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OBSERVATIONS ON THE FAT-TAILED DUNNART IN CAPTIVITY

By S. R. WHITE, Government School, Morawa.

INTRODUCTION

The Fat-tailed Dunnart or Pouched Mouse *(Sminthopsis crassicaudata)* is a marsupial which should be better known to Western Australians than it is, for the original specimen was taken at Williams in 1844 and described and named by John Gould, the famous ornithologist. For over a century it has remained to most of those who come in contact with it as just a "field mouse." Few have regarded it as other than a slightly different form of an unpopular rodent pest. Its food habits suggest that it is a valuable ally of man, as a destroyer of insect pests and possibly of mice. It appears to be a marsupial that may have adjusted itself to the changed environment following on settlement, or at least found it temporarily favourable, and its usefulness should be publicised.

OCCURRENCE

The Fat-tailed Dunnart is not uncommon in the central Midlands and the northern Wheatbelt. It is most frequently seen during stone and root picking operations when its shelters are disturbed. Most local residents who know and can recognise the Dunnart consider that it has increased in numbers during recent years. This could be due perhaps, to a temporary expansion influenced by favourable seasonal conditions, for Prof. F. Wood Jones *(The Mammals of South Australia,* 1923, p. 115) says: "It is nowhere abundant, and its numbers in any given locality obviously depend upon season." On the other hand the clearing of land for agriculture, and its consequential effects, may have favoured the Dunnart, for both grasshoppers and ground caterpillars are relished as items of fare.

I found the Dunnart plentiful in certain areas of the Coorow and Waddi Forest districts in 1947. In April and May of that year five specimens were captured by the school children during root and stone picking operations. In 1950 other specimens were found at Morawa.

METHODS OF STUDY

The Coorow specimens were placed in a specially constructed out-doors cage for observation purposes. This was made of wire-gauze and antproofed by standing the legs in cans of water. They appeared to be thriving but after some weeks tragedy overtook the colony. They fought viciously, one being killed by its fellows and partly eaten, and two died as the result of the injuries sustained. The remaining two were liberated.

The second attempt at studying these marsupials was made at Morawa when a single male was placed in an observation box on June 10, 1950. At the time of writing, over six months later, it is apparently in a good state of health. The cage measures 22 in. by 16 in. and is 15 in. high. It is fitted with a sand tray floor. Two sides are of wire gauze and two are of glass. The top is open but a wide ledge prevents the animal from escaping. A nest box 8 in. by 4 in. by 4 in., with a moveable lid and a hole 1¼ in. in diameter at one end, provides shelter from light and is a convenience for nesting.

Observations were carried out at night with the aid of an electric torch. All of the photographs were taken with a flashlight apparatus.

BEHAVIOUR

Captured Dunnarts were at first extremely timid. They crouched with ears flattened to the head and quickly sought concealment inside the small boxes provided for the purpose.

The animals were never observed outside these nest-boxes during daylight hours—unless disturbed by examination. Illumination from the electric flash, such as during photography, did not, however, disturb the animals unduly, provided the beam was held steady, but they were extremely sensitive to the slightest sound or movement. The Dunnart at present in captivity shows the same characteristics. It is housed in a room equipped with electric light. When this is switched on at night it will continue its activities without interruption, provided there is not too much noise or movement, but I have never seen it on the move during the day.

Wood Jones' description of it (*l.c.*, p. 111), as "a savage and alert-looking little animal" is apt. The extraordinarily large eyes and conspicuous ears help to emphasise its nocturnal habits. Its whole demeanour, including the hesitant forward movement with one foreleg raised, and the upright "prop," suggests its alertness. It can move with incredible speed when it wishes to.

Locomotion at top speed when the animal is in the open is accomplished by means of rapid kangaroo-like bounds; over short distances it has a peculiar quadrapedal amble (Fig. 4) and the tail is held in a stiff upward curve above ground. The Dunnart

Fig. 1.—Fat-tailed Dunnart; the ears are flattened when the animal is alarmed.

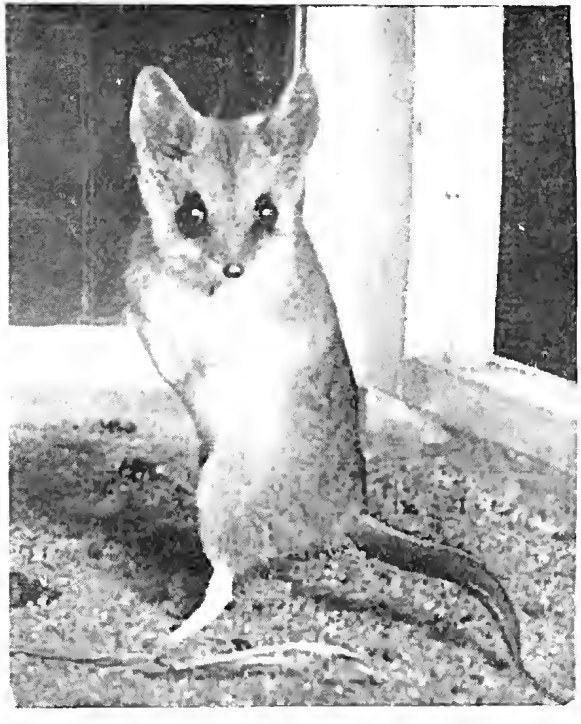

Fig. 2.—The tail being used with the legs as a "tripod" to raise height and increase the range of vision.

can jump on to obstacles six inches high within its cage with apparent ease and it is a remarkably agile climber. Mr. L. Glauert, of the W.A. Museum, who has also kept Dunnarts in captivity, has noted this ability but, strangely, it has not been commented on by other writers. Ellis Troughton *(Furred Animals of Australia*, 1941) says: "They are terrestrial and live in holes amongst rocks, under logs, or in the ground, and in the hollows of logs and fallen limbs, or in heaps of debris." All of the animals observed by me in the wild state were found in situations similar to these; nevertheless their ability to climb freely suggests that this capacity may be employed in food-gathering.

In positions of rest, alarm or curiosity, the tail is a highly important unit. It acts as a "prop" and with the two hind legs gives a "tripod" support which must considerably increase the animal's range of vision when it stands at full height (Fig. 2).

NESTS

All of the Dunnarts constructed snug nests for themselves inside the shelter compartments in the cage within a few days of capture. Grass, leaves and pieces of wool thrown into the cages were used. Although I watched on several occasions with the purpose of finding out, I could never discover how this material was transported. It would have been of considerable interest to observe whether the highly flexible and sensitive tail was used.

When sufficient material had been provided the nests assumed the form of a loose ball with no defined exit or entrance. The animals curled up snugly inside the debris. Despite the provision of two nest boxes during the brief period when all five individuals were kept at Coorow, they showed a preference for "bundling," the five clinging together in a ball. This feature has been noted in the wild state also and Troughton *(l.c.)* tells of a native at Namoi, New South Wales, who said he found as many as five in a single nest.

A peculiarity noted in the animal at present under observation at Morawa, and now in its seventh month of captivity, was the loss of the nest-building urge. During the first few months whenever a nest was removed it was immediately reconstructed. After September, however, grasses have not been taken into the box. This might be due to the effects of confinement and artificial conditions, but it suggests a normal behaviour pattern referred to by Charles Barrett *(An Australian Animal Book,* 1947, p. 33) who says it "uses its nest in winter-time, usually deserting it in summer for a shelter among stones."

FEEDING

Captive animals watched by me readily accepted grasshoppers, caterpillars and small lizards. When these were not available they took finely cut raw meat and sheep's heart, small quantities of

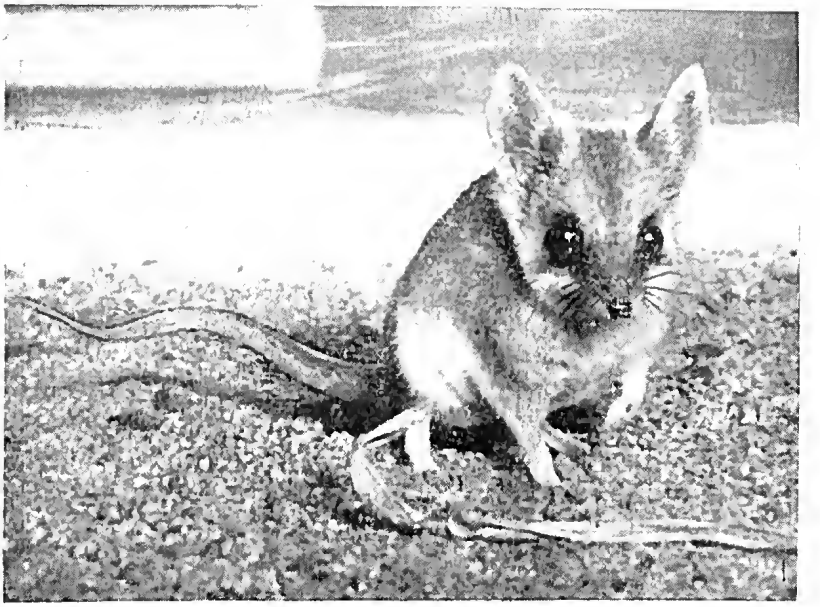

Fig. 3.—Typical alert stance with one forepaw raised.

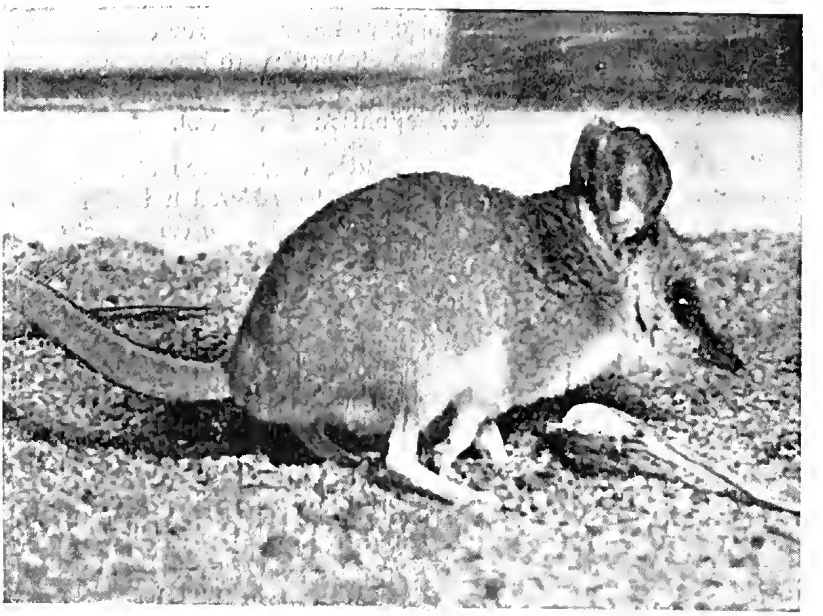

Fig. 4.—The shuffling amble with tail held well above ground.

Photos S. R. White.

cheese and hard-boiled egg yolk. Other foods, including cooked meats, sweet foods and cakes, were tried without success.

On one occasion when caterpillars were plentiful a single hairy specimen was introduced with a number of others. The same hairy caterpillar was a sole survivor each morning for a week until its removal despite the fact that as many as forty of the smoother kinds were consumed in a single night.

The method of dealing with a caterpillar was both simple and swift. The larva would be raised lightly in the forepaws and manipulated into position. The head was bitten off quickly and the remainder consumed at leisure. With all forms of live prey the head was first attacked. The legs, wings and harder portions of grasshoppers were discarded.

