a human hair belt, both front and back, by the initiated men. From the Garadjeri these ornaments were bartered and exchanged as gifts along traditional trading routes which extended down the north-west coast, along the Canning Stock Route, southward through the deserts to South Australia, westward into the Northern Territory, central Australia and western Queensland. The further they travelled the more valuable they became and each shell was cut into strips to meet the demand for them by distant inland tribes who used them for magical purposes—rain and love making, hunting, sorcery, and as charms against sickness. They replaced the traditional quartz crystals in many areas as the media of magic, their lightness, flashing surfaces and the qualities imparted to them by their distant origin giving them tremendous mystical powers in the minds of the Aborigines.

In a similar fashion, oval pieces cut out of the baler shell on the mid-east coast of Cape York travelled south-eastward into inland Queensland where they were mounted in pairs on a blob of black gum on the grip end of spearthrowers. In western Queensland and the Northern Territory they were decorated with neatly incised stars painted red or black and worn as highly valued pendants.

A pearl shell pendant from the Garadjeri tribe, north-western Australia. These ornaments were cut into strips to enable the demand for them to be met as they travelled through tribes in the interior of the continent. [Photo: Howard Hughes.]

Thus, shells travelled up to 2,000 miles, through the local groups of Aborigines, across the vast interior of the continent, to meet the demand of the initiated men for ornaments and magical media, and to maintain their gift exchange relationships with lifelong partners in their own and neighbouring groups.

An equally interesting example of shells forming the central feature of a gift exchange and trading system is that of the Kula in the Louisiade Archipelago in south-eastern Papua. Here a *Conus* shell arm ring, called *mwali,* was prepared by removing the top and end and polishing the outside; it was decorated with shell discs and strips of pandanus leaf. Another ornament, the *soulava* necklet, consists of strings of red shell discs with attachments of cowries and other shells. The *mwali* and *soulava* were passed in opposite directions from partner to partner, and island to island, in a remarkable gift exchange system. Both were highly valued, and the older examples were named, but were not owned by individuals; great pride was felt in their temporary possession, and the names of previous holders were recited like a genealogy. Elaborately decorated canoes were constructed for the Kula voyages, while restrictions on the behaviour of the participants, much ceremony and ordinary trade added to the interest and excitement of fulfilling the ritual and social obligations imposed upon the individuals and communities involved in the circuit. The arm-shells became a valued ornament along the entire south coast of Papua. Beautifully carved weapons, polished adzes mounted on ceremonial handles, and other domestic objects were also Kula valuables not used in daily life.

Currency

One of the most important uses of shells was as a currency by the Micronesians and Melanesians, but the Australian Aborigines

Various uses of shells by man are shown by the two fish hooks (top left) from the Solomon Islands; two examples of Nko and Ndap shell money (bottom left) from Rossel Island; a pearl shell plaque from New Georgia and (below it) a clam shell plaque from Malaita, Solomon Islands; and an oyster shell knife from north-western Australia. [Photo: Howard Hughes.]

did not follow this custom and had no such measure of value. In Micronesia discs up to half an inch in diameter made of a white or red shell were combined with wooden discs to form strings of money. In the Bismarck Archipelago, white nassa shells, threaded on cane into strips and rolls, became a currency called *diwarra*. In southern Melanesia, from the Solomons to the Banks and Santa Cruz Islands, discs of red or white shells, a quarter-inch or less in diameter, formed a currency in which the red type was the most valuable. These discs were also fashioned into elaborate belts and other ornaments.

These shell currencies were used in the more important transactions in native life as a rule, but the *diwarra* also served as money in daily life. Prestige was derived from the possession of wealth of this kind and every effort was made by leading men and families to add to their holdings of it. A young man entering a secret society paid the members of higher ranks with shell money and other valuable objects as he rose in status in these important organizations. Carvers who created the spirit and ancestral figures and other decorative work for relatives of a dead person in New Ireland received payment which included shell money. The family of a girl to be married was similarly paid by the groom's family as part of the bride price. Canoe builders, guardians of young initiates and magicians were paid by this means for their services. A most complex monetary system existed on Rossel Island based on two kinds of money, the one made from polished *Spondylus* shells and called *ndap*, the other consisting of thick discs of clam shell, from half to one inch in diameter, strung on cane and called *nko*. Wonajo, a great ancestral creator spirit, made the bulk of the money before

Cowry and Nassa shells, opercula and pigs' tusks give this Sepik River mask a rather terrifying appearance, though they were probably intended to be decorative. [Photo: Howard Hughes.]

the people came to Rossel, and it therefore possessed a traditional as well as a monetary value. There were 22 values of *ndap* and 16 of *nko,* and a limited amount of the currency in circulation. In the southern Solomons large clam shell rings and cylinders were objects of great value, as were the arm rings on Tanga and Feni Islands to the north. Shells were not important in the ritual and economic life of the Polynesians.

Inlay Decoration

An interesting type of decorative art in Southern Melanesia is that of inlaying the war canoes, carvings, bowls, clubs and other objects with shell segments carved into a variety of shapes. Grooves, cut in the wooden surfaces, were filled with gum into which the segments were pressed. Hundreds of pieces were used in a variety of patterns on the high prows and sterns of the war canoes which were among the most elegant craft of Oceania. As the wooden surfaces of the various objects were painted black, the white shell inlay pattern formed a strongly contrasting note. A rare type of shield from the Solomons is inlaid with vertical rows of white shell rectangles, and a similar motif is borne by the chiefs' staffs from this area.

Music

Shells strung together as rattles, and the conch trumpet sounded by successful warriors and fishermen as their canoes neared their home villages, were the main uses of shells as musical instruments.

It will thus be seen that a variety of molluscs entered into a wide range of activities among the natives of Australia and the Pacific Islands. They provided a valuable source of food, tools, utensils, ornaments, currency, musical instruments and decorative material, and were the central feature of magic, gift exchange and important transactions in many communities.

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"The Story of Money," by F. D. McCarthy, in *The Australian Museum Magazine*, Vol. V, No. 11, July, 1935, pages 386-393. "The Shell Inlay Decoration of the Solomon Islands," by F. D. McCarthy, in *The Australian Museum Magazine*, Vol. VIII, No. 5, July, 1943, pages 154-9.

MUSEUM'S NEW CURATOR OF ANTHROPOLOGY

Mr. D. R. Moore has been appointed Curator of Anthropology at the Australian Museum in place of Mr. F. D. McCarthy, who recently resigned to become Principal of the Australian Institute of Aboriginal Studies, Canberra.

Mr. Moore, who was educated at Cambridge University and the University of Sydney, has in recent years been research assistant in the Department of Anthropology at the University of Sydney, research officer in bibliography, Australian Institute of Aboriginal Studies, and a member of archaeological expeditions in the Hawkesbury River area, New South Wales, and Cape York Peninsula, Queensland.

Spawning Behaviour in the Queensland Lungfish, Neoceratodus forsteri

By GORDON C. GRIGG
Department of Zoology, University of Queensland

While on a field trip to the Burnett River, Queensland, in connection with research into other aspects of the biology of *Neoceratodus*, some observations were made on its behaviour at spawning. No first-hand account of such behaviour exists in the literature. Macleay (notes on a collection of fish from the Burdekin and Mary Rivers, Queensland. *Proceedings of the Linnean Society of New South Wales*, viii, 1883, 211) gave hearsay evidence that spawn was deposited in indentations on the muddy bottom in water six to ten feet deep, but spawn is found adhering to water-weed such as *Hydrilla* and *Cladophora* in water two to four feet deep, and among the floating roots of Water Hyacinth, which casts doubt on the validity of Macleay's report.

Spawn can be found from August until October (Dr. M. C. Bleakly, personal communication). On the night of 10th August, 1964, in Barambah Creek, about half a mile above its junction with the Burnett River, Mr. N. Milward (Department of Zoology, University of Queensland) and I observed several large lungfish swimming about close inshore, over a large weed-covered bank in from two to three feet of water. After watching them for a short while it became obvious that two of the fish were staying close together, the movement of one clearly influencing that of the other. From an elevated rocky ledge six feet above the water we were easily able to view the fishes' activities with the aid of head torches, the light from which did not seem to disturb the fish. Gradually their movements became more restricted in range to a patch of weed about ten feet from the edge of the water. Swimming to and fro, over and through the weed, they gave the appearance of playing "follow the leader". During this time the second fish repeatedly nosed the cloacal region of the leader and was seen to "bump" it several times with its snout. This same fish was seen several times to take in its mouth a long strand of what appeared to be weed, and wave it about. Both fish were then observed from time to time to dive repeatedly through a localized area of weed, often disappearing from view for a few feet. During these "dives", one fish would follow the other closely and both were seen to shake their tails rapidly from side to side. On one occasion a third fish approached but one of the pair dashed at it, causing the intruder's rapid retreat. We had commenced watching at 9 p.m. An hour later the two fish had ceased diving through the weeds, and the shallow bank was deserted apart from a couple of later visits by single fish, probably to feed.

By now there was little doubt in our minds that we had been watching a pair of lungfish spawning. Their behaviour fitted with what we knew about other fish, and with what we would have expected. Further, the weed where the fish had spent most of their time was searched the following morning, and about 80 eggs were found within a short time. Undoubtedly further search would have revealed many more.