H. H. Finlayson *(The Red Centre,* 1935), illustrates a closely related desert form, the Nilee. The following caption is given: "A little carnivorous marsupial, *Sminthopsis crassicaudata centralis,* that follows and preys upon the mice hordes during rodent plagues." This indicates the ability of the fierce little predator to cope with comparatively large forms of prey.

HYGIENE

The ritual of personal hygiene is always a fascinating procedure to watch. It follows each meal. Forepaws are employed in a characteristic feline-like "face-washing." The fur on the head, face, fore-paws and underparts are cleansed with great care. Hind legs are used for body-scratching and frequently the process is completed with an elaborate examination of the tail.

Within the nest box one particular corner was always used for depositing the faeces. The animal also showed a tendency to convey its prey or food to a particular site before commencing to eat.

ADDENDUM

Since the preceding notes were written, the Morawa Dunnart has continued to thrive and has now been in captivity for over 12 months. In January 1951, its fur appeared to be in very poor condition, and a large patch on the back, extending to the base of the tail, had moulted. By the end of April the fur had completely re-grown and the tail had fattened considerably.

Several additional animals were obtained in May 1951, from Morawa, Pintharuka, Merkanooka and Mullewa. The tails of these animals at the time when they were taken in no case exceeded in size that of the captive animal although they developed rapidly. Only four Dunnarts have been retained, including the original male. They have been paired off in separate observation cases and both pairs have constructed grass nests.

THE NATURAL HISTORY OF THE MARRON AND OTHER FRESH WATER CRAYFISHES OF SOUTH-WESTERN AUSTRALIA

By BRUCE SHIPWAY, South Perth.

PART 1.

1.—INTRODUCTION.

At the request of the Superintendent of Fisheries (Mr. A. J. Fraser), and financially assisted by a grant from the Commonwealth Science and Industry Endowment Fund, the writer is conducting an investigation into the bionomics of the Marron. This creature, from the economic point of view, is the most important fresh water crayfish in Australia. It is still plentiful, and its extremely palatable flesh is considered by many to be superior in flavour and texture to the marine crayfishes. Experiments in preservation of the flesh resulted in a pack which was less dry and stringy than its marine equivalent.

The edible portion, the abdomen (or "tail") is larger in proportion to the rest of the body, the carapace, than in the other species of large fresh water crayfish which occur in Australasia.

2.—SPECIES AND IDENTIFICATION.

At least three distinct species of fresh water crayfish are positively known to occur in South-western Australia. To most people fishing for these crustaceans the large specimens are known as Marron and the small ones, indiscriminately, as Jilgies. The aboriginals, from whom we adopt the vernacular names, were, however, well aware of three separate species, and called the third Koonac.

It is not my intention to enter on a detailed discussion into the correct nomenclature of these species, and the names used by A. R. McCulloch (1914) have been adopted, as these are in most general usage. Anyone desirous of studying the systematics of the group will be confronted with a considerable literature on the subject not readily accessible.

The three Western Australian species mentioned afford an illustration of the serviceability of the native names: *they* have remained constant, whereas the scientific appellations have been changed in nearly every review of the species.

All three are members of the genus *Cheraps** Erichson (1846) and for them McCulloch accepts the names, *C. tenuimanus* Smith (1912), the Marron; *C. quinquecarinatus* Gray (1845), the Jilgie; *C. preissii* Erichson (1846), the Koonac with its doubtful sub-species *C. preissii angustus* McCulloch (1914).

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*The "correction" by E. Clark (1936) of this name to *Cherax* is an ultra-zealous and scarcely warranted application of the "original spelling" rule and the reasons given are hardly sufficient to dislodge a well-established name.

Some workers, notably G. W. Smith (1912), report a fourth species occurring in South-western Australia—*Parachaeraps bicarinatus* (Gray, 1845),* the Yabbie. However, the Western Australian Museum has no record of its presence in this State.

The following is a simplified key for the field identification of the fresh water crayfish of South-western Australia. The Yabbie has been included, on the remote chance that it might possibly be found as an inland species or in the streams that occur east of the known range of the Koonac.

Marron, *Cheraps tenuimanus. Five* ridges or keels on the back of the head. These include those forming the sides of the rostrum, or spike, on the front of the head. *No mat of fine hairs* on the upper surface of the inner portion of the hand (carpus).

Jilgie, *Cheraps quinquecarinatus. Five* keels on the back of the head as above. *A mat of fine hairs* on the upper surface of the inner portion of the hand.

In some instances the tomentose patch on the great claw of the Jilgie may be worn to such an extent as to be visible only under a lens. In these cases an additional means of identification is the number of serrations or teeth on either side of the rostrum. The Marron possess *three or more,* the Jilgie *less than three.*

Koonac, *Cheraps preissii. Four* ill-defined keels on the back of the head. *A mat of fine hairs* on the upper surface of the inner portion of the hand. Distance between the tip of the rostrum and the cervical groove (the deep groove that divides the carapace into two portions) *twice* that between the cervical groove and the posterior margin of the carapace.

Yabbie, *Parachaeraps destructor.* Four keels as above, *a mat of fine hairs* on the upper surface of the inner portion of the hand. Distance between rostrum and cervical groove *one and a half* times the distance between the cervical groove and the posterior margin of the carapace.

3.—DISTRIBUTION.

The precise original habitat of each of the three species cannot now be determined owing to indiscriminate introductions by persons unaware of the fact that there are three species. The Koonac was frequently introduced in the belief that it was the Marron. The

*The type locality of *bicarinatus* is stated to be Port Essington, but Glauert (1947) has pointed out that this is an error of labelling. There is no doubt that the type came from South-western Australia and was a Koonac. Unfortunately the name *bicarinatus* later became associated with the eastern States' Yabbie, for which Clark has proposed *destructor* as a replacing name. Thus the prior name for the Koonac is *bicarinatus* and not *preissii,* but I would suggest that the International Commission on Zoological Nomenclature place the name *bicarinatus* on a list of *nomina rejecta,* because its future employment for the Koonac is likely to cause endless confusion, as it has long been in use for the other related but separate species.

writer has found all three speeies in the same watereourse, the Serpentine River.

As yet, little is known of their respeetive eeologieal preferenees.

The Western Australian Museum has speeimens or reeords from the following loealities:—

Marron: Rivers of the South-west from the Harvey and Collie in the north to the Hay River in the south-east (Mt. Barker distriet), and the King and Kalgan Rivers near Albany. It is known also from the Carrolup Brook, Correealup and Gordon Rivers. Introdueed (date unknown) into the Murray, Serpentine and Canning Rivers, and has spread to the Swan River where it has been reeorded at Guildford.

Jilgie: Yanehep, Chidlows, Gingin Brook, Moore River, Avon River system, Helena River, Mundaring, Canning River, Serpentine River, Englehope, Harvey River, Vasse River, Yallingup Brook, Cranbrook.

Koonae: Guildford, Cannington, Jarrahdale, Harvey River (in billabongs), Katanning, Broomehill, Stirling Range, Tambellup, Williams River, Darkan, Kojonup, Busselton distriet, Manjimup, Calgardup Cave, Mammoth Cave, Gnowangerup, Ongerup (in salt water in a roek hole), Albany distriet in swamps.

Marron and Jilgies are only known from permanent waters, but Koonaes are frequently found in swamp lands where they have deep burrows to the water table. Koonaes found in peat swamps are blue in eolour but otherwise are similar in strueture and do not warrant sub-speeifie elassifieation.

4.—METHODS OF CAPTURE.

Two methods are in popular use for eapturing Marron, the snare and the drop net.

The first, the snare, calls for little equipment but a great deal of eare and patienee. A thin stiek is eut of a length great enough to reaeh to the bottom of the pool to be fished. To one end of the pole is fastened a flexible wire, usually bronze pieture wire, and a running noose fashioned in the free end of the wire. The loop so formed is enlarged to three or four inches in diameter. Baits, eommonly of raw meat, are lowered into the water, by means of a length of string, at various suitable loeations and allowed to remain on the bottom.

The fisherman then moves around from position to position examining his baits, using a powerful lamp if it is after dark. When a worthwhile Marron is seen feeding at one of the baits the stiek is pushed down into the water and the wire loop carefully manoeuvred over the erayfish's telson until it reaehes the earapaee, when a quiek pull tightens the noose and the victim is hauled to the surfaee.

What is considered the less sporting way of making a eateh is by the use of drop nets. These are fabrieated from two heavy

gauge wire hoops, two to three feet in diameter, suspended one above the other with the vertical side and the bottom covered with fish net. A bait, which varies with the individual fisherman's idea of what might attract a Marron, is tied or fastened to the centre of the lower hoop, and the net lowered into the water from a convenient log or overhanging bank. At intervals the net is hauled rapidly to the surface, the catch removed, and the net replaced in the water.

The drop net method undoubtedly catches more crayfish than the snare but entails carrying bulky equipment to the scene of operations, sometimes for considerable distance through dense scrub.

Fixed traps or conventional craypots are not used to any extent owing to transport difficulties and concealment of their whereabouts when set.

There are no restrictions at present on the size of Marron that may be caught, nor any close season. There is, however, a prohibition on the sale of Marron, or any other fresh water crayfish, by other than licensed fishermen.

5.—HABITS AND FOOD OF THE MARRON.

Jilgies and Koonacs can survive longer periods out of water than Marron, and also weather worse water conditions. Marron show signs of distress when the dissolved oxygen present in the water drops to 2.0 p.p.m. and die when it is reduced to 0.9 p.p.m. Marron have been kept alive several months in water containing only 4.0 p.p.m. of dissolved oxygen.

During these experiments it was noted that a native fish *Nannoperca vittata,* used as a control, was unharmed when the oxygen deficiency fell to the lethal point for Marron.

Marron will die more rapidly in oxygen deficient water than if they are completely out of the water. They will survive for more than 24 hours when wrapped in a wet bag, the popular way of keeping them alive while awaiting the pot. Tolerance levels of salinity and temperature are yet to be determined, but indications go to show that temperature is dependent on oxygen saturation point.

During heavy rains following bush fires large numbers of Marron leave the water to fall victims to predators such as water rats, birds, etc. Kookaburras have frequently been seen by the writer catching small Marron and other species, then flying off to a tree and smashing them up by hitting them against a limb.

Marron inhabit the lower reaches of the rivers and are not normally found in the very small feeder streams in any quantity or at any large size. They are most commonly found in pools and streams with a mud or silt bottom and do not have the burrowing tendencies so strongly developed as the Jilgie or Koonac. They seem more content to seek shelter under logs or stones in the bed of the streams. Although primarily nocturnal creatures they may frequently be seen in daylight foraging in an endeavour to satisfy their rapacious appetites. Food values are low in the South-western

streams and the competition intense within the relatively dense populations of crayfish.

There are many references in literature to the diet of fresh water crayfishes. Millet (1870) states that the European *Astacus fluviatilis* feeds during the night on vegetable matter, insect larvae, molluscs, and dead and decaying creatures that have fallen into the water. Huxley (1880) adds that few things in the way of food are amiss to the crayfish, living or dead, fresh or carrion, animal or vegetable. His statements that calcareous plants, such as *Chara*, are highly acceptable, would not seem to apply to the Marron, or to any of the other South-western crayfishes, as species of the Characeae are almost the only true aquatic plants flourishing in the streams and pools densely populated by them. Experiments by the writer in this and other States have shown that crayfish are particularly destructive, however, to any of the flowering aquatics such as *Elodea, Hydrilla, Vallisneria, Sagittaria,* etc., well-rooted plants being cut off close to the ground and the leaves chopped into pieces. They have been seen to eat the plants and algae in aquaria. This habit of the crayfish might have contributed to the almost complete lack of flowering aquatic plants in the South-west streams.

Ellen Clark (1937) has fed Australian species on earthworms and scraps of meat but does not state for what period they have been kept alive or whether they have bred successfully on this diet.

In a pond at the Pemberton Trout Hatchery, with water flowing through continually at the rate of 50 to 100 gallons per minute, the writer has kept individuals under observation for a period of 12 months, but none have survived longer.

The water in the pond carries a considerable quantity of fish excreta and the crayfish have been given such trout that died in the main ponds. The stomachs of these were torn out by the crayfish and in the majority of cases the remainder was ignored. Dead crayfish have also been partly consumed.

The Marron is also reported as being found at night, out of the water, feeding on bran and pollard mixtures in domestic fowlyards, and also feeding on the remains of cattle and sheep which had perished when bogged at the water's edge.

During the cleaning of the small pipe-head dam at the trout ponds a Marron was caught which had partly consumed a larval lamprey (Ammocoetes) about 10 cm. (4 in.) in length. The remaining half was still protruding from the Marron's mouth parts. The specimen was killed and preserved in this condition. The streams in the Pemberton district abound with Ammocoetes larvae of lampreys which live in the terrigenous silt, and it is probable that the Marron capture a number of these.

Marron kept in glass aquaria have been seen using the posterior ambulatory limbs to rake ova off their swimmerets, and then to eat them. The males have also been seen to eat any eggs which had become detached from the females' swimmerets.

There has been considerable controversy regarding possible depletion of the Marron stocks by the introduction of a large exotic carnivore such as the Trout. Observation of both creatures, so far, leads the writer to believe that the opposite is more likely to occur. Trout, Perch *(Perca fluviatitis)*, Callop *(Plectroplites ambiguus)*, Murray Cod *(Maccullochella macquariensis)*, Carp *(Carassius auratus)* and other fish have been released in various streams throughout the South-west since 1890, but, unless the stock is maintained artificially, the species tend to disappear, and only occasional specimens caught.

The Marron, together with the Koonac and Jilgie, appear to be the successful competitors for the scanty food supplies in the South-western streams. Crayfishes, with their method of feeding by exploring the detritus on the bottom with their chelate limbs and with their ability to move fairly large stones and other debris with their great claws, can capture a large number of insect larvae and other water creatures that fish, particularly trout, would take in their free-swimming or emergent stages only.

Stomachs of trout occasionally contain the remains of crayfish, but since the trout captures its food mainly by sight, and the crayfish is primarily a noeturnal creature, the number of Marron destroyed by trout is probably considerably less than that removed by other predators. In New Zealand where natural food values are considerably higher, Mr. G. Stokell informs me he has found crayfish in the stomachs of three trout only in the several thousand examinations he has made.

If unrestricted fishing depletes the stocks of large Marron, leaving only small and immature creatures, the above statements may have to be reviewed.

As far as has been observed the Marron do not display aggressive tendencies towards each other or other species. The use of the great claws apparently is confined to moving large objects, defence, and the carrying of food particles too large to be consumed on the spot.

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(To be continued)

REPORTS OF EXCURSIONS

LAKE COOLOONGUP (or White Lake)

On May 6, 1951, the W.A. Naturalists' Club paid a visit to Lake Cooloongup, east of Rockingham. This and the lake further south are commonly known as White Lake and Salt Lake, respectively, but it is better to replace these indefinite names by the old native ones, Cooloongup and Walyungup, which have been adopted by the Army in the new military maps.

Lake Cooloongup was at a low level but not as low as it had been a month earlier. The abnormal April rains had caused a slight rise in the water table. A water sample collected was analysed by Mr. A. Middleton of the C.S.I.R.O.; the chlorinity was 5.14 parts per thousand (equivalent to 300 grains per gallon); phosphate phosphorus, 17 parts per thousand million; nitrate nitrogen, none.

The lake is bordered with rushes and its bed is composed of a marl which causes the lake to appear white when the water is shallow. On the dried out shoreline, in the rushy zone, were found the dead shells of the pond snail, *Lenameria proteus* Reeve, often in vast aggregations. Further in, on the bare lake bed, were the shells of *Coxiella confusa* Smith. Specimens of both were sent for identification to Mr. B. C. Cotton, of the S.A. Museum. He reported that those of *Lenameria* were typical of this very variable Western Australian species, ranging from fusiform and elongate to short and angular. The *Coxiella* were identical in shape, size, sculpture and aperture with South Australian specimens of the species.

At the southern end of the lake the rushy flat runs right up to the Safety Bay road and Lake Walyungup. This flat must be covered in water most winters and in odd seasons is possibly wet through the summer. Patches of rushes had been burnt recently, exposing several burnt carapaces of the Long-necked Tortoise *(Chelodina oblonga)* and the exoskeletons of Jilgies *(Cheraps quinqueearinatus)*.

Under rocks at the water's edge were collected several small amphipods. Small fish were present, probably the introduced *Gambusia affinis*.

Water birds were fairly plentiful. Around the shore on the west side were seen 16 Little Stints, a Red-capped Dotterel, 4 Greenshanks and a Little Pied Cormorant. The main observations, however, were made from near the main road on the east. From here were seen a flock of 50 or more of Hoary-headed Grebes, with some Crested Grebes, over which were flying some Marsh Terns (?)—apparently a mixed feeding flock. A number of Marsh Terns were also on their own. Two Blue-winged Shovelers were seen in female plumage—possibly a pair. A number of Grey Teal, numerous flocks of Coots, about 40 Black Swans and odd Hoary-headed Grebes were present. Besides these there were a considerable number of unidentified birds in the distance which were probably mostly Musk Ducks and Blue-billed Ducks. On the shoreline were a number of White-faced Herons and 4 White Egrets.

Generally bird life in the surrounding bush was at a low ebb. Honeyeaters were noticeably absent—they are so plentiful here when the *Templetonia* and *Dryandra* are in flower. The only flowering tree seen was the swamp banksia. In the sand hills on the western side the only birds met with were the Yellow-throated (Dusky) Miner, Brown Thornbill, Black-faced Cuckoo-Shrike, King Parrot, Twentyeight and Western Rosella.

In the afternoon the members covered the whole eastern side of the lake from the shore to the top of the first sand hill. In places the sand hill was covered with a very dense *Acacia* thicket while in addition to the tuarts, which were present on the western side, there were many jarrah and zamia palms. It was different from the open country of the west. This forest country was carrying a number of birds, the commonest being the Brown Thornbill. A Fantailed Cuckoo was seen in the *Acacia* thickets and was also heard calling. A male Mistletoe-bird was seen and a Rufous Whistler heard. Other birds noted were the Magpie, Splendid Wren (in female plumage only), Raven, Yellow-tailed Thornbill, Grey Fantail (singing), Willie Wagtail, Red Wattle-bird, Silvereye, Scarlet Robin, Western Warbler, Kookaburra and, near the lake, the Magpie Lark.

Two juvenile Stump-tailed Lizards *(Trachysaurus rugosus)* were found, one 7½ and the other 8 inches in length.

—A. H. ROBINSON.

A NEW VARANUS FROM EAST KIMBERLEY

Varanus mertensi sp.n.

By L. GLAUERT, W.A. Museum, Perth.

A slender species with well developed limbs and claws suitable for climbing.

Width of the head twice in the length, the height behind the eyes twice and one half times in the length; temporal region swollen, snout long and slender, depressed at the tip, as long as the distance from the anterior angle of the eye to the ear; canthus rostralis obtuse, slightly arched over the nostril which is nearly twice as far from the eye as from the tip of the snout. Nostril oval.

Limbs long and slender, the adpressed limbs overlap by the length of the hand. Tail long, compressed for the greater part of its length with a distinct double dorsal crest; length of the tail about 1.4 in the head and body.

Scalation.—Scales on the top of the head, large, flat and smooth, many bearing pustules, irregular in outline, largest between the eyes and around the interparietal, smallest on the snout; supraoculars about as large as the head scales with the central series of slightly larger transverse scales tending to become differentiated; temporals small but larger than the nuchals. Scales on the dorsal surface of the body small, oval, convex and smooth, becoming elongated towards the tail where they are distinctly

keeled. Ventrals smooth, larger than the dorsals, in about 120 rows from the gular fold to the insertion of the hind limbs. Scales on the tail keeled except near the base below where they resemble the ventrals, about 160 in a ring near the base of the tail, some rings incomplete as the subcaudals are slightly larger than the dorsals, a distinct double dorsal crest. Limbs with scales on the upper surface faintly keeled and larger than the smooth one on the inner surface. Digits long and slender with curved claws.

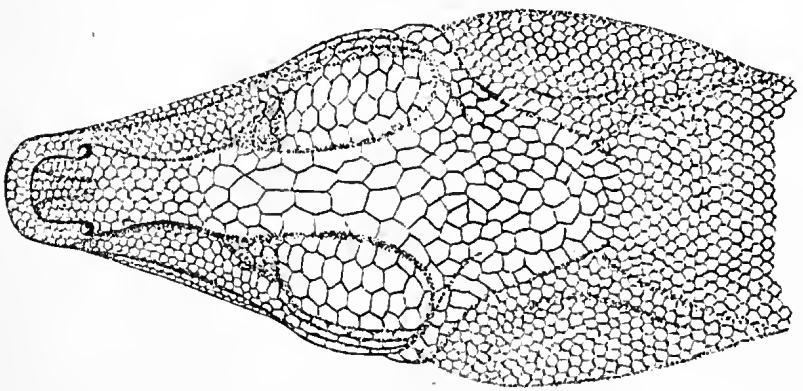
Colour.—(in spirits). Head olive brown, many scales blotched with white, chin and throat cream, immaculate. Body brown above with numerous blackish spots most of which have a white centre about the size of an individual scale scattered irregularly over the back and sides, but arranged in rings on the proximal half of the tail and on the outer aspect of the limbs. Lower surface and inner aspect of the limbs cream with dark spots, under surface of the tail near the vent similar, the rest unspotted.

Measurements.—(on account of the condition of the specimens these are only approximate). Total length, 315 mm.; head and body, 130 mm.; tail, 185 mm.; head length, 29 mm; head width, 15.; head height between eyes, 9.5 mm.; fore limb and claw, 35 mm.; hind limb and claw, 48 mm.; fourth digit of hind limb, 15 mm.

Locality.—The holotype, R5819, was obtained on Moola Bulla Cattle Station near Halls Creek, East Kimberley, by Mr. H. W. Hall, who presented it to the W.A. Museum on February 20, 1936.

Relationships.—The species is closely related to *Varanus indicus* from which it differs in the position of the oval nostril, the scalation on the top of the head with the slightly differentiated supraoculars, whilst the scales on the tail with few exceptions form complete rings. From all other Western Australian species it is easily separated by the large flat scales on the top of the head.

I have pleasure in associating this lizard with Dr. Robert Mertens, whose monograph on the family ("Die Familie der Warane (Varanidae)", *Abh. senckenberg. naturf. Ges.*, 462, 465, 466, 1942) has been of the greatest assistance.