By way of interpreting the behaviour described above, it would seem that three phases were observed. Firstly, there was a phase in which the fish moved about together over a wide area of the bank. This could have been in search of a suitable area. Secondly, we observed the "follow the leader" phase, during which one fish, presumably the male, showed interest in the cloaca of the female, nudging her with his snout. This would probably stimulate her to oviposition. The significance of one fish taking strands of weed in its mouth is unknown. Thirdly, the fish dived together through the weed, the male following the female and presumably pouring milt over the eggs. Tail shaking at this stage might facilitate the flow of reproductive products. Macleay reported also that the fish stayed near the eggs after spawning, and were not easily disturbed, but our observations do not support this.

Because of the intermediate evolutionary position of the Dipnoi, a study of the reproductive physiology and behaviour of *Neoceratodus* would be most worthwhile, particularly with a view to comparing it with fish on the one hand and amphibians on the other.

CORRECTION

In an article entitled "The Macleay Museum at the University of Sydney," published in the June, 1965, issue of *Australian Natural History*, the author made mention of "Sir Alexander Macleay".

Our attention has been drawn by Mr. A. H. Chisholm to the fact that Alexander Macleay did not receive the honour of knighthood.

The author of the article and the editor regret this error.

One of the sandstone quarries at Gosford, New South Wales. Note the vertical working face on the lower bed of freestone from which blocks of dimension stone are quarried. The outlines of the blocks can be seen. The overlying thin-bedded flaggy sandstone is of no use as a building stone. [Photo: Author.]

BUILDING STONES OF A GREAT CITY

By R. O. CHALMERS

IN large cities a great variety of building materials, both in the form of natural stone and manufactured substances, is to be seen. When big costly buildings are being planned, the architect specifies whatever building stone he wishes to use, even if it is available only from far-distant parts of the country, or even from abroad.

Up to the beginning of the steel and concrete era of building, if there happened to be an ample source of good building stone in or near big cities, it was of course used in abundance, usually in the form of dressed blocks that formed an integral part of the structure of the buildings. In instances like these the particular stone imparts quite a distinctive character to a city.

Hawkesbury Sandstone

Sydney is a notable example of this. It stands in the centre of a sedimentary basin of great thickness and extent. These sediments were deposited and accumulated in Triassic time, 220 million years ago, in a great freshwater lake. The dominant member in this sequence of sedimentary rocks is a bed of massive sandstone, about 900 feet thick, described by geologists as the Hawkesbury Sandstone. In the trade it is named according to the locality where it is quarried,

e.g., Paddington Sandstone. The best type of building stone, and this is particularly abundant among the Hawkesbury Sandstone, is "freestone" in which bedding planes are absent and there is therefore no tendency for the rock to split.

This freestone, although moist and grey when first quarried, soon dries out and mostly turns yellowish-brown due to the oxidation of the iron compounds that cement the sand grains. Some varieties turn white on drying. The attractiveness of the Hawkesbury Sandstone in Sydney buildings could only have been fully appreciated in the pre-industrial era when there was little discolouration in the absence of smog. From 1788 onwards it was used in practically every notable building, such as the University of Sydney, the Australian Museum, the Public Library, the Art Gallery, the Town Hall, Central Railway Station, the G.P.O., the two cathedrals and innumerable churches and private homes.

In the early days the many pressing problems of the infant colony left little time to worry about principles of sound selection of building stone. In fact, whatever was handy in the form of surface boulders or natural outcrops was used. Therefore, in some of the earliest buildings crumbling and fretting of sandstone can be seen. By the time the period of major building was beginning, about the 1850's, important quarries were being worked at Pyrmont. In quick succession, to cope with the increasing demand, more quarries were started at Annandale, Marrickville, Waverley, Cooper Park, Mosman, Hunter's Hill and in so many other suburbs that it would be impossible to list them all. Outside the metropolitan area to the north, there are also big sandstone quarries at Gosford, Wondabyne and Pyle's Creek. These developments ensured an abundance of good-quality stone.

Bowral Trachyte

Mt. Gibraltar, better known as "the Gib", which rises above the town of Bowral, consists of a medium-grained igneous rock that has been intruded into the adjacent Hawkesbury Sandstone as a large plug-shaped mass. It is more durable, harder and much less porous than sandstone. For this reason, from about the 1880's on, it has been used extensively in the form of dressed blocks for the foundations and basecourses of many of Sydney's older sandstone buildings, and in one or two instances in the entire construction. Its correct name is microsyenite but it has always been known in the building stone trade as Bowral Trachyte.

It can also be seen in many city buildings in the form of polished slabs forming a decorative veneer on exteriors. One of the most notable examples is the head office of the Commonwealth Banking Corporation. The rock is easy to identify. It is an attractive greenish-grey colour and the presence of occasional coarse-grained intersecting veins of intermingled light-coloured feldspar and dark-coloured pyroxene, forms a pleasing contrast in pattern.

Building Stone As Veneer

As the design of stone-cutting equipment and the quality and variety of abrasives improved, and with the advent of the steel and concrete framework in major construction, the older practice of using big blocks of stone as major units was gradually abandoned. Stone can be fashioned in much the same way as timber. It can be sawn, planed, turned on a lathe, fluted and polished. Building stone for many years now has been used only in the form of a veneer never exceeding 2 or 3 inches in thickness. These slabs are attached firmly to the building by metal cramps and cement. Even our abundant Hawkesbury Sandstone is used now only in this veneer form. A notable recent example of sandstone slabs applied in this way is to be seen on the new wing of the Australian Museum, where both Bondi and Maroubra stone have been used. Sandstone slabs are given a smooth or rubbed finish since fragmental sedimentary rocks cannot be polished. Igneous rocks such as granite, trachyte and porphyry are much harder and more compact, and take a high, lasting polish. These are called "hard stone" in the trade and are most commonly seen in the form of polished slabs used as exterior facings on the lower courses. Granite slabs, unpolished but with an even surface, are used for flooring or paving. Limestone and marble, chosen for their

attractiveness of colour and pattern, are used in polished form as panelling and skirting in interiors. In smooth but unpolished form these rocks are used both as flooring slabs in interiors and on exteriors. Strictly, it is a misnomer at the present to call any stone a "building stone". Probably the best name would be "decorative building stone". Most building stones are given distinctive names. The two best known local red granites used in Sydney buildings are called "Rob Roy Red" and "Regent Red". The former comes from Sodwalls and the other from near Mudgee.

A working face in the granite quarry at Sodwalls, N.S.W. The large regular blocks are awaiting transport to Sydney, where they will be sawn into slabs. Note the small, closely-spaced drill holes (marked by white lines) along the upper edge of some of the blocks. A special type of chisel known as the "plug" is driven, between two short steel bars called "feathers", into each of these holes and the expansion of the "feathers" splits the block. [Photo: Author.]

Three Major Building Periods

Since the foundation of Sydney, three major periods of building can be defined, firstly from 1788 to 1914, secondly, from the early 1920's to 1939. The third and present period began about the mid-1950's. In the pre World War I period, Sydney sandstone and Bowral Trachyte were mostly used. Moruya grey granite made an appearance, notably in the polished columns of the G.P.O. and the Customs House. Highly coloured marbles showing striking patterns were favoured at about the turn of the century. There were two notable types, Fernbrook in the Bathurst district and Borenore between Orange and Molong; examples of the former are now hard to find but the renovation of the main booking hall at Central Railway Station shows a fine display of Borenore panelling to much greater advantage than previously.

Decorative stones, especially limestone and marble, gain and lose favour more or less according to the dictates of fashion. Fernbrook is rather an ornate, overpatterned marble, so variegated that it was difficult to get large quantities showing any degree of uniformity.

In the post World War I period, architectural taste inclined towards simpler patterns and new local marbles came into favour for interior decoration. Two from the Mudgee district, one dark grey with light yellowish-brown veining and the other a mottled green, were used, the former fairly extensively. This period marked the rise to fame of Wombeyan, which has come to be the most widely used marble in Australia. Polished slabs of a most attractive variety, showing a relatively coarse saccharoidal texture and a cream body colour veined with thin yellowish-brown stringers, are to be seen in the entrance halls and vestibules of many of the major buildings of this period, notably in the Post Office Box hall of the G.P.O. extension. Other buildings favoured either a pink and green veined cream marble from Caleula, a few miles north of Orange, or an antique type ivory marble from Cudgegong.

The two previously mentioned attractive New South Wales red granites, "Rob Roy" and "Regent", made their first appearance as polished slabs. The best display of the

The Wombeyan marble quarry, N.S.W. Note the closely-spaced drill holes both on the quarry face and on the loose blocks on top. [Photo by courtesy of Melocco Bros.]

former is on the Australian Fixed Trusts building in O'Connell Street.

A major quarry was developed at Moruya to supply the huge quantity of rough dressed granite blocks for facing the Harbour Bridge pylons, but the grey granite favoured for polished slabs came from Uralla. This can be seen on the exterior of the head office of the Bank of New South Wales and the Government Insurance Office.