Head of *Varanus mertensi*, sp. n., x 3.

—O. Seymour, del.

KEY TO THE WESTERN AUSTRALIAN SPECIES

A. Tail laterally compressed for the greater part of its length.

a. Distance from the tip of the snout to the nostril more than half that from the nostril to the eye; scales on the head very small, larger than the supraoculars, not larger than the temporals, 122-147 smooth ventrals ..... *gouldii* (Gray).

b. Distance from the tip of the snout to the eye about half that from the nostril to the eye.
a1. Scales on the head large, irregular in outline, supraoculars differentiated, almost as large as the head scales ..... *mertensi* sp. n.

b1. Scales on the head small, regular, supraoculars small not differentiated.

a2. 118-135 slightly keeled ventrals, fourth toe of the hind foot with a row of enlarged scales forming a comb ..... *varius* (Shaw)

b2. 150-155 smooth ventrals, no comb on fourth toe ..... *giganteus* (Gray)

B. Tail with basal portion not compressed.

a. Keels on the caudals projecting backwards to form sharp spines ..... *acanthurus* (Blngr.)

b. Keels on the caudals not forming sharp spines.

a1. Tail shorter than the head and body constricted at the base ..... *brevicauda* (Blngr.)

b1. Tail longer than the head and body not constricted at the base.

a2. Scales on the top of the head keeled *eremius* (Lucas and Frost)

b2. Scales on the top of the head smooth.

a3. Scales on the top of the head large, irregular in outline, supraoculars differentiated ..... *semiremex* (Peters)

b3. Scales on the top of the head, small, regular, supraoculars not differentiated.

a4. Scales on the top of the thigh keeled. Two groups of spines at the base of the tail laterally.

a5. Back with 10-12 dark cross bands. *timorensis scalaris* Mertens

b5. Back with light ocelli *timorensis tristis* Schlegel

b4. Scales on the top of the thigh smooth, no groups of spines at the base of the tail, laterally.

a6. 62-74 ventrals, head and body spotted. *caudolineatus* (Blngr.)

b6. 82-90 ventrals, head with linear marking. *gilleni* (Lucas and Frost)

FROM FIELD AND STUDY

Murchison River Snails.—The R.A.O.U. camp held at the mouth of the Murchison River in 1948 has stimulated three articles in the *W.A. Naturalist* since the original report appeared in *The Emu*, vol. 48, 1949, p. 212, so, in an endeavour to make the published results of the survey even more complete, I place on record the following observations:

Two species of land molluscs were collected near the camp site. These were identified by Mr. L. Glauert as *Bothriembyron costulatus* (type locality, Sharks Bay) and *B. minor* (type locality, Dirk Hartog Island).

Dead shells of *Bothriembyron* were in evidence at Red Bluff, four miles to the south of the river, and a number of live shells were found by uprooting small shrubs and searching among the roots. These were identified as *B. costulatus.*

—ERIC H. SEDGWICK, Leonora.

Introduced Land Snails at Esperance.—Further to the various reports on this topic *(W.A. Naturalist,* vol. 2, pp. 38, 119 and 167), I have the following additional information.

Helix pisana, though occurring plentifully in the Esperance area to a distance of over a mile inland from the sea, is totally absent from the islands of the Recherche Archipelago. On the mainland it occurs in conjunction with a local species of *Bothriembryon.* It will be interesting to witness the effects of competition between the two species.

Also found at Esperance was the Dune Snail, *Cochlicella acuta.* This was found only in one garden, that of Mr. E. Paton. The species had the same habit as in *Helix pisana* of clustering on the top of fence posts or sticks. Several thousand individuals were present. At the time (February 28, 1951) the conditions were fairly humid with some showers and many of the snails were active. However, Mr. Paton informed me that they were not a very serious pest as far as gardening was concerned.

—V. N. SERVENTY, Subiaco.

Young Butcher-bird with Giant Moth.—At Point Peron on January 27, 1951, the behaviour of a young Grey Butcher-bird *(Cracticus torquatus)* in its endeavour to dismember a giant moth came under the notice of Mr. Eric Schmidt and myself. We did not know if the huge insect had been brought to the young bird by one of its parents, both of which were about, or if it had made the capture itself. Our interest centred in the method by which it was attempting to pull it to pieces.

It was attacking the problem on a sloping platform of tangled branches at the edge of the scrub, and the procedure was to wedge the insect in a fork or other suitable place, and then pull at the

wings in an effort to tear them off. Time after time while we watched, the moth was dragged from the hold without the desired result, when it was immediately taken up and wedged in some other place. Once it slipped and began to fall, but the quick-footed bird went after it and caught it in its bill. Only a small measure of success was achieved when, alarmed by an increasing number of spectators, the bird suddenly took up its booty and flew off.

A young Magpie would have held the insect down in its foot while pulling it to pieces. The procedure followed by this young Butcher-bird appeared to be in line with the larder-stocking habit inherent in its kind.

—W. H. LOARING, Bickley.

Pallid Cuckoo Report, 1950.—Many voluntary observers have co-operated during 1950 in the survey of first calling dates of the Pallid Cuckoo.* The first date quoted for each locality during 1950 was as follows:—

April
10—South Perth
12—Mogumber
16—South Bunbury (?)
22—Tenindewa (seen only)
23—Bunbury
25—Bejoording (?)
26—Wilray (seen only).

May
13—Thomsons Brook (Donnybrook)
15—Maida Vale (seen only)
25—Mount Kokeby
28—South Coogee

June
6—Wickepin (seen only)
17—Maida Vale
24—Donnybrook
26—Bassendean

July
3—West Pingelly
6—Cookernup
9—Pintharuka
9—Wagerup (Harvey)
10—Harvey
11—Bayswater
12—Nedlands
16—Bunbury (other observer)
17—Buckingham (Collie)
18—Dunsborough
22—Redmond
27—Pinjarra

August
4—Shotts (Collie)
6—East Guildford

It will be noticed that several early records are either uncertain, or based on sighting only. The very early dates quoted for South Perth and Mogumber are very interesting—there was an inrush of tropical maritime *(Tm)* air on April 10, and this might perhaps partly explain the early call of the bird, because of the greatly increased humidity brought by this type of air. On the other hand, there was an outstanding inrush of *Tm* air on May 9 and 10, and yet the only call record in that period dates from May 13, at Thomsons Brook near Donnybrook.

It might be desirable to observe all instances of Pallid Cuckoo calls during 1951, and not the first calls only, in order to find out whether any weather situation has any effect on the bird.

—J. GENTILLI, Nedlands.

*The 1949 report appeared in the *W.A. Naturalist,* vol. 2, 1950, p. 59.

Blue-breasted Wrens at Mosman Park.—In the *W.A. Naturalist,* vol. 2, 1950, p. 108, Mr. W. H. Loaring has presented some interesting data on the extending of the recorded range of the Blue-breasted Wren *(Malurus pulcherrimus).* By 1950 its presence had been established from the mouth of the Murchison River to as far south as Scarborough.

Now, in May 1951, it inhabits the scrub-covered sand dunes near the Cable Station, Mosman Park. Possibly it has been there many years, but it is my first personal encounter with any kind of wren in the Mosman district. These birds are not shy. A pair, the male in full plumage, popped out of a dense clump of *Scaevola*, about 10 feet away from us, and with Wagtail fearlessness, remained to look us over. Before they casually skipped into the next clump we had a perfect opportunity for observation. Mr. Loaring has given a very full description of the Blue-breasted Wren and I will simply add that I received the impression that the male was the smaller of the two birds, but this could have been an illusion due to colour differences. Though these were the only birds seen, the air was full of wren call notes, indicating a good population in the neighbourhood.

If this apparent extension of range is due to a general southward movement, it will be interesting to see just how long this very beautiful bird will take to negotiate Fremantle harbour and its surrounding industrial and residential areas without the friendly protection of the dunes.

—(Mrs.) J. LYON, Mosman Park.

Bird Counts From a Motor Car in the South-west.—In October, 1950 a motor drive was made through the South-west. Upon a suggestion by Major H. M. Whittell, of Bridgetown, a count was made of the frequency of the Kookaburra *(Dacelo gigas)*, in order that some idea be gained of its increase since its original introduction into Western Australia in 1896. Certain other species were also counted for comparison, all observations being made from the front seat of the car. The information is tabulated according to the following sections:—

October 16:

A. Pemberton to Manjimup, 21 miles.
B. Manjimup to Bridgetown, 23 miles.
C. Bridgetown to Donnybrook, 37 miles.
D. Donnybrook to Picton, 21 miles.

October 17:

E. Picton to Harvey, 27 miles.
F. Harvey to Pinjarra, 37 miles.
G. Pinjarra to Armadale, 37 miles.

Total distance, 203 miles.

Species	A.	B.	C.	D.	E.	F.	G.	Total
Dacelo gigas	2	6	4	3	5	9	1	30
Halcyon sanctus	—	—	1	4	2	1	—	8
Cractieus torquatus	—	—	1	3	4	1	3	12
Gymnorhina dorsalis	—	4	11	4	3	24	5	51
Total	2	10	17	14	14	35	9	101

The times of the day during which the counts were made were as follows:—Sections A to D, 1500 to 1800 hours; sections E to G, 1100 to 1530 hours.

—BRIAN GLOVER, Mitcham, South Australia.

Paper Nest Wasp at Bickley.—Since the discovery of the Paper Nest Wasp *(Polistes variabilis)* in the metropolitan area about a year ago *(W.A. Naturalist,* vol. 2, 1951, p. 169) the spread of the insect has come under extensive comment. It was with surprise, nevertheless, that I found a nest attached to a lemon tree in my orchard at Bickley on February 23 this year (1951).

This was quite small, barely two inches in diameter, but some of the grubs were already full grown. Here and there in the centre of the nest one could be seen spinning a cover to its cell, while some cells were already closed with a cap of silk. Numbers of the outer cells still under consideration were each seen to contain a grub, these obviously being built out as need arose to accommodate the growing inmate, an arrangement that assured capacity stocking of the nest while building proceeded. Incidentally, feeding of the small grubs is facilitated while they are housed in these unfinished cells.

Presence of the wasps led to the discovery that patches of outer bark up to half an inch in diameter had been removed from the branches of a number of lemon trees. Some of these scars were comparatively old, others fresh. The wasps have not been seen taking this bark, but as removal of it continues as the nest is enlarged, it seems likely that this is where they are obtaining the raw material for building.

At the time of discovery only nine or ten wasps were seen about the nest during the day, but 14 were counted on it by the aid of a torch at night. At the present time (early April) emerging insects have swelled the total to fully 30. None of these appear to be less than three-quarters of an inch in length.

In passing, some of their more conspicuous habits are interesting. It has been noticed, for instance, that incoming wasps with jaws crammed with building material not infrequently pass over a portion of their load to one or more insects already at the nest, and sometimes an insect on receiving a portion will divide it with another, an excellent arrangement by which the time and labour of transporting raw material is cut down to a minimum. Similarly, food for the grubs, which often consists of a viscous, greenish coloured ball, may also be divided on arrival at the nest.

On March 16 Mr. George Parton discovered a deserted nest attached to a lemon tree, where some of the old bark scars had been noticed, this being something over 100 feet from the one now in use. It was of interest that in this tiny structure, less than an inch in diameter, 14 cells had been occupied, suggesting that the small band had migrated from there to establish the present nest.