Imported granites were used for the first time on a grand scale in Sydney. Vast quantities of granite of the most attractive colour and uniform texture are exported to all parts of the world from the same quarries in Finland that Peter the Great drew on so extensively in the building of Leningrad. Red granite from these quarries has been used most lavishly on the lower portion of the head office of the Commonwealth Savings Bank (formerly the New South Wales State Savings Bank). The many other fine buildings in Martin Place show a great variety of decorative and building stones, both Australian and foreign. Mention must be made of the two superb tall columns of Finnish red granite, each turned from a single block, on the Martin Place corner of George Street.

A dark coarse-grained igneous rock from Norway is appropriately named by the trade "Blue Pearl" or "Emerald Pearl" because of the abundance of lustrous feldspar crystals showing a shimmering pale-bluish iridescence. This was used to good effect on one or two Sydney buildings in this period.

The Present Building Period

The third building period, starting in the mid-1950's, again brought many changes. Probably the most striking development is the extensive use of greyish-white, smooth but unpolished Wombeyan marble on exteriors. The most notable examples are the Commonwealth Centre and the Reserve Bank. Attack by atmospheric acids should be limited on such a compact unpolished marble. Some of the contorted and banded French and Italian marbles that have been used externally may give easier access to

these damaging atmospheric constituents which may hasten deterioration.

Beautiful deep-green brecciated serpentinites from the Italian Alps, some with white calcite veins, and bearing attractive names such as Verde Issore and Verde Antico, have appeared on the exteriors of many of Sydney's newest buildings. One hopes that the deep green will not fade in our bright Sydney sunshine.

A safer choice, even if it is not so spectacular, is the green porphyry from Bookham seen on the QANTAS and P. and O.

The Reserve Bank building, Martin Place, Sydney. The square white slabs on the whole of the exterior are of Wombeyan marble. Thin vertical panels of South Australian "Imperial Black" gabbro are placed between the marble slabs. [Photo by courtesy of the Reserve Bank.]

buildings. On this latter the Bookham porphyry is used in conjunction with a lighter green granite imported from Germany. Polished slabs of Bowral Trachyte are still being used. The N.S.W. granites from Sodwalls, Mudgee and Uralla seem to be in the discard—only temporarily, one hopes. The grey granite mostly used now on exteriors is from Harcourt, near Bendigo, in Victoria. Another Victorian granite from Dromana, near Melbourne, has become popular. It is an unusual colour. The feldspars are green and stand out in a dark, somewhat purplish, background.

Black rocks have always been sought as a contrast to the more extensively used lighter coloured building and decorative stones. In the 1920-1939 period one such igneous type, a gabbro, was imported from Sweden for exteriors. A black marble from Yass was used as a skirting in numerous banking halls and vestibules. Two Australian gabbros have admirably filled the need for hard, dark rocks and surely make it unnecessary ever again to import Swedish Black. One is from Adelong, N.S.W., and the other is "Imperial Black" from Sedan, 40 miles north-east of Adelaide. Exterior use of the former is seen in many city buildings, notably QANTAS and the Commonwealth Centre. The latter is tastefully used as relatively narrow panels on the exterior of the Reserve Bank, and can also be seen on the Guardian Assurance Building.

Time will not permit mention of the many manufactured types of materials that have always competed with natural stone. The use of these materials is becoming increasingly common. One hopes that a return to using building and decorative stones is heralded by the excellent example of the Reserve Bank, one of our newest buildings. Here nothing but natural Australian stone has been used. In addition to those already described, ground-level flooring and paving slabs are made of pale greyish-white, very coarse-grained granite from Tocumwal. The lift fronts are faced with polished slabs of striking white saccharoidal marble, with bold black streaks from Ulam, near Rockhampton. A pure white variety of this was used as flooring in the main banking chambers of the Rural Bank Head Office, built in the 1920-1939 period. While this black-streaked variety has been used in Brisbane and Melbourne, it is apparently only starting to come into favour in Sydney.

White-Winged Choughs

By IAN ROWLEY

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AUSTRALIA appears to have more than its share of birds which live in groups larger than the simple pair necessary for effective reproduction. This fact has been emphasized during the last decade by the advent of bird-banding and, in particular, the use of colour bands to distinguish individuals and to enable their behaviour to be followed in detail.

Perhaps the most sociable of all our birds is the White-winged Chough, *Corcorax melanorhampus*, which occurs throughout eastern Australia from central Queensland to the South Australian fringe of the Nullarbor desert; it is absent from Tasmania. Despite a superficial resemblance to the European choughs, unfortunately perpetuated in their common name, no close relationship to these corvids exists, and their exact taxonomic position is something of an enigma. Peter's *Birds of the World*, Vol. XV (1962) groups the four Australian mud-nest builders together in a family of their own, the Grallinidae; this is subdivided into two subfamilies, the Grallininae containing the two magpie-larks (Australian and New Guinean) and the Corcoracinae containing the chough and the apostle bird, *Struthidea cinerea*.

Corcorax are medium-sized birds (350 grams) with strong legs, a long curved bill and relatively poor powers of flight; their plumage is soft in texture and dull black relieved only by a white wing patch extending over all 10 primaries.

Social Organization

Choughs live in groups of from two to 20 birds, averaging about eight, and throughout their lives live as a community, each individual contributing to a greater or lesser extent towards group activity.

Over the six years of this study it has been possible to build up a quota of known-age birds in the population by banding nestlings. Lately, improved trapping techniques have enabled entire groups to be individually colour-banded (133 birds) and group composition, behaviour, and interchange between groups have been studied. It was obviously very important to know the sex of the birds under observation but despite thorough search no external clue could be found. As a last resort, the sex of birds was ascertained by viewing the gonads through a small incision in the left flank. (My thanks are due to Dr. W. K. Whitten, D.Sc., B.V.Sc., for this work.) No ill-effects were observed and since then a clearer understanding of the social relationships has been possible.

An adult chough with two three-week-old nestlings. The nest shows several rings of mud corresponding to the number of work sessions spent building it. [Photo: M. S. R. Sharland.]

Young birds on leaving the nest are dependent on older group members for at least two months and their plaintive high-pitched piping, as they beg for food, is a feature of early summer. By autumn they appear to be self-supporting but remain with the group, which forages and roosts close together. This persistence of the young

Typical view of the study area near Canberra. Stands of Brittle Gum, *E. maculosa*, such as these are becoming rare, and a recently ringbarked block is visible to the right of the middle distance. [Photo: Ederic Slater.]

within the group for several years is fundamental to the social structure. A typical example of a group of eight is: an adult male and female with six immatures consisting on an average of two progeny from each of the last three breeding seasons. In time, a group may arrive at a stage where more than one adult female is present and then multiple laying occurs, as is shown by two eggs being laid in less than twelve hours and the occurrence of a total clutch double the usual size. However, the rigid mud nest (on the average, a bowl 7 inches in diameter and 3 inches deep) makes it physically impossible for more than four young to reach fledging despite the large number of potential attendants; in fact I have only once recorded four fledgelings. At first glance this appears to be a thoroughly wasteful process and in fact the rarity of its occurrence in other families suggests that it is an evolutionary cul-de-sac. Nevertheless, it appears to be these groups with more than one mature female (and these alone) which can manage to raise two broods in the season; the first brood is cared for by part of the group while the remainder re-nest. Later the whole group reunites. Some groups have more males than females, while in others females predominate.

Sometimes a group disintegrates following the death of a member and the fragments may attach themselves to established groups or start afresh on their own. The adult male appears to be the corner-stone of the group and his loss is usually followed by group break-up; the loss of an adult female may be made up from within the group with little disturbance to the society.

Nest Construction

The nests are characteristically placed on a horizontal limb of a tree, frequently a simple branch, as illustrated, but sometimes a lateral fork or even vertical stubs are incorporated in the structure. Shade leaves are important as protection from sun and predators, but these are usualy borne on another, higher limb so that from the ground the nests present a clear and surprisingly obvious silhouette. Although we call them "mud-nests" they are not entirely made of mud any more than are adobe houses; about equal volumes of fibre and mud are used. The birds first gather a bill-full of grass or bark and then take this to the mud-source

—puddle, edge of dam or stream—and dabble the bundle energetically in liquid mud until it (and they!) are well covered. They then fly to the nest site and place their load with all the skill and care of a bricklayer.

Three stages in the building of a nest can be distinguished. Firstly, a "saddle" is plastered over the branch with the "flaps" extending three-quarters of the way round. This is largely, if not solely, of clay and is left to dry thoroughly. Next a platform is constructed by raising the "shoulders" of the saddle to provide a flat base on which the nest proper can be built. Finally, the sides are raised over several days and involve the first bowl-shaping movements. The chough places its bill sideways against the outside of the wet structure, opening and shutting the mandibles very rapidly ("scissoring"). These bill movements are so rapid that they probably have the same effect as a vibrator in concrete construction work—i.e., they help settle the mix—besides the obvious shaping and smoothing functions as the bird shifts round the nest. The fibre in the load is usually from 4 to 6 inches long, and before shaping takes place the loose ends are carefully tucked in. Internal shaping is similar to that used by most other nest builders; the bird presses its breast against the inner wall and the body is shifted gradually round the nest.

The vibrator-effect of the scissoring operations described above leaves only plastered mud visible on the outside of the nest structure. The surface is ridged in horizontal rings when finished and dried hard. These rings roughly correspond to the number of work sessions involved, since little more than an inch a day can be added safely without the wall sagging (67 loads per session is the most recorded). Near Canberra, where most of my observations have been made, it is too cold in spring for rapid drying and only one session a day, or even every other day, takes place. On the coast or farther inland two sessions a day are frequent and therefore nest-building is quicker.

At first sight it would appear that this form of nest construction would restrict *Corcorax* to the wetter environments, and nesting to the rainy season. In fact, the species is far more adaptable. Only a small proportion of the nests used each year are new ones, the majority being old structures that have been patched up and relined. (Some nests may persist for five or more years.) As alternative materials I have seen one nest built of cow dung and another of emu dung so that a scarcity of mud does not necessarily stop building.

Breeding

All the birds in the group may help to build the nest, though the efforts of the previous year's young often appear as more hindrance than help. Usually only the older birds incubate, but, again, all help feed and brood the nestlings. Three to five eggs form the normal clutch and they are laid on successive days; incubation starts with the first egg and hatching is asynchronous. Clutches of seven to nine eggs are by no means rare (they occur in about 20 per cent of cases) and are the work of more than one female laying in the same nest. Besides choughs only the apostle bird and the Central American anis carry sociality as far as this. Anis, however, form definite male-female pairs, whereas the Corcoracinae behave throughout as one social group. Incubation lasts 19 days and the nestlings leave the nest 23 to 28 days later, depending on growth rate and whether they have had to wait for a younger (and smaller) nestling—even so, fledging of the full family may be on successive days. The young birds just out of the nest cannot fly at all but their strong legs enable them to run fast and to clamber off the ground to roost. When the group sounds the alarm call, these young freeze motionless and are very hard to locate; the retention of four lines of fawn baby down on the head (as in photo) throughout the first 60 days of life may well provide a disruptive effect to the otherwise plain, black plumage (the white wing flash does not show in the "freeze" position). Choughs also employ a most effective escape reaction; just as the predator makes contact with the prey the bird gives an explosive leap-flight, accompanied by an ear-piercing shriek. From the point of view of the "predator" writing this paper, it is a most effective (and annoying!) performance.

The majority of chough groups only raise one brood a year, rearing at most four fledgelings. If early attempts meet with

disaster, relaying, and even rebuilding, may occur until success is attained. In New South Wales the earliest eggs are laid in July and clutches have been recorded for each month up to and including February. There appears to be no correlation with rainfall and most of the late clutches are laid in response to earlier failures.

Territory

Choughs feed mainly on insects "raked" from their hiding places by means of the long, curved bill. Despite their strong legs, food-searching by scratching with the feet has never been observed. For most of the year the favourite foraging area is forest litter, which provides a wide range of food from frogs and centipedes down to ants; observation at many nests has shown that fat white melolonthoid grubs form the main part of nestling diet. After the young fledge the group spends most of the next two or three months litter-raking; the closed canopy of the forest provides good protection for the young from aerial predators. Towards autumn the group moves into more open habitats, such as pastures, stubbles and cultivation; a change of diet occurs, and seeds become more important but never make up more than 15 per cent of the diet. At this time choughs are liable to be accused of depredations on newly-sown cereal crops. Certainly they find the friable surface of the seed-bed easy to rake over and the recent seeding operations have probably exposed many insects in the process. Birds shot for examination under these conditions always contained insects and only sometimes grain; those stomachs which included a few grains contained many other items as well, suggesting that, if encountered, a seed was accepted, but that there was no definite search for grain.

Since arable farming is relatively uncommon on the Southern Tablelands of New South Wales, cultivated areas act as foci of attraction for the choughs in the neighbourhood and give rise to quite substantial flocks in autumn and winter. These flocks are most conspicuous and have been frequently reported; in reality they are not true flocks with any unity of behaviour, but are fortuitous agglomerations of *Corcorax* groups at a localized food source. Each group maintains its identity and, indeed, they can usually be clearly separated by eye as they forage; if put to flight each group departs as a unit, often in different directions.

By trapping at these winter feeding places, we found that only certain groups frequented each one and that, although they often travelled two or three miles to get there and

A group of eight choughs drinking close together at a waterhole. [Photo: G. S. Chapman.]

might retrap readily, we rarely trapped them elsewhere. This suggested that, although chough groups foraged over a wide area in the non-breeding season, these movements were not truly nomadic but were restricted to an area familiar to the group. Observations of colour-banded birds has defined this "home range" as from two and a half to three square miles and within this area the group tends to follow a regular feeding route or "beat" which may take several weeks to complete. Chough groups may forage over home ranges which overlap those of neighbouring groups; due to the size of these areas and the time taken to complete the beat, it is rare for groups to meet, but when they do a brief but very noisy display-battle ensues with much posturing and whistling by the birds. This posturing is very characteristic of the species and consists of alternately fanning the tail and wings. The fanning display occurs in many contexts, is highly contagious and appears to serve an appeasement rather than aggressive role. After this show of strength the two groups may feed peacefully within sight of each other on the ground—as happens in the "flocks" mentioned already. In many hours of observation I have never seen actual physical combat between choughs.

Breeding, necessarily, restricts movement over the full home range and, in fact, a clearly defined "territory", or defended area, develops around the nest site and consists of some 10 acres from which choughs other than group members are excluded and within which all feeding takes place. The group regularly roosts near the nest site at night.

Advantages Of Group Existence

The group existence practised by choughs appears to offer them four distinct advantages: foraging, alarm, defence and training. Foraging choughs are seldom more than two yards apart and move like a pack of rugger forwards; frequently an insect disturbed by one, and missed, may be picked up by a neighbour. This group foraging also means that local food abundances are less likely to be missed because a larger area is covered. Once such a source is located, mutual tolerance between individuals permits all to benefit.

Eight pairs of eyes alert for danger are far more efficient than one; I have never been convinced that one of the group acts as sentry, but they very rarely all have their heads down together and in practice are very difficult to stalk unobserved. The need for constant alertness in a species which is rather slow and clumsy in its movements and spends most of its time conspicuously on the ground is self-evident.

In defence, the group excels itself. Choughs' constant enemies are magpies, *Gymnhorina tibicen*, who feed on very similar items and are extremely common in the open savannah country traversed by choughs for much of the year. Magpies are very aggressive and are much faster and stronger on the wing, so that bird for bird they are more than a match for choughs. On the ground, however, as soon as a strafing attack is imminent, one of the group calls the alarm and all members clump together, face the attacker with wings partly open to display the white flash, and utter a loud "hiss". The effectiveness of this defence must be seen to be fully appreciated, and I have never seen a magpie press home the attack. From the magpie's point of view the trespassing strangers of its own dimensions are suddenly transformed into a mass, ten times as big, piebald and hissing! For a species which forages over a very large home range, and in consequence must be continually trespassing the territories of more static and very aggressive species, such an efficient defence mechanism is of great value.

Choughs, like many passerines of their size (magpies, ravens, etc.) mature slowly and probably do not breed until they are at least three or four years old. The first winter of a chough's life appears to be a testing time and mortality is heavy. It is likely that young birds foraging on their own would fare even worse if they were deprived of the experience of older group members in food searching. Further, my observations made during nest building showed that first-year birds contributed little to actual nest construction. Comparatively few loads were carried and most of these were dropped during the building attempt. This display of inefficiency by first-year birds suggested that some of this behaviour is not fully innate, and that group membership enables the immature individuals to pass through a form of apprenticeship.

Blistering from Bristle-worm

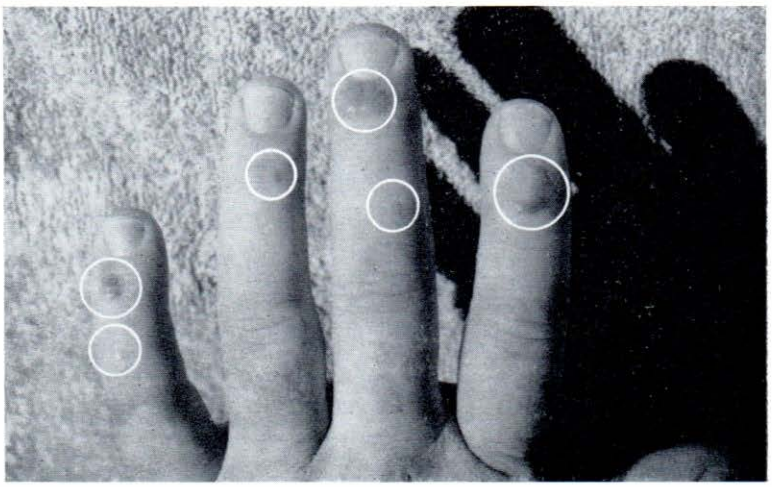
Marine naturalists and collectors in many parts of the world are well aware of the painful stinging caused by the almost world-wide, warm-water, intertidal bristle-worm *Eurythoe complanata*. This is a polychaete worm, and, as the name suggests, has a fringe of numerous setae, or "bristles", projecting from each side of the body. The setae of this particular polychaete, unlike those of most other members of the group, are slender, rigid and brittle slivers, composed mostly of calcium carbonate, which stick into the fingers or other unprotected skin of the unwary collector and then break off to remain as a closely-spaced, but irregularly-shaped, full white pincushion. It is these setae, or the fragments embedded in the skin after removal of the projecting portions, which cause the stinging reaction. *Eurythoe* is light salmon-pink in colour, up to about 7 inches in length and is found on rocky beaches under stones or within narrow crevices or cracks. It is figured in W. J. Dakin's *Australian Seashores* on plate 27, figure 7, and by Miss E. Pope in *Australian Museum Magazine*, Vol. IX, No. 5, page 167, August, 1947.