—W. H. LOARING, Bickley.

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NEW RECORDS OF DISTRIBUTION OF *Pilostyles Hamiltonii*

By G. G. SMITH, University of W.A., Nedlands.

At the May 1951 meeting of the W.A. Naturalists' Club, I exhibited a fresh specimen of a rare parasitic flowering plant and its host which had been collected from the bush at Carmel by Mr. N. H. Speck.

The host-plant was the woody papilionaceous shrub, *Daviesia pectinata* (Lindl.), and along its stems numerous small dark brown flowers of the parasitc, *Pilostyles Hamiltonii* C. A. Gardn., protruded from the lesions in the bark.

The history of the occurrence in Western Australia of *Pilostyles* is of unusual interest. *Pilostyles* belongs to the family Rafflesiaceae, a group of parasitic flowering plants distributed in the Indo-Malayan region, tropical America and tropical Africa. All the members of the family parasitise stems or roots of certain trees or shrubs to such an extent that the root and shoot systems of the parasites have become reduced to very simple colourless tissues ramifying through the bark of their hosts. The flowers, however, are not always reduced or modified from basic floral structure. One species, *Rafflesia Arnoldii,* found on the surface roots of certain jungle trees in Sumatra, sends forth from the host bark a spectacular flower 40 inches in diameter—the largest known flower in the plant kingdom.

In March 1944, Mr. C. D. Hamilton, the District Forester at Mundaring, collected near the Greystones pine plantation a branch of *Daviesia pectinata* with a peculiar stem eruption. The brown protuberances in the eruptions proved to be the flowers of one of the Rafflesiaceae, and the parasite was described by the Government Botanist, Mr. C. A. Gardner, as a new species of the genus *Pilostyles (Journ. Roy. Soc. W.A.,* vol. 32, 1948, p. 77).

This was the first record of a species of Rafflesiaceae in Australia and was of particular interest as the other 15 species of *Pilostyles* are scattered through South and North America while closely allied genera are found in tropical Africa and Persia.

What is of immediate interest to us, of course, is the distribution of this rather inconspicuous plant found at Mundaring. It has been repeatedly found on *Daviesia pectinata* in the Greystones area, but only this year, 1951, has it been reported and collected from other localities and from other species of *Daviesia*.

Mr. C. D. Hamilton found infected plants of *Daviesia incrassata* at Kirup in January 1951. Mr. Speek collected *Pilostyles* on

Fig. 1.—Heavy infestation of *Pilostyles Hamiltonii* on *Daviesia pectinata*, from Bedfordale. Notice the characteristic way in which the flowers of the parasite emerge from the tissues of the host. (Half natural size).

D. pectinata, *D. polyphylla* and *D. rhombifolia* from Carmel in May, and reported that at least 50% of the plants of *D. pectinata* on his property were heavily infected. Mr. A. Notley collected infected shoots of *D. rhombifolia* from Gosnells, between the Cascades and the Sixty Foot Falls, also in May. Members of the W.A. Naturalists' Club (Miss J. Bungert and Mr. W. H. Butler) found infected plants of *D. pectinata* and *D. rhombifolia* during a Club excursion in the Wongong-Bedfordale area on June 3, and Miss J. Bungert also on the same two species at Parkerville on August 12. Here the infected hosts were growing within a few feet of each other. The latest record is of its occurrence at Donnybrook on *Daviesia inerassata*. The parasite appears only to infect species of *Daviesia*—a genus of the family Papilionaceae of the order Leguminoseae. The American and African Rafflesiaceae likewise are restricted in their host-range to the Leguminoseae although they parasitise species from the three families of that order.

More intensive searching for this strange plant will probably show it has a fairly wide distribution in the south-west of Western Australia, and even extending, perhaps, to the eastern States. *Daviesia rhombifolia* and *D. polyphylla* are confined to the Darling scarp and Sussex district but *D. pectinata* ranges from Murchison River to King George's Sound, and also from South Australia to Victoria. *D. inerassata* extends through the sclerophyllous forest from the Swan River to King George's Sound and eastward to the

Fig. 2.—Enlargement of flower buds of *Pilostyles Hamiltonii* (x 8) showing details of their outer structure and shape.
—Photos, J. Gentilli.

Bight. Species of *Daviesia* are found in all the Australian states and in Tasmania. As *Pilostyles Hamiltonii* very likely parasitises more than the four known host species it may occur extensively through the forest and scrub regions of southern Australia. It is just possible that *Pilostyles* infects other genera of the Papilionaceae or even genera of the Mimoseae and Caesalpineaeeae. If this should be the case the parasite's distribution would be even more extensive.

The details of seed germination and establishment of the seedlings of *Pilostyles* on its host are not known. Here is a problem that awaits investigation by a professional or amateur botanist.

THE LIFE HISTORY OF THE BROWN-TAIL MOTH, *Pterolocera isogama*

By JEAN McGAURAN, "Bunya Bunya," East Yuna.

The brown-tail moths were first recorded here, in the 1949 season, on June 22, their appearance coinciding with the opening rains. In the evening, almost immediately after a steady fall of rain, numbers of the moths came fluttering around the light. They measured nearly two inches across the fully expanded wings and were brown in colour, the females being somewhat lighter than the males.

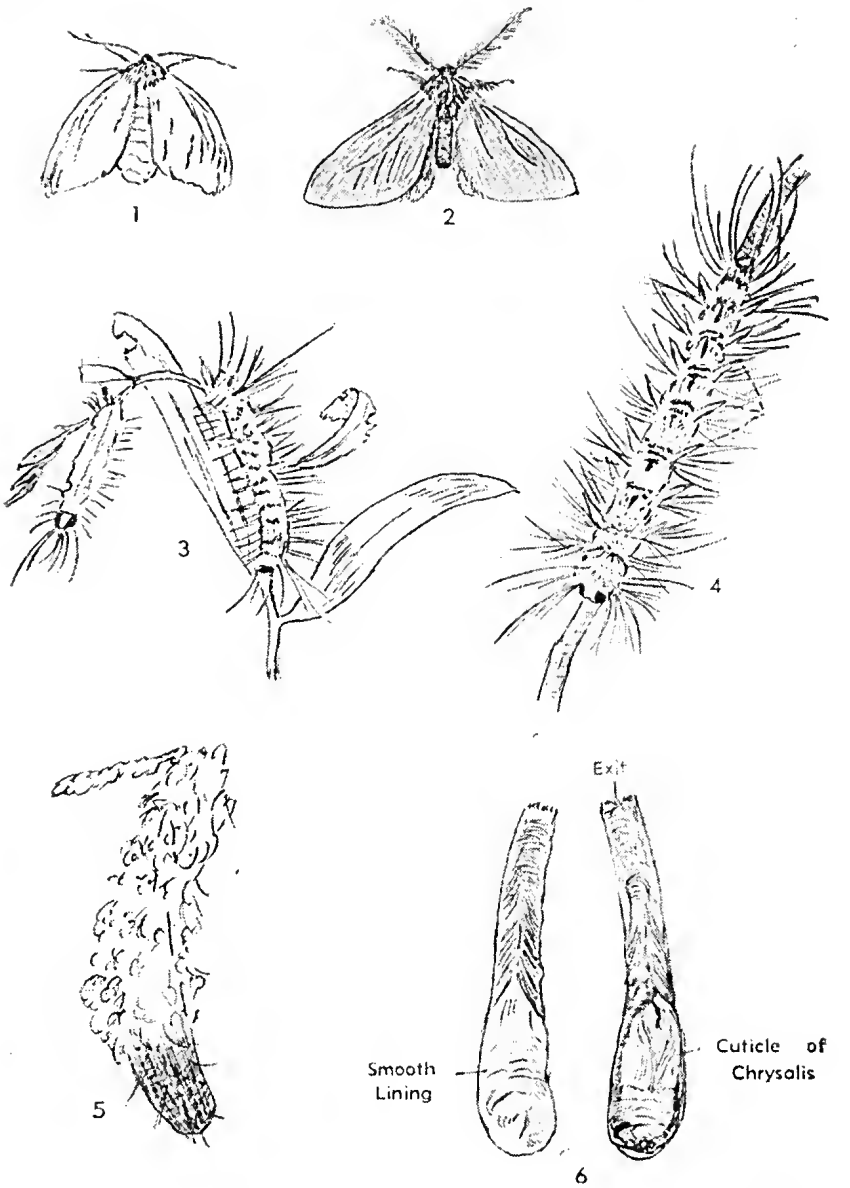
Many eggs were laid. They were about the size of a pin-head and were of two colours, some being pinkish, others pinkish-grey. Some eggs were kept for study.

On July 20—28 days later—I found tiny, very hairy, grey caterpillars hatching. I reared two of them trying at all times to provide them with, as near as possible, natural conditions. For food I offered the caterpillars mallee leaves and various grasses and herbs, but these were ignored. Leaves of euraras, jams and wattles (namely species of *Acacia)* were readily accepted, and on them the caterpillars fed throughout the larval stage.

The caterpillars moulted several times in the early stages, but after they had begun to develop their green and blue markings (when they were about three-quarters of an inch long) I did not see any discarded skins.

One caterpillar grew more quickly than the other, and by September 26 measured nearly two inches in length. The other caterpillar was somewhat smaller. They had grey, blue, yellow and green markings on the upper portion of the body. Their sides, below the pointed tufts of white hairs indicated in the sketch, were black. Claspers and legs were reddish-brown. The ventral surface was reddish-brown with black markings.

The larger caterpillar went underground to pupate on October 4. It dug a hole apparently straight down, pushing the earth up and



Brown-tail Moth *(Pterolocera isogama)*. 1—Female. 2—Male. 3—Caterpillars 8 weeks after hatching. 4—Larger caterpillar 10 weeks after hatching, September 26. 5—Pupal case of larger caterpillar. 6—Empty pupal case, cut longitudinally.

—Jean McGauran del.

out from the hole to a radius of about half an inch. I went away for a little while, and when I returned, could just distinguish some movement below the surface, the opening being covered with loose earth.

On October 10 I dug up and examined the pupal case. It measured about two inches in length and was slightly curved. The upper portion was soft and covered with sand, which clung to a webby surface. About half an inch at the tip was purplish-black, and devoid of sand. A number of hairs adhered to the surface of the cocoon.

The smaller caterpillar pupated on October 13. Its cocoon was similar to the first but less sandy, allowing a greater area of the dark surface to be seen.

The two pupæ remained in the gound until June 22, 1950. That night, good, soaking rain fell, and next morning I found that the moths had emerged. Judging by the antennae, they were both females. Their abdomens were large, and their wings were crumpled, as though not fully extended.

The rain which fell on June 22 was not the first of the season, over three inches having been recorded for May.

Several "brown-tails" were seen on June 10, when 17 points of rain fell, and on June 17, when 38 points were registered. One moth was seen near those I had reared.

Specimens of moths similar to those reared in this experiment, and presumed to be the same species, were forwarded to the Division of Entomology of the C.S.I.R.O. for identification and Mr. I. F. B. Common reported as follows: "The specimens sent are *Pteroloccra isogama* Turner (Family Anthelidae) *(Proc. Linn. Soc. N.S.W.,* 56 (4): 328). The only other species in the genus *(P. amplicornis)* has an apterous female and the larvae food on grasses."

ADDENDUM.

Observations during 1951 differ slightly from those reported in the preceding article.