Eurythoe and its habit of stinging have been known and recorded for a long time, as, for example, when John Steinbeck and Ed Ricketts in their classic book *Sea of Cortez*, state that "he stings like the devil, his hair-like fringe breaking off in the hands and leaving a burn which does not disappear for a long time". Though so widely known as a stinger, detailed accounts of reactions are not readily available and for this reason it is useful to record the following recent case:—

On 14th February, 1965, a male member of the Australian Museum staff, about 35 years of age, collecting intertidally at Minnie Waters, near Grafton, northern New South Wales, brushed the back of his left hand against an average-sized *Eurythoe complanata* in a rock crevice. Bristle penetration occurred extensively on the distal joints of the second to fifth fingers. The bristles were immediately removed as completely as possible by hand, the remaining broken pieces being rubbed off on a rough surface. (This action was probably a mistake. It is thought now that a lot more trouble should have been taken over the careful removal of these bristles with forceps or adhesive tape, with as little breakage as possible.) No pain was noticed, though the penetrated areas were irritated. No medication was used.

Seven hours later, the finger joints affected were puffy and swollen with the skin tight. The actual areas of penetration were tender. Oral antihistamine tablets were taken, though external use of an antihistamine cream would probably have been more effective. Next morning, eight hours after the above observations, the finger joints were still puffy and swollen, but multiple and extensive blistering in areas of penetration had taken place (see photo). The blisters were tight and swollen, many of them were blood-filled, and the general area of the blisters was very tender.

A day later, the puffiness and swelling of the joints had gone but blistering was still extensive. It took a week for the blisters to subside completely, leaving extensive areas of peeling red skin, and an additional three weeks for peeling to be completed, leaving the skin areas of the largest blisters shiny and red, but completely healed. Minor damage to the growing area at the base of the third finger nail was still apparent two months later.—*J. C. Yaldwyn.*



Swollen and blood-filled blisters (indicated by white circles) on the back of a hand, caused by the sting of the intertidal polychaete bristle-worm *Eurythoe complanata*. [Photo: D. F. McMichael.]

Part of a muddy estuary with burrows of *Heloecius cordiformis* surrounded by mounds and, between them, burrows of *Hemiplax latifrons*. [Photo: Author.]

The Behaviour of Shore Crabs

By D. J. G. GRIFFIN
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ON the mud flats at river mouths, on mangrove swamps and sandy beaches throughout the world are to be found colonies of burrowing crabs. These crabs have a wide, rectangular body and long eyestalks which are generally raised vertically when the crab is active but can be folded into prominent, similarly elongated sockets. These are the Fiddler Crabs, Ghost Crabs and Sentinel Crabs which belong to the Family Ocypodidae. Belonging to the same family and to another closely related one, are the Soldier Crabs, with convex, oval bodies, slightly shorter eyestalks and extremely large outer mouthparts, covering nearly all of the front below.

Two species of ocypodid crabs occur in Tasmania: *Hemiplax latifrons*[1] *and Heloecius cordiformis*[2]. *Hemiplax* is most closely related to the Sentinel Crabs, *Macrophthalmus*, of tropical regions. It has a flattened body with the outer borders twice notched near the front and is sandy brown in colour. *Heloecius* is closely related to the tropical Ghost Crabs, *Ocypode*, and Fiddler Crabs, *Uca*. It has a very convex body with unnotched outer borders and is dark purple or brown in colour. Outside Tasmania *Hemiplax* occurs along southern parts of the Australian mainland while the distribution of *Heloecius* extends up the eastern seaboard of Australia at least as far as Brisbane. In Tasmania these two crabs are commonly found together on mudflats from lowest low tide to highest high tide level, and are active when the tide is out. *H. latifrons* burrows low down on the shore, sometimes preferring rather sandy areas, while *H. cordiformis* is found on higher, well-drained parts of the shore.

Burrowing Behaviour

The burrows of the two species are quite different. In *H. latifrons* the tunnel pro-

ceeds at a shallow angle into the mud. In the burrows of *H. cordiformis* the tunnel is vertical and quite deep and ends in a slightly larger chamber close to the water table; the mouth is almost always circular, sometimes flush with the surface and sometimes, in wet mud, surrounded by a prominent mound of excavated material. Melbourne Ward[3] described, more than 30 years ago, the process of burrow construction in *Heloecius*. Mud is scraped up and held by the claws of the walking legs and the crab moves out of the burrow to deposit the ball of mud close to the mouth or drag it a short distance away. As Ward observed, the deposition of the mud ball involves its passage across the front of the body. Burrow construction in *Hemiplax* is essentially the same, the wet mud being dragged out into the open and deposited in a heap close by and in line with the direction of the burrow. In both species one burrow often has two and sometimes three entrance tunnels.

Feeding

The method of feeding is essentially the same in both species. While feeding, the crab sits on its "haunches". Small particles of mud are picked up by the nippers, which are spooned and hairy, and carried to the top of the mouth, the outer mouthparts gaping to receive them. Each nipper supplies the mouth alternately. After the extraction by the mouthparts of the organic food material, the mud to be discarded forms in a large wet ball at the bottom of the mouth and either drops on to the ground or is wiped away with one of the nippers. The ground where the crab is feeding thus becomes littered with these small balls of mud. The crab begins feeding as soon as it emerges from its burrow. Then it moves off, stopping nearby to feed again. If undisturbed it continues moving away from its burrow in a straight line. However, discarded food pellets do not form the regular arrangement found in several other species of shore crabs.

Fighting And Aggressive Wandering

While wandering across the mud every crab passes near other crabs and burrows. Sometimes a wandering male appears to take no notice of others but at other times will stop and attack its neighbour. In *Heloecius* the nippers are extended forward straight in front or in a bent position, and the body is raised quite high off the ground. The nearby crab responds with a similar posture. The two combatants then move towards each other until the nippers of one crab pass over or under those of the other, sometimes passing on each side of the opponent's body. Frequently they move closer, nippers forwards, and push against

Male *Heloecius cordiformis* displaying (left) and feeding (right). [Photo: Author and D. Shepherd.]

Two male *Heloecius cordiformis* fighting. The one on the left has just emerged from its burrow. Note the mud pellet drooping from the bottom of the other's mouth. [Photo: Author and D. Shepherd.]

each other or feebly grasp the body of the opponent. At length one of the crabs withdraws and moves away. Such fights seldom last more than about a minute. If, as usual, fights take place near a burrow, the victorious crab, if it is the intruder, immediately sets about enlarging or modifying its newly acquired home. If an owner has successfully defended its burrow it usually continues feeding. Although these crabs were studied mainly in their natural habitat some were marked with a quick-drying lacquer and placed in a large tank partly filled with mud. Observations of these marked crabs show that larger males nearly always win fights. Indeed, it is the larger males which most frequently wander through a colony dispossessing burrow-owners, sometimes several in succession, spending only a small time at each new burrow. Furthermore, defeated owners usually wander off to attack a nearby burrow-owner, thus initiating a chain reaction. However, this does not result in all the crabs in the colony fighting for burrows since only a few males at any one time engage in such "aggressive wandering" and many owners successfully defend their burrows.

In *Heniplax* similar aggressive wandering occurs but fights take a slightly different and more complex form. They begin with forward stretching of the nippers and raising of the body, as in *Heloecius*, but after a very few abrupt lunges each individual extends the nippers outwards from its body so that those of each combatant almost touch at their extremity. Pausing for a moment like this, each crab suddenly jerks its nippers backwards and forwards very quickly several times in mutual tapping of the extremities. Just as suddenly, one crab sinks to the ground, folds its nippers and moves off. Feeding, burrow maintenance and fighting occur throughout the year.

Burrow Defence

During the warmer part of the year, especially in summer, male crabs may be seen motionless near the mouth of a burrow in a characteristic posture. In *Heloecius* the body is usually raised off the ground, the legs almost straight, the nippers slightly flexed and hanging down from the body. In *Heniplax* the body is not raised quite so high off the ground and the nippers are somewhat more flexed. Crabs may remain in this position, only shifting a leg or two, or turning around a little, for up to an

hour at a time, showing little attempt to rush into the burrow at nearby sounds or movements, the body gradually drying in the sun. This stance can probably be interpreted as burrow defence; crabs standing like this have never been seen approached aggressively by another crab.

Reproductive Behaviour

At certain times of the year, mostly from October through January, males of both species will be seen near the mouth of their burrow, elevating the body on outstretched walking legs and waving or jerking their nippers. In *Heloecius* this waving has given rise to the species' common name of Semaphore Crab. The nippers, normally folded in front of the body, are stretched out until the hand is slightly more than at a right angle to the arm, the body is raised up and tilted back on the hind legs and the nippers, which unflex further, are carried higher into the air above the body. The nippers are then jerked down very quickly with scarcely a pause and the body falls forward on to the front legs, which are frequently raised off the ground at the time of maximum elevation of the nippers. Generally both nippers are raised and lowered in unison and only very seldom does one become slightly out of phase with the other. Several of these "waves" occur consecutively, each set interspersed with feeding. At the height of display in *Heloecius* such wavings may occur at up to 20 or more per minute quite regularly. However, each display seldom includes more than 10 separate waves.

In *Hemiplax* the form of the display is rather different. The body is raised high off the ground and tilted backwards, the nippers fully unflexed and extended upwards, the body sometimes held vertically on the almost straight legs. Sometimes the body is balanced on the second and third walking legs, the others being lifted off the ground. The first part of the display, the raising of the nippers, takes place quickly whereas the downward movement is relatively slow. At the maximum reach of the nippers the whole body and the nippers remain poised momentarily and sometimes tremble slightly. The rate of display is about 11 waves per minute; each display seldom includes more than six separate waves.

A male *Hemiplax latifrons* displaying. [Photo: Author and D. Shepherd.]

In both species approach of a female may coincide with a brief sideways movement of the whole crab, nippers still elevated or stretched sideways. However, females apparently take no notice of displaying males. This "display" takes place at a certain time of the year preceding the appearance of egg-bearing females and is usually intensified or initiated at the approach of a female. It is therefore clearly sexual in nature and homologous with the "fiddling" of species of *Uca*.

At the height of summer some male *Heloecius* will be observed at the mouth of a burrow with the walking legs of one side partially inserted, each leg moving quickly and independently in a kind of drumming. Soon a female emerges and is quickly grasped by the male, whose nippers extend around the body of the female

so that the two crabs face each other with the undersides almost touching. The two may remain like this almost motionless for many minutes except for the male picking gingerly at the female's back. Such mating occurs outside the burrow but has not so far been observed often. In *Hemiplax* mating is carried out in a similar fashion but does not appear to be preceded by "drumming".

Cycles Of Behaviour

Each of the behaviour patterns so far described occurs in a cycle. When the tide recedes, the crabs emerge and immediately begin feeding. Soon a few start excavating their burrows or wandering about, often as far as the water's edge, collecting mud which is packed in front of their face and dragged into their burrow. Several such collecting expeditions, sometimes interspersed with feeding, may take place. Others may take up aggressive wandering. In summer others begin displaying, retreating into their burrows or feeding for short intervals. As the time of high tide approaches and the sea returns to cover them for a few hours, many male crabs which have been displaying or fighting revert to burrow maintenance. Now, in *Heloecius*, crabs may be seen depositing collected mud at the burrow mouth or pushing mud up to the mouth from inside the burrow to seal themselves inside. In *Hemiplax* the burrow remains open all the time. This cycle of activity probably varies for each individual crab so that some spend nearly all their time displaying on one day while on other days they may engage only in feeding or burrow maintenance or they may remain underground.

Finally, as already stressed, there is a seasonal cycle, fighting being common in summer, sexual display and mating being confined to spring and summer, whilst on cold winter days, at least in Tasmania, many crabs remain underground.

Other Shore Crabs

The behaviour of some ocypodid crabs, particularly Fiddler Crabs, *Uca*[1] and others such as the Malayan Soldier Crab, *Dotilla mycteroides*[5] and the Ghost Crab, *Ocypode ceratophthalma*[6] have been closely studied in recent years. One of the main aspects of the relatively new field of animal behaviour is the analysis of similarities in the behaviour patterns of closely related species. It is instructive therefore to compare the behaviour of these two Tasmanian crabs with that of closely related species. It is not surprising to find that many of the patterns exhibited by *Heloecius cordiformis* are strikingly similar to those of Fiddler Crabs. The method of feeding and burrow construction, the habit of plugging the burrow, the female's disregard of displaying males and the "drumming" preceding mating are all found in species of *Uca*. Species of *Uca* also stand near their burrow for long periods in a characteristic posture. More interestingly, the form of the sexual display in *Heloecius* closely resembles the "vertical waving" of "narrow fronted" *Uca* species while this same display is similar to the threat display of the Malayan Soldier Crab and a closely related species of *Ilyoplax*[7]. Indeed, in *Heloecius* one male sometimes repulses another with an extraordinarily quick movement which is rather like abbreviated sexual display. The placing of *Heloecius* and *Hemiplax* in different subfamilies on solely morphological evidence is substantiated by the differences in certain aspects of fighting and sexual display. Further, the similarity of the ritualized fights of *Hemiplax latifrons* to those of the New Zealand *H. hirtipes*, studied recently by Dr. Colin Beer[8], emphasizes their close relationship.

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[1] Illustrated in H. M. Hale's *The Crustaceans of South Australia*, Part I (Govt. Printer, Adelaide, 1927).

[2] Illustrated by F. A. McNeill in *Australian Natural History*, Vol. XIV, No. 2 (1962).

[3] In *Australian Museum Magazine*, Vol. 3, No. 7 (1928).

[4] See Jocelyn Crane's papers in *Zoologica*, Vol. 42, Part 2 (1957) and Vol. 43, Part 4 (1958).

[5] See M. W. F. Tweedie in *Bulletin of the Raffles Museum*, Vol. 23 (1950) and in *Animals*, Vol. 1, No. 22 (1963).

[6] See Tweedie's article in *Animals*, Vol. 4, No. 7 (1964).

[7] R. Altevogt (1957) and M. W. F. Tweedie (1950), quoted by H. Schöne in T. H. Waterman's *The Physiology of Crustacea*, Vol. II (Academic Press, New York, 1961).

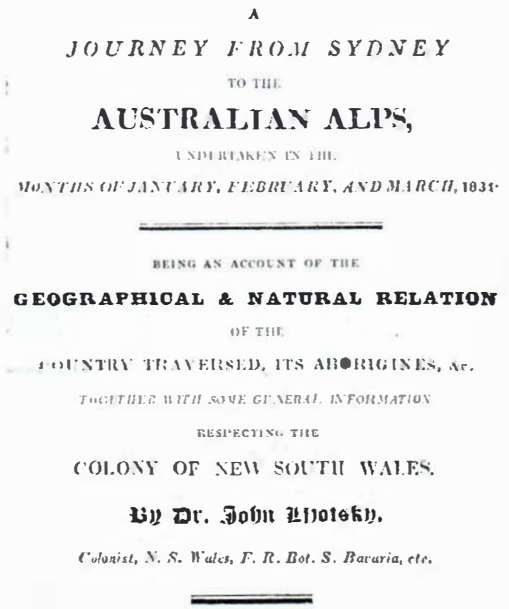
[8] In *Transactions of the Royal Society of New Zealand*, Vol. 86, Parts 3 and 4 (1959).

JOHN LHOTSKY AND THE AUSTRALIAN MUSEUM

By G. P. WHITLEY
Honorary Associate, Australian Museum

THE Australian Museum is still indebted for fragments of its early history, which might otherwise never have been preserved, to an extraordinary character who arrived in Sydney from Brazil in 1832. He was John Lhotsky, a 32-year-old doctor and naturalist, interested in politics and many other subjects, but who had an unfortunate and chronic tendency to get into debt and run away from his creditors.

Perceiving that there was a vacancy for a Colonial Zoologist at the Colonial Museum, as the Australian Museum was then called, Lhotsky put his name forward for the position to the Governor, Richard Bourke, and the Colonial Secretary, Alexander Macleay. I have been privileged to consult, at the Archives Office of New South Wales, the Colonial Secretary's correspondence of 1832-3 and, at the Mitchell Library, the newspapers of those years, from which, with grateful acknowledgment, the following extracts bearing on John Lhotsky and the infant Museum are quoted. Lhotsky was never appointed to the Australian Museum staff; he went on an expedition to the Snowy River (which he named in 1834), he wrote an early description of the Canberra district and was an early discoverer of gold in Australia. He went to Tasmania in 1836 and to England in 1838 but his later career is unknown. He had held views, in advance of his time, on treating convicts and Aborigines with kindness and consideration and on the sharing of land and wealth. In the *Sydney Gazette* newspaper, 6th October, 1832, for example, Lhotsky recommended the Government to purchase some Aboriginal babies and educate them. He wrote, "I dare to say that these Papuas [as he called them] will have, perhaps, as good Franklins and Washingtons, Byrons and Shakespeares, as the cannibals and wild fellows which the Romans once called Picts." He made large mineralogical, botanical and zoological collections, since dispersed. He



A
JOURNEY FROM SYDNEY
TO THE
AUSTRALIAN ALPS,
UNDERTAKEN IN THE
MONTHS OF JANUARY, FEBRUARY, AND MARCH, 1834.

BEING AN ACCOUNT OF THE
GEOGRAPHICAL & NATURAL RELATION
OF THE
COUNTRY TRAVERSED, ITS ABORIGINES, &c.
TOGETHER WITH SOME GENERAL INFORMATION
RESPECTING THE
COLONY OF NEW SOUTH WALES.

By Dr. John Lhotsky,

Colonist, N. S. Wales, F. R. Bot. S. Bavaria, etc.

SYDNEY: 1835.—
SOLD BY J. INNES, BOOKSELLER, PITT-STREET.
LONDON:—
By Commission at R. ACKERMAN'S Repository of Arts, Strand.

The title-page of John Lhotsky's "Journey", which was published in parts in 1834 and 1835 and is now a very rare book. [Original in the Mitchell Library, Sydney.]

wrote diffusely (and sometimes scurrilously) on many subjects and lectured in Sydney on politics and science.