The moths appeared in numbers on June 1. The eggs laid this year did not hatch in 28 days but in about 6 or 7 weeks. Four moths laid 99, 94, 50 and 45 eggs, respectively. However, these may not necessarily have been the total numbers, as the moths might have laid other eggs before I captured them.

Last year I collected two caterpillars which I believed were "brown-tail" larvae. They burrowed in October. Their cocoons were much shorter than those of the "brown-tails" previously studied and were almost entirely covered with sandy web. The portion of cocoon that was visible was whitish, not purplish-black. The moths emerged in June this year. They were "brown-tails," both males. It would appear that the cocoon differs with the sex.

THE NATURAL HISTORY OF THE MARRON AND OTHER FRESH WATER CRAYFISHES OF SOUTH-WESTERN AUSTRALIA

By BRUCE SHIPWAY, South Perth.

PART 2.

6.—SIZE AND GROWTH RATE OF MARRON.

There are few authentic records regarding the size attained by Marron. Ellen Clark (1936) states that the average length of adult Marron is 375 mm. (14.8 in.). This figure appears high, particularly as she examined only 12 specimens. She refers to "fully-grown" specimens equal in size to the large Murray River crayfish, *Euastacus serratus* Shaw. I find no indication that the Marron, or the Jilgie or Koonac, can ever be said to be "full-grown." Growth appears to continue throughout life.

The largest specimen in the Western Australian Museum collection, at present, has a carapace length of 162 mm. (6.4 in.), but since the specimen has been in preservative for a considerable period total length and weight cannot be determined with any reasonable degree of accuracy.

In December 1950, Master Brian Richards of Northcliffe, captured a large male Marron in the Gardner River, near Northcliffe, and forwarded it to the writer. This creature was larger than the Museum specimen, having a carapace length of 165 mm. (6.5 in.), a total length of 380 mm. (15 in.), and a weight of 3 lb. 8¾ oz. It was accepted as the record until April 24, 1951, when Messrs. Jim Warr, F. G. Thorpe, J. Rickert and J. Walsh captured a large male Marron in a tributory of the same river at a point approximately 7 miles S.E. of Northcliffe. This specimen, which the writer has lodged in the W.A. Museum (No. 31-1951), weighed 4 lb. 1¼ oz., with a carapace length of 171 mm. (6.75 in.), and a total length of 385 mm. (15.25 in.). The creature was caught by means of a snare at 8.30 p.m.

This record would make the Marron the third largest fresh water crayfish in the world, *Astacopsis franklinii* Gray, from Tasmania, holding pride of place as the largest, its recorded maximum weight being 8 lb. Mr. F. McNeill of the Australian Museum, Sydney, informs me that *Euastacus serratus* Shaw, can reach a length of 18 in. between the tip of the rostrum and the end of the telson. No weights are available.

Neither the Tasmanian nor the Murray River Crayfish are at all common at the sizes mentioned above, but many Marron are caught each year in the vicinity of three pounds weight.

The writer was one of a party in March 1950 which caught 47 Marron from a pool in the Warren River which measured only 150 ft. in length, 20 ft. in width, and up to 8 ft. in depth. The total weight of the catch was 60 lb. Several specimens were over 2 lb. each. This quantity was caught in 4 hours, using 11 "drop nets" of 1½-2½ in. mesh net approximately 2 ft. in diameter.

At the same time of the year, Mr. W. Loud of Pemberton, gave the writer a Marron he had caught in the Warren River (Fig. 1). Mr. Loud's Marron had a carapace length of 157 mm. (6.2 in.), total length 346 mm (13.6 in.) and a weight of 3 lb. 2¾ oz.

Although it would be impossible to determine the annual catch of Marron, the figure would certainly run into several thousand pounds weight. An examination of numerous catches has shown the average individual weight caught to be 8.8 oz. This would represent an average carapace length of 100 mm. (4 in.).

So far no observations of individuals of known ages have been made to establish direct evidence of the growth rate, while marking is difficult owing to the shedding of the exoskeleton periodically (ecdysis). However, experiments to provide such data are proceeding. In the meantime some indirect evidence from length frequency measurements is available.

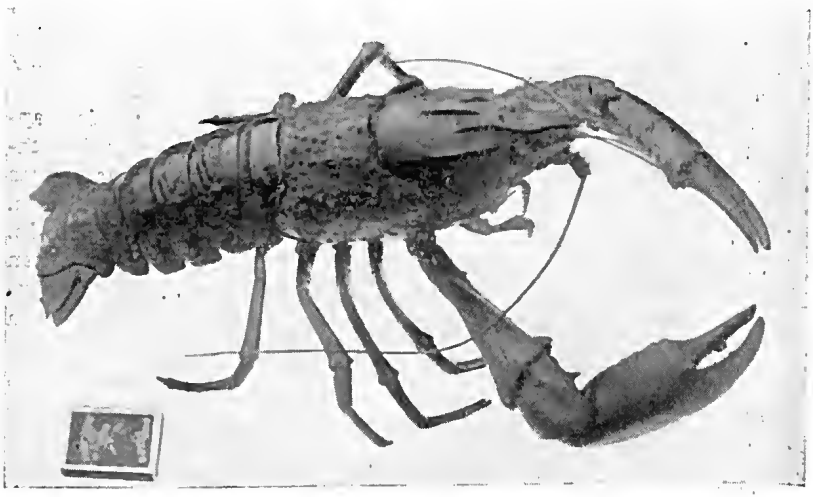


Fig. 1.—A large Marron, weight 3 lb. 2¾ oz.; note matchbox to indicate comparative size.

On September 26, 1950, the swimming pool at Pemberton was drained and a number of specimens were obtained for examination.

The pool is formed by an earthen wall or dam, 45 yards long with a maximum height of 15 ft., across a small stream. The water thus impounded forms an isosceles triangle 220 yards long. The bottom is covered to a depth of 1-2 feet with terrigenous and organic sediment on which grow extensive banks of *Chara sp.* A small portion of the bottom, less than 5%, has been covered with a bituminous compound, which is, of course devoid of plant life. The Trout Ponds are situated some 200 yards above the swimming pool and the waste products of the fish are carried into the pool by the stream.

Assisted by my wife and Inspector J. Simpson, of the Fisheries Department, we collected 416 Marron from the pond. As time was limited it was not possible to make the collection complete: I collected every specimen I found, but my wife and Mr. Simpson were directed to concentrate on the larger and smaller specimens. This selection somewhat militated against the suitability of the data for length-frequency analysis, introducing some anomalies in the accompanying graph and table. However some tentative inferences may be drawn.

The Marron captured ranged in carapace length (measured from the tip of the rostrum to the posterior margin of the carapace) from 15 mm. to 102 mm. The detailed measurements are given in the following table and are graphed (Fig. 2) in class intervals of 3 mm.

TABLE 1.—Carapace lengths of Marron, September 26, 1950.

m.m.	No.	m.m.	No.	m.m.	No.	m.m.	No.
15 -	2	37 -	1	59 -	17	81 -	0
16 -	3	38 -	2	60 -	21	82 -	0
17 -	1	39 -	0	61 -	9	83 -	1
18 -	6	40 -	5	62 -	12	84 -	0
19 -	7	41 -	2	63 -	11	85 -	3
20 -	17	42 -	5	64 -	2	86 -	1
21 -	24	43 -	6	65 -	8	87 -	0
22 -	19	44 -	4	66 -	2	88 -	0
23 -	14	45 -	3	67 -	5	89 -	1
24 -	27	46 -	0	68 -	3	90 -	0
25 -	22	47 -	6	69 -	2	91 -	0
26 -	14	48 -	7	70 -	3	92 -	0
27 -	16	49 -	3	71 -	0	93 -	0
28 -	9	50 -	7	72 -	1	94 -	0
29 -	3	51 -	2	73 -	0	95 -	1
30 -	3	52 -	5	74 -	1	96 -	0
31 -	1	53 -	5	75 -	2	97 -	0
32 -	2	54 -	3	76 -	1	98 -	0
33 -	0	55 -	9	77 -	1	99 -	0
34 -	0	56 -	8	78 -	1	100 -	1
35 -	1	57 -	15	79 -	1	101 -	0
36 -	0	58 -	14	80 -	2	102 -	1

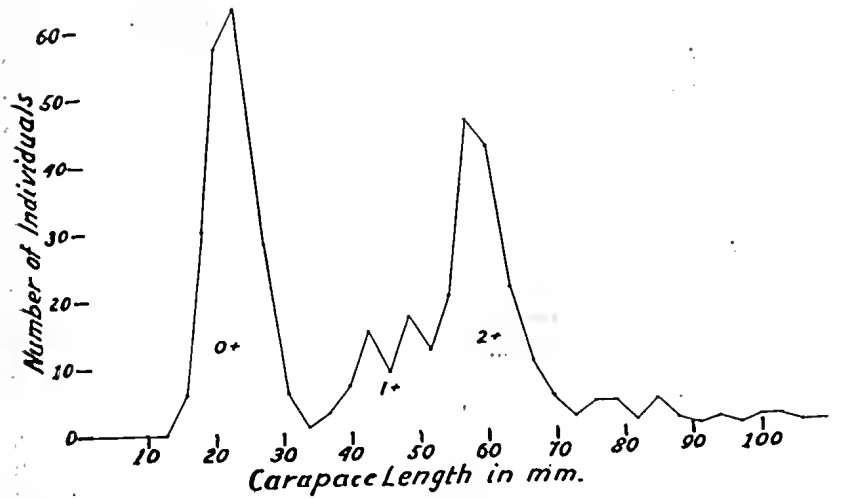


Fig 2.—Length frequencies of a Marron sample, September 26, 1950, showing presumed age groups.

It will be seen that two well-defined modes and one ill-defined, are represented in the graph, which it may be permissible to interpret as representing the mean lengths of successive year classes. When plotted on a graph the three modes lie on a reasonable growth curve.

The smallest size-group ranges from 15-32 mm., with a mode at 23 mm., at which size the weight is approximately 1/3 oz. This group would consist of Marron of somewhat less than one year in age, as spawning takes place in spring—September to October—and hatching takes place approximately 3-4 months later. It would comprise the 0+ group on the conventional method of designating age-classes.

The next two groups, the second and third year Marron respectively, show an appreciable overlap and that the 1+ age-class (hatched in the summer of 1948-49), represented by an irregular curve, is considerably less abundant than the 2+ age-class. The form and size of the 1+ curve would be caused largely by the method of collection just stated, and also to the fact that the swimming pool had been drained each previous year. Hot dry conditions prevailing at the time of emptying would naturally affect the survival rate of the creatures inhabiting the pool. It is understood, also, that at such times children captured the majority of edible-sized Marron.

The modes of the overlapping curves are readily separated, one at about 47 mm. and the other at about 60 mm. At 47 mm. carapace length the approximate weight is 1½ oz. and at 60 mm. 2¾ oz.

The smallest example found with ova at this time measured 48 mm. in carapace length so that sexual maturity must be presumed to begin in the region of that carapace length.

Older groups are impossible of clear identification from the length frequency curve owing to the small number of individuals.

A reasonable lower limit for Marron of a size worth while for eating would be about 75 mm. carapace length (3 in.) equivalent to a total length of 165 mm. (6.5 in.), with a weight of 5-7 oz.

From information to hand, but not yet verified, it would appear that the growth rate in newly-stocked streams and ponds is faster than that suggested by the present incomplete curve. It has been claimed that Marron 150 mm. (5.9 in.) in total length have been caught 2 years after their introduction (as ova still attached to the parent). The dams had been hitherto unstocked by crayfish.

The growth rate is relatively rapid during the juvenile stages, ecdysis occurring frequently with an expansion in carapace length of 15-17% at each moult. After one year the moults occur less frequently and probably take place only annually. If food supplies are abundant, as suggested by the size of Marron in newly-

stocked ponds, ecdysis continues to occur fairly frequently as at a carapace length of 85 mm. (3.3 in.) the expansion is only 4% after ecdysis, and the creature could not attain this size with only an annual moult.

An eye witness account of the ecdysis of a large Marron has been reported by Mr. K. Cruickshank of Pemberton.

On February 18, 1951 Mr. Cruickshank was fishing for Marron in the Warren River near Pemberton when he noticed a large specimen approximately 1 foot long lying on its side in the shallows near the edge of the stream. The creature was at first thought to be dead but on closer examination it was seen to be alive and the posterior margin of the carapace was lifting away from the abdominal shell. Mr. Cruickshank saw the creature withdraw its carapace and then its abdomen, the limbs still being contained in the old shell. After a short pause it struggled violently for a few seconds and succeeded in withdrawing its limbs, whereupon it made off rapidly into deeper water and disappeared from sight. The whole process occupied less than ten minutes.

The discarded shell was collected and brought to the writer. It was most unfortunate that the creature itself escaped, as the proportion of expansion is not known for a Marron of this size, but it was not expected that the creature would be so active after completing its ecdysis.

Much of the information still required may be obtained from the carapace only, and as it is the "tail" portion, or abdomen, that is used for consumption, "marroners" are asked to forward carapaces, raw or cooked, to the W.A. Museum for examination. The proportion of total length to carapace length has been found to be reasonably constant at 2.23 : 1, and varying from 2.16 : 1 to 2.37 : 1.

7.—REPRODUCTION OF MARRON.

The sex may be easily determined by the presence of genital papillae, fleshy protuberances, on the basal joint of each of the last pair of ambulatory limbs of the male, and the opening of the oviduct on the basal joint of the third last pair of the female.

The males' genital papillae become more erect during the breeding season, at other times being somewhat flaccid. I have been unable to verify a statement by Clark of the presence of a swelling on the outer edge of the great claws of the male as an indicator of sexual ripeness. The great claws of the male are definitely more robust, but this may be misleading as a rejuvenated limb does not regain the size of one lost. The ratio of length to width of the great claw of a mature Marron has been found to be approximately 2.5 : 1 in the male and 3.5 : 1 in the female.

Mating occurs in spring from September to October when the male deposits a mass of gelatinous spermatozoa between the last two pairs of ambulatory limbs, near the sternal keel of the female.

The spermatozoa have the appearance of boiled household starch and the mass is extremely viscid. The ova are deposited on both the front and rear side of the swimmerets. Specimens have been found with such a large number of ova that the available space on the swimmerets had been used up and ova were also attached to the posterior legs.

The Marron is a prolific egg producer compared with the Koonac or Jilgie, but the number of ova varies with the size of the parent. The youngest sexually mature individuals (members of the presumed 2+ year-class) produce 200-360 eggs; the larger individuals examined (carapace length 125-150 mm. or 4.9-5.9 in.) of unknown age but of a weight of 1½-2 lb., averaged 670 eggs. The ova are elliptical in shape and the size also varies with the age of the parent. Young individuals 60 mm. (2.4 in.) in carapace length have ova measuring 2.4 x 1.6 mm. Ova from the larger Marron, 125-150 mm. in carapace length, measure 2.8 x 2.1 mm.

Examination of catches made during the non-breeding season, namely February to August, show the sexes to be represented equally in numbers. However, during the season when they are carrying external ova or young the females represent only about 10% of the catch, and of these less than 10% actually have young or ova attached. The females apparently go into hiding during this period and this behaviour must assist materially in the preservation of the species.

Many "Marroners" are deceived regarding the spawning period by the presence of the egg of one of the Platyhelminthes, *Temnocephala,* a creature of leech-like appearance that is commensal with fresh water crayfish. The small eggs of *Temnocephala* may be found attached to the swimmerets of both male and female Marron, Jilgies and Koonacs when the crustaceans themselves are not carrying their own ova. They are easily recognised by their small size, about 0.5 mm. in diameter, and their pear-like shape.

Hatching occurs after a period of from 3-4 months, and both larvae and unhatched ova may be found in January. The newly-hatched larvae are similar in general appearance to those illustrated by Clark (1937) of the Gippsland crayfish. The swollen carapace contains a large quantity of black yolk. The larvae retain their hold by means of small hooks on the last two pairs of legs and hang head downwards, thereby differing from the crayfishes of Europe and North America.

The young remain attached to the swimmerets of their mother for a further 4 weeks, during which period they pass through a series of stages approaching and finally resembling the parent except that the great claws are very slender and rounded at their extremities. The first free-swimming young were observed on February 3, 1951 and females previously seen to be carrying ova or young were completely free of them on February 14, 1951.

When the juvenile Marron reach the stage where they take up an independent existence they have not been seen to return to their mother when disturbed.

8.—MARRON CULTURE.

Though their natural habitat is in rivers they have been known to flourish in still waters of quite limited extent. Probably the best example is provided by the experiment in stocking the disused open-cuts around the tin mining town of Greenbushes some years ago with berried females. These pits are drained occasionally and large numbers of Marron are caught.

In the Wheat-belt, near Katanning, Mr. J. F. Haddleton introduced Marron and Koonac to his dams, where they have thrived and multiplied.

It will be seen, therefore, that the habits and life history of the Marron are such that it appears eminently suitable for stocking farm ponds and dams and there are possibilities of its furnishing a valuable addition to the fare of country people in areas where fresh sea foods are unavailable.

9.—SUMMARY.

The Marron *(Cheraps tenuimanus)* occurs in all the streams between Albany and the Harvey River, and has been introduced to the Murray, Serpentine, Canning and Swan Rivers. It keeps to the larger deep basins of the rivers, usually those with a mud bottom. It is omnivorous in diet and at present would appear to be the successful competitor against any of the introduced fish. It is normally very dark red to black in colour but a deep pink and blue or an all-blue form may be occasionally found. Marron do not possess such strong burrowing tendencies as the other native species and seem more content to shelter amongst debris on the bottom of the pools. Mainly nocturnal.

Presumed growth rates under normal stream conditions are:—1st year, carapace length 23 mm., weight 1/3 oz.; 2nd year, carapace length 47 mm., weight 1½ oz.; 3rd year, carapace length 60 mm., weight 2¾ oz. Matures the third year of life (2+ year class), bearing 200-360 ova and 670 ova when the carapace length is 125-150 mm. and weight 1-2 lb. The largest specimen examined, a male, had a carapace length of 171 mm., total length 385 mm. and weight 4 lb..1¼ oz.

Sexes may be distinguished by the presence of genital papillae on the last pair of ambulatory limbs of the male, and by the opening of the oviducts on the third last pair of legs of the female. The great chelae are more robust on the male. Ova are deposited on the swimmerets of the female in early spring. The male deposits masses of gelatinous spermatozoa near the female's sternal keel. The development of the egg before hatching takes 3-4 months. Young remain attached to their mother's swimmerets for a fur-

ther month before taking up an independent existence in mid-summer.

The Koonac *(C. preissii)* is found in association with the Marron but also occurs as a semi-land-inhabiting form, blue in colour, which lives in swamps, burrowing to the water table. It occurs from Perth southwards to Albany and inland to the Great Southern districts eastwards to Ongerup, but it is unknown how far introductions have contributed to this range.

The Jilgie *(C. quinquecarinatus)* is recorded from Yallingup and all the coastal streams and fresh water lakes north to the Moore River.

All species are host to a commensal Temnocephalid, which deposits its ova on the swimmerets during that portion of the year when the crayfish are not carrying their own eggs and larvae.

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NATURAL HISTORY NOTES FROM THE SOUTH COAST

By V. N. SERVENTY, Subiaco.

The following observations refer to three localities, all being beaches east of Esperance. These are Israelite Bay, Point Malcolm and Duke of Orleans Bay.

They were visited during the Australian Geographical Society's expedition to the Recherche Archipelago, and though only a short stay was made at each place, it has been thought worthwhile to place the information on record in view of the fact that the localities are so seldom visited. Our party included Messrs. J. Bechervaise (leader), J. Willis (botanist) and D. McKenzie (skipper of the schooner *Water Lily).* The time of the visits was from November 27 to 29, 1950.

ISRAELITE BAY.

BIRDS.

Blaek Cormorant *(Phalacrocorax carbo)*.—12 of these were seen, and another group of 3, as we approaehed the Bay.

Blaek-faeed Cormorant *(Phalacrocorax fusccscens)*.—One bird flew around the boat as we approaehed, and 5 were found on the old jetty.

Caspian Tern *(Hydroprogne caspia)*.—On a bare granite headland to the north-east of the Bay a nest with two eggs was found. Although conneeted to the mainland, this eould be eonsidered an island situation as the neck of land joining the roek to the land was only a few feet wide at some points.

Fairy Tern *(Sterna ncrcis)*.—One bird was seen.

Silver Gull *(Larus novac-hollandiae)*.—A few birds were present.

Paeifie Gull *(Gabianus pacificus)*.—One individual.

Pied Oyster-eateher *(Haematopus ostralegus)*.—Two groups were met with. One pair had onc large young, while the other pair had two. All the young could fly. They were browner on the wings than the adults and thc beaks were paler.

Sooty Oyster-cateher *(Haematopus fuliginosus)*.—Two birds were seen.

Grey Plover *(Squatarola squatarola)*.—8 birds were observed.

Red-eapped Dotterel *(Charadrius alexandrinus)*.—4 birds.

Bar-tailed Godwit *(Limosa lapponica)*.—One bird.

Little Stint *(Erolia ruficollis)*.—2-300 birds were present.

Kestrel *(Falco ccnchroides)*.—One bird.

Grey Faleon *(Falco hypolcucus)*.—One bird seen.

Golden Bronze Cuekoo *(Chalcites lucidus)*.—One bird was heard ealling.

Welcome Swallow *(Hirundo ncoxena)*.—Several birds about.

Crested Bell-bird *(Oreoica gutturalis)*.—One bird was heard by Mr. J. Willis.

Black-faeed Cuekoo-Shrike *(Coracina novae-hollandiae)*.—One bird seen.

Brown Thornbill *(Acanthiza pusilla)*.—One bird.

Spotted Scrub-Wren (*Sericornis maculatus)*.—Several birds noted.

Silvereye *(Zosterops australasiac)*.—Several birds seen.

Brown Honeyeater *(Gliciphila indistincta)*.—One bird seen.

New Holland Honeyeater *(Meliornis novac-hollandiac)*.—One bird seen.

Singing Honeyeater *(Mcliphaga vircscens)*.—Several birds.

Red Wattle-bird *(Anthochacra carunculata)*.—Several birds were seen.

Australian Pipit *(Anthus novac-seelandiac)*.—One bird was seen on a sandy point near the beach.

Raven *(Corvus coronoidcs)*.—12 birds were seen.