In an advertisement for his lectures, Lhotsky wrote (*Sydney Gazette*, 9th April, 1833, p. 3): "access to this place shall answer as far as possible the scruples even of the more timid sex, as the opportunities offered to this part of the society, to obtain scientific knowledge, may be rather scarce on this side of the world . . . "

John Lhotsky arrived in Sydney in May, 1832. He said that a white servant had robbed him of a large sum of money in Brazil, so in August he requested the

Colonial Government to advance him £40 for which he gave a bill on the Austrian Ambassador in London.

Letter To Governor

On 3rd October, 1832, he addressed himself to the Governor of New South Wales, Richard Bourke (Colonial Secretary letter, 1832/7404):—

May it please Your Excellency.

[After a flowery introduction, Lhotsky points out the Museum of the Cape is not unknown, the Botanic Gardens at Calcutta and the Mauritius are celebrated.] But Your Excellency will permit me to express my surprise that in this Country . . . there exists no public collection of living or dried plants. . . . But the inconvenience resulting from the deficiency of a general Museum are most palpable in the department of Mineralogy, since this is of all others the science, which by its strong conection [sic] with the metalic [sic] and mining arts—possessing the greatest effect over public economy. In all events the establishment of a scientific Museum might prove interesting to the Colony, but above all the Mineralogical part would be the most important. Although there may exist indeed the commencement of a Zoological Collection in this town, yet even this must suffer from the want of professional inspection. . . .

Lhotsky's Proposals

Lhotsky then proposed:—

That it may be perhaps beneficial to the Colony, to apply to the establishment of a general Museum of New South Wales, this properly scientific funds, which are as I understand, undisposed of. I allude to the salaries of the Colonial Botanist and Zoologist, both of which situations are, I perceive unoccupied.

That the person employed for this purpose should form a Herbarium and a Mineralogical Collection, which should be incorporated with the existing Zoological Museum, which of course should be completed.

That such a person should begin with the systematical arrangement of the Botanical Garden, the Seminarium, etc.

Lhotsky then most respectfully "sollicits" the situation for himself. He submitted as documents: Diploma as Dr. of the Grand Ducal University of Saxe-Weimar, Diploma of Roy. Bot. Soc. Bavaria, Mineralogical printings, and a letter to Sir E. Parry.

Lhotsky's request to the Governor is minuted: "Dr. Lotsky to be informed that both a Zoologist and a Botanist are expected out, the latter having been applied for thro the Secy of State and that I can not therefore with propriety avail myself of the Doctor's services".

Rival Newspapers' Views

The *Sydney Gazette* supported Lhotsky, for in its issue of 18th June, 1833, we read:—

The situation of Colonial Zoologist having become vacant now two years by the death of its occupant, we take the opportunity of expressing our earnest hope that it may be conferred upon that talented and enterprising Natural Historian, Dr. Lhotsky. . . As the salary is only £150 per annum, we are sure *no man of science* would come out with so paltry an inducement; and we therefore doubt not that His Excellency will provide for our Colonial Museum, which is now in a state of Orphanship near two years, with a person of Dr. Lhotsky's abilities and activity, who happens to be already on the spot. We are happy to learn that the Dr.'s Lectures continue to be attended by highly respectable audiences, who derive increasing benefit from them.

The *Sydney Gazette* had a rival newspaper, the *Sydney Monitor*. Under a heading, ZOOLOGY, in bold capitals, we read in the *Sydney Monitor*, 19th June, 1833, p. 2, col. 3:—

The *Sydney Gazette* earnestly beseeches the Governor to job away the public money in appointing Dr. Lhotsky to be Zoologist. The Governor declined to give anything towards a Colonial Agent, on the plea, that he was not authorised to do so. How then can this proposal of the *Sydney Gazette* be attended to? The editor speaks of appointments, as if the public money were His Excellency's own patrimony; and that while churches and schools in our interior, and a Colonial Agent, are denied us for want of sufficient funds, His Excellency is at the same time at liberty to spend it in philosophical gew-gaws? No. Let those who are fond of birds, fishes, beasts, and minerals indulge their taste *at their own cost*, as the subscribers to our several colleges do, until we are abundantly provided with schools, churches, a Colonial Agent, roads, bridges, salaries to Members of a House of Assembly, &c., &c.

W. C. Wentworth's Comments

In the *Sydney Monitor*, 13th July, 1833, is a long account of a public meeting at which W. C. Wentworth strongly criticized Government expenditure and advised drastic reduction in salaries, from that of the Governor downwards: "The Colonial Botanist," he fumed, "was once a necessary Establishment, but . . . the Colonists can do very well without it. The sum expended on this gew gaw is 764*l*. 18*s*. 8*d*. without apparent

good done to the Colony . . . ". And again (p. 2, col. 4), Wentworth speaks:—

I must draw your attention to another item, namely 200*l. for a Museum*: I would ask what benefit the *public* derive from this piece of superfluous expense? Gentlemen, the person who filled the situation of Zoologist, *died* some time ago; and his place has not yet been filled! yet his salary has since been going on! I would ask Gentlemen, what has become of the arrears? (Hear, hear). Can it be supposed that any person has been allowed to pocket the money? These are questions which I cannot answer. One thing I do know that the contents of this *valuable* institution (a laugh) are conveyed home, and that H.M. Ministers are fairly *stuffed* with birds and rare curiosities; and by these means an influence is maintained at home, equally disgraceful to the parties and to the Colony (Loud cries of hear). Gentlemen, I will not say that this is bribery, but it certainly tends to perpetuate that ascendancy at home of certain personages, so long the bane of New South Wales.

Government "Extravagance"

In the *Sydney Monitor* of 20th July, 1833, the alleged Government extravagance again comes in for comment (p. 2, col. 2). The Mineral Surveyor's branch ought, it was thought, to merge into that of the Surveyor-General; the Colonial Botanist was overpaid at £200 a year; and the annual cost of his Department was £764 18s. 8d. "This is a large sum to pay for the science of Botany. We have the same objection to this Establishment as to that of Zoology. Zoology and Mineralogy, and Astronomy, and Botany, and other sciences, are all very good things, but we have no great opinion of an infantile people being taxed to promote them . . . We might as well give salaries to painters, sculptors, and chemists, as to botanists, astronomers, and Museum collectors".

[In England (William) *Cobbett's Register* was similarly complaining of the cost of upkeep of the British Museum and asked "what use any part of the whole thing can

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NEXT COLUMN

Two pages from John Lhotsky's *Journal* (1834) in which he complains about the vacant position of Colonial Zoologist at the Museum. William Holmes, the Australian Museum's first custodian, died in 1831, not 1830 as stated by Lhotsky. [From the original in the Mitchell Library, Sydney.]

because my time and attention being taken up by selling wood and vegetables, my mind is consequently not quite in that equable state, which a work of this kind requires. But as the cause is connected with the acts of the existing administration, I may be permitted in this work (the object of which is to convey general information respecting New South Wales), to advert to it. Although this young, and (as it now is) poor, distressed, lingering Colony is annually taxed from £1000 to £1300 for Natural History, the writer of these lines was not deemed worthy to receive, either before or subsequent to the expedition herein narrated, any official assistance whatever. My offence against the Government was indeed an inexpiable one. I reminded Governor Bourke and Mr. M'Leay, nearly two years since of a salary, which was and continues to be voted for a dead man,* and I petitioned that the vacant situation might

* It was under the administration of Governor Darling, that a Museum was very judiciously founded in Sydney, and the situation of *Colonial Zoologist* was given to a Mr. W. Holmes, who died at Moreton Bay in August 1830. However the salary continued to be voted, as appears by the following account of

COLONIAL ESTIMATES VOTED.

1831 (for 1832).	1832 (for 1833).	1833 (for 1834).	1834 (for 1835).
No detailed expenditure is to be found. But a salary which was voted in 1833 for a man who died in 1830, was beyond doubt also voted at an earlier period.	*Colonial Museum.* Colonial Zoologist.... £130 Purchase of specimens, &c. 70 £200	*Colonial Museum* Colonial Zoologist .. £130 Purchase of specimens, &c. 70 £200	Towards the support of the Colonial Museum £200. The latter item as a mere shift, in consequence of the voting of a salary to a dead man, having been commented upon at a public meeting, etc.

The sum thus annually voted is said to be given to Mr. M'Leay

be bestowed upon me pro tempore, until confirmed or revoked by the Home Government. From that moment every thing I have set about, is condemned to frustration. Thus was treated my "*Australian Mine Exploring Company*," my "*View of Mount King William the 4th*," (of which the Colonists have purchased two copies by raffle for £21). Thus also was it with the discovery of my "*Mineral spring*"—vilipending as it were even the health of the citizens, for the mere sake of annihilating my exertions. And it is only by the patronage of the community, that this frail work (the first however—frail though it be—wherein it happens that Australia speaks for herself), is continued. But it gives me satisfaction amid the sorrows, and strength amid the difficulties under which I labor, that this work will be a lasting warning to the future Governments of the Colony, not to — (divert) even such insignificant amounts of public money, and to distress in that way any person, who has a just claim upon such funds. This work, combined with other facts, may also induce our home government, to send in future to these distant Colonies men of aptitude for rulers; as individuals of an opposite description, (like Governor Darling for instance, who realized in different ways, £50,000 during his administration), are rapidly alienating the feelings of the community from that line of respect and affec-

for his scientific, and Mr. Deas Thompson, (Clerk of the Council Chamber, in which place the Museum is kept), for his *mechanical* attendance. The collection is (if at all!) increased by additions, ordered to be made occasionally by some prisoner or other gratis. Such and similar facts are loudly clamouring for a more numerous legislative body, than the present one of 15 members.

be to the *industrious* classes of this kingdom?"—*Sydney Monitor*, 7th August, 1833, p. 2, col. 4].

In a later article, entitled "Dr. Lhotsky's Expedition", *Sydney Monitor*, 7th August, 1833, p. 3, cols. 2-3, there is a further reference:—

We perceive in the estimates for 1834, the sum of £200 appropriated for a Zoological affair. We have heard that a Mr. Home came out some years back, appointed Zoologist by the Home Government, with a salary of £130 a year; but he died at Moreton Bay in August, 1831. In looking over the revenue account for 1832, we can see no item among the disbursements, on account of Zoology or a Museum . . . If a Hovell or a Hume or a Sturt or a Lhotsky choose to go a botanising or geologising . . . pay their expenses for the time-being and THEN HAVE DONE WITH THEM. But have no hangers-on, no regular ESTABLISHMENTS, no PERMANENT SALARIED men of science . .

The name Mr. Home in the above paragraph was an error for Holmes. (See G. P. Whitley, *Australian Museum Magazine*, March, 1961, p. 306.)

In view of the sentiments regarding museums and zoologists held by W. C. Wentworth and the press of the age, it is small wonder that Lhotsky was never appointed our Colonial Zoologist in succession to William Holmes.

Wentworth's Views Opposed

Some correspondent (perhaps Lhotsky himself?) attacked W. C. Wentworth's deplorable views as to museums and scientists, in the *Sydney Gazette*, 1st August, 1833, p. 3, col. 4:—

Natural History of the Colony.

To the Editor of the Sydney Gazette. SIR.

In a late number of your paper, some reference is made to the vacancy in the Natural History department in this colony . . . and I am only surprised that a paper bearing the title of "*Monitor*", should style it a gew-gaw, or that a man of Mr. Wentworth's education, should call it a trifle.

As to the real merits of Dr. Lhotsky to fill that situation, I will not speak; but from his zeal and perseverance in collecting objects of Natural History, all must allow he has the best claim to it. The expense is nothing compared to our justly stiled Botanic-cabbage-garden; and I am sure its object is equally important . . . and may not some of our youth at a future period, be worthy to be ranked with a Linnaeus or Buffon, a Banks or a Humboldt? . . .

It is a disgrace to this prosperous colony which is as rich in the animal and vegetable kingdoms as well as in the mineralogical, that we cannot say to the stranger visiting our shores—come and see our museum of curiosities which are almost peculiar to our extensive continent.

I remain, Sir,

Your obedient servant,

T.D.

A letter from John Lhotsky to the editor of the *Sydney Monitor* was published in that newspaper on 18th October, 1834 (page 2, column 6), as follows:—

To the Editor of the Sydney Monitor.

Sir,

. . . The situation of Colonial Zoologist, and respectively the £200 were claimed:

1st. By J. Lhotsky, R.D. in the latter end of 1832.

2nd. By G. Bennett, of the Royal College of Surgeons, London, in the beginning of 1833. Mr. Bennett (a rather known man amongst English naturalists), was so little encouraged here, that he was obliged to sell his boats, implements, &c., and to leave the Colony.

3[rd]. By D. De Dassel, a native and graduate of Hanover, about the same time, for the sake of which he made an expedition from Moreton Bay, landwards.

Every one got an evasive answer.

The *Gazette* says:—"The money was voted, but not drawn out of the Treasury." *"Credat Judeus Apella".** This reminds me of a servant who would bring in account hay and corn for a dead horse saying it was never eaten by *any body*. And if the money was voted but not paid, it ought to *appear annually* in the COLONIAL REVENUE; which it did not.

Dr. Lhotsky can wish no public situation under *present* circumstances; he inscribed his book *"to the inhabitants of New South Wales"* (the number of which is 75,000 souls); and if *these* will have a good and sound administration, they must support men of the opposition. Without opposition, no popular party, no *liberty*, no prosperity of the great mass of the people; nothing but oligarchy, bureaucracy, aristocracy, *monopoly*, and confusion.

I remain, Sir,

Yours truly,

J. LHOTSKY.

[* Lhotsky was quoting Horace's *Satires* 1 (5), 100, i.e., "A disbelieving Jew would give credit to the statement sooner than I should."]

Poor Lhotsky, he must have been a lonely genius, he may have been a humbug, even a rogue in some respects, but at least we can recall with gratitude the snippets of history he left behind him concerning the early Australian Museum.

References to Lhotsky and the Colonial Museum additional to those quoted in the text:—

J. Lhotsky, 1833. "Natural History Department." New South Wales Magazine, Vol. 2, No. 1, pp. 120-122; 1835. "A Journey from Sydney to the Australian Alps . . . 1834," especially pp. 57 and 66.

J. McPherson, 1938. "The Turbulent Dr. Lhotsky," Medical Journal of Australia, 9th April, 1938, pp. 661-667.

Australian Museum Field Trip to Northern Territory

Through the kindness of the Director of the Animal Industries Branch of the Northern Territory Administration, the Acting Biologist, Mr. K. R. Slater, invited the Museum's Curator of Reptiles and Amphibians, Mr. H. G. Cogger, Curator of Birds, Mr. H. J. Disney, and Curator of Mammals, Mr. B. J. Marlow, to visit the Northern Territory to collect specimens. Exceptionally good rain had fallen in some areas in early March, which gave promise of good collecting conditions during late March and April, when the Museum party was in the field.

Four major field trips were made with Mr. Slater, who is based at Alice Springs. These included Kings Canyon, an area north-east of The Granites, Palm Valley and the northern edge of the Simpson Desert.

Valuable specimens of mammals, birds and reptiles were collected for the Museum and interesting comparisons of the various habitats which were encountered were made.

Significant observations were made on the reproduction of insect-eating birds, and specimens of reptiles which were new to the Museum's collections were obtained. Several species of interesting mammals were trapped alive and brought to Sydney for further study.

The success of this field trip was largely due to the facilities and experience which were placed at the disposal of the staff of the Museum by Mr. Slater.

WHAT ARE GAS WORMS?

In the winter of 1964, an intriguing inquiry was received from the manager of a pastoral company in the Broken Hill area. While sinking deep bores for water, some worm-like animals (?) had been brought to the surface in gassy water, and our correspondent wanted to know if we could tell him anything about them. Unfortunately, none of the so-called "gas worms", which are apparently known to drilling contractors, was preserved and, although a lookout has been kept for them since, none has been seen.

Our correspondent also informed us in his letter that a drilling contractor (whose name he gives) once found small live minnows in gassy water removed from a test bore he was sinking in the Menindie area.

The occurrence of "worms" and fish in water coming up from bore holes is most interesting and it is important that any such animals should be preserved and labelled and sent to the Australian Museum for examination and identification. An appeal is therefore made to any land worker who sees any animal actually brought to the surface during bore-sinking operations to collect a good sample of them and to place them in methylated spirits or in a solution of formalin in water (7 parts formalin to 100 parts water), and to send them to the Museum with a note describing the circumstances. So little is known about the animals living in the soil spaces or underground water that even the smallest bit of evidence is important.

—*E. C. Pope.*

THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY

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The Australian Museum

The Museum is open free, daily, at the following times: Tuesday to Saturday, and public holidays, 10 a.m. to 5 p.m.; Mondays, 12 noon to 5 p.m. (during school holidays 10 a.m. to 5 p.m.); Sundays, 2 to 5 p.m. It is closed on Good Friday and Christmas Day.

To teachers and pupils of schools and other educational organizations special facilities for study will be afforded if the Director is previously advised of intended visits. A trained teacher is available for advice and assistance.

Gifts of even the commonest specimens of natural history (if in good condition) and specimens of minerals, fossils and native handiwork are always welcome.

The office is open from 9.30 a.m. to 1 p.m. and 2 to 4.30 p.m. (Monday to Friday), and visitors applying for information there will receive every attention from Museum officials.

College St., Hyde Park, Sydney

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Australian Museum Card

REG.NO.: **PUN4035** DATE: **14 Jun 2013**

ITEM: **DOMICILE stone**

GEOGRAPHICAL AREA[am locality ref]: **"East Sepik, Papua New Guinea"**

HOW ACQUIRED: **Donation** NAME(S): **Unknown**

ACQUISTION HISTORY: NAMES: ROLE DATE

OBJECT NAME CHANGE: **1 stone**

INDIGENOUS NAME OF OBJECT:

CULTURAL ASSOCIATION: NAMES: ROLE

RECORDS:

BIBLIOGRAPHY:

NOTES:

RESEARCH:

DESCRIPTIONS:

DIMENSIONS: Height: Length: Width: Weight:

Diameter: Circumference: Depth: Clothing Size:

PERMANENT LOCATION: **[P3-11-01-03]**