Grey Butcher-bird *(Cracticus torquatus)*.—One bird was seen

REPTILES

Scaly-foot *(Pygopus lepidopodus).*—This snake-lizard was captured within 30 yards of the beach under a bush. The head was held some 3 or 4 inches off the ground, the sides of the neck being flattened, giving the creature a very snake-like appearance. The scale-feet were prominent when the animal was held in the hand, as these were moved vigorously. The general body colour was a blue-grey, while the belly was a faint pink. The body design is notable for three prominent dark stripes starting from the head. These are not continuous but are interrupted by light brown. There is also a light brown line through the centre of each stripe. Halfway down the tail the design ends abruptly, and only three thin, black lines continue.

Crowned Snake *(Denisonia coronata).*—This snake was caught moving over the samphire flat near the beach, during the afternoon. The description was the same as in the *Handbook of the Snakes of Western Australia* by L. Glauert, except that towards the head and just past the dark collar were two pale blue patches, one on each side of the head.

The introduced snail, *Helix pisana,* was very common.

POINT MALCOLM

The following birds were recorded:—Sooty Oyster-catcher (3), Twenty-eight Parrot *(Barnardius zonarius*—2), Welcome Swallow (common), Spotted Scrub-Wren, Silvereye (common), Spinebill *(Acanthorhynchus superciliosus*—quite common inland from the beach), Red Wattle-bird (common), Grey Butcher-bird (common)

Again *Helix pisana* was common and another specimen of the Sealy-foot Lizard was collected.

DUKE OF ORLEANS BAY.

Birds: Pacific Gull (1), Spotted Scrub-Wren, Silvereye, Singing Honeyeater (1), New Holland Honeyeater (common), Yellow-throated Miner *(Myzantha flavigula*—very common), Red Wattle-bird *(Anthochaera chrysoptera*—2 were seen in a paper bark swamp), Grey Butcher-bird (2).

Interesting plants included the Christmas Tree *(Nuytsia floribunda),* locally called Munjee, that being the native name, and the tall Zamia *(Macrozamia Dyeri).* The latter was said by D. McKenzie to occur as far east as Thomas River, near Cape Arid. The limit is given a little further east, to the level of Cape Pasley, by J. P. Brooke in his interesting paper on the local vegetation and physiography ("Natural Features of Israelite Bay," *Proc. Australas. Assoc. Adv. Sc.,* 1895, vol. vi, 1895, pp. 561-569). Brooke gives the western limit of this species of Zamia as 30 miles west of Esperance Bay and provides information on the eastern limits of a number of plants, including the Christmas Tree, Blackboys, Jarrah and others.

IRRUPTION OF BUDGERYGAHS INTO THE SOUTH-WEST, 1951

[Editor's note: This year has witnessed an unusual irruption of the Budgerygah *(Melopsittacus undulatus)* into the South-west. These birds have not previously been recorded far within the forested corner of the South-west. There are reports of sporadic occurrences in parts of the wheat-belt (cf. Mr. Sedgwick's observations hereunder). Tom Carter *(The Emu,* vol. 23, 1924, p. 225) regarded them as erratic visitors to the Broomehill district and referred to one observation at the Williams River in August, 1917.]

Mouth of Murchison River.—"Recently I visited Booley Pool which is one of several large pools just inland from Murchison House Station on the Murchison River . . . In the same locality, but at the mouth of the river, many flocks of Budgerygahs were also sighted and it was remarked that it was unusual to find so many so far south."

—JIM LAWRENCE, Como (in *Wild Life* (Melbourne), vol. 14, no. 2, August 1951, p. 168).

Morawa.—During the early part of June, 1951, large numbers of Budgerygahs appeared in the Morawa district in flocks varying from a dozen or so individuals up to large groups exceeding 200 birds. Although small flocks are often seen, mainly to the eastward, it has apparently been many years since such a large influx of this species occurred here. Some residents who have lived in the district for over 30 years consider that it is more than two decades since such a large-scale irruption of Budgerygahs from the north last occurred. The birds became so conspicuous that many people not usually interested in bird movements have remarked on their presence, and until mid-July I had entertained the hope that numbers might remain in the district to breed, as did the Cockatiels after their incursions in the spring of 1949. At the time of writing (August 15), I have not seen any for some weeks. Their presence, and the passage of flocks, began to dwindle about mid-July.

—S. R. WHITE, Morawa.

Bolgart.—Although Budgerygahs are known to have visited Bolgart many years ago they have not been seen in this district for at least 17 years. This year, however, they have been present in good numbers and noted by several people. The first flock, of about 100 birds, was seen late in May. Early in June another flock of about 50 birds was seen one mile from town. On August 30 at the same place a smaller flock of about a dozen was noted.

—(Mrs.) RICA ERICKSON, "Fairlea," Bolgart.

Gingin.—Mr. Edgar, of Gingin, informs me that in June last a flock of about 30 Budgerygahs appeared in his paddocks, feeding on the grass seeds. They disappeared during a rainy spell following but returned afterwards.

—L. GLAUERT, W.A. Museum, Perth.

Yanchep.—The Budgerygahs were here for about 3 or 4 days, one day being May 17. There must have been 2-300 of them, but it was difficult to count them as they flew about all the time. We did count 35 once on a small tree and they lined the wireless and laundry lines. I wondered what they were finding to eat, as we had no fruit in the garden at the time. On the last day of their being here about a dozen of what we believed to be "Ceylon Crows" turned up and flew about among the Budgerygahs, we thought in a friendly fashion. Next morning the Budgerygahs and Crows had disappeared, but we found 30 of the little birds dead in the grass and vegetable garden, each with a wound at the back of the head and a long rip in the chest, some of their insides being eaten out apparently.

—(Mrs.) MARY LINDSAY, Yanchep Estate, Yanchep.

Lake Coollelal, north of Perth.—On June 12, 1951, Mr. C. F. H. Jenkins and I took Mr. Tom Spence, an ornithologist from England, on a run to Yanchep. Whilst watching water birds at Lake Coollelal, on the Wanneroo Road, 10 miles north of Perth, we were greatly surprised to see a flock of 25-30 Budgerygahs fly swiftly past to the southward. This was our first record of the species for the Swan River District.

—D. L. SERVENTY, Nedlands.

Wooroloo.—On July 29, 1951, I saw a flock of Budgerygahs fly into a peach orchard near Wooroloo. Seventeen birds, possibly the entire flock, perched in the trees, but from time to time groups of birds flew down to the ground and fed among Cape Weed *(Cryptostemma calendulaceum)* and other herbs growing between the trees. Eventually all the birds descended to the ground and were still feeding when I left.

A week later, with my son Lindsay, I revisited the orchard and again located Budgerygahs. On this occasion there appeared to be c. 50 birds present, their behaviour being similar to that of the flock encountered previously.

On August 12 my son and I walked out 4 miles along the Bailup Road looking for Budgerygahs. On the way back we found a flock of 35 in an orchard. These were 1½ miles from the locality of our earlier observation. We heard the birds before we saw them and, strangely enough, the first bird we sighted proved on close inspection to be an undoubted Elegant Parrot *(Neophema elegans)*. When we had finished with him we located our real quarry.

On August 7, the mechanic of the Mobile Film Unit informed me that on his way from Werribee to Wooroloo he had passed a flock of about 50 "Love-birds" and asked me whether I thought it possible!

In 1940 I saw a flock of Budgerygahs near Lake Richmond, Rockingham, but attached no great importance to the observation

at the time, assuming that the birds were aviary escapees, a conclusion that in the light of recent observations may not have been justified.

On October 12, 1941, I observed Budgerygahs at Wongan Hills, and, in late January 1942, Budgerygahs were present at Dangin. These are my only records for the agricultural areas of the South-west.

—ERIC H. SEDGWICK, Wooroloo.

Near Baker's Hill.—When motoring along the Northam Road on August 14, 1951 with Messrs. A. R. Tomlinson and J. S. Crawford of the Vermin Branch of the Department of Agriculture, we met with a flock of Budgerygahs in jarrah forest country 7 miles on the Perth side of Baker's Hill. There were 15-20 birds in the flock and they were feeding on spilled wheat at the roadside.

—D. L. SERVENTY, Nedlands.

Bickley and district.—On June 8, G. F. Parton noted a single bird flying a zig-zag course amongst the roadside trees here in the evening, its notes and appearance on wing being unfamiliar. In the light of subsequent events we concluded it was one of these small parrots which had become separated from the flock, and was therefore the first recorded here in a wild state. In the forenoon of June 10, I saw a flock of about 20 flying swiftly in close formation north along Piesse gully, the bright green of their backs leaving a vivid impression. Nevertheless for the moment I was not sure of them. On June 18 I saw a flock of 18 about in the forenoon, there no longer being any doubt whatever about their identity. They were once perched in rows along the limbs of a dry sapling, some of them moving about a little and chattering amongst themselves. Suddenly they were all away on wing again in a close flock. Their notes while perched were different to their call when in flight. This small flock was seen in flight several times during the forenoon.

Subsequently Mr. John Rose, who was familiar with the birds in the North-west, told me he saw a flock of about 20 near his home at Lesmurdie early in June. The species was also noted at Pickering Brook by Mr. and Mrs. G. Spriggs. Flocks were about the grazing fields at Walliston during the greater part of July, and were repeatedly seen in that locality by Mr. L. Gilchrist.

From the Chittering district Mr. E. G. Schmidt reports that small flocks appeared early in July, two birds falling to a neighbour's gun.

—W. H. LOARING, Bickley.

Beverley.—On August 31 I saw a flock of 15-20 Budgerygahs about 2 miles west of Beverley, on the road to the Avondale estate.

—J. S. CRAWFORD, Department of Agriculture, Perth.

A JEWEL BEETLE, *Curis intercribrata*, OF THE SHEOAK

By R. P. McMILLAN, Culham

In the dead limbs and trunks of the giant sheoak *(Casuarina glauca)* growing in the Toodyay district there is to be found a most interesting species of jewel beetle, *Curis intercribrata* Fairm., 1877.

The adult beetle is a most beautiful insect as the following description shows. Head, violet with green mouth parts. Thorax, dark bronze; from some angles a green line can be seen down the centre. Elytra, burnt bronze, emitting fiery copper reflections. Antennae, green and gold. Legs, purple. Under side purple, with the abdominal segments clothed with white hairs. Length, female about ¾ in., male about ½ in.

The first indications of the *Curis* were noted on November 18, 1950, when I cut open a dead *Casuarina* stump, and obtained several larvae. They were yellow, elongate and with a rounded head. They measured about 2 in. in length, their bodies being a little thicker than a match. Their movements were very sluggish.

Six larvae were placed in an observation case in their tunnels chipped from the original wood. Five of these died soon after and the sixth began to pupate on November 25. Unfortunately this pupa did not survive for long and shrivelled up a few days later. The larva, just prior to pupating, assumed a pinkish tinge which disappeared later and the pupa became a waxen white.

On November 25 I obtained 6 more pupae from the *Casuarina* and on December 14, 20 and 23 I cut out 12 specimens. These 18 pupae were placed in observation cases and three weeks later the survivors commenced to turn into adult beetles.

It was noticed that when this transformation was about to take place the eyes were the first parts to colour; they were purple. Next the legs became purple and the bases of the antennae, green. Then the abdomen became purple, the thorax purple underneath and bronze above. The elytra were the last to develop.

When formed the beetles lie dormant until the fatty part of the abdomen is absorbed. This process takes about three weeks. The first movements noted in the newly-formed *Curis* were waving legs and antennae. This went on for nearly one week. Next the legs became active and the beetles moved around for a day or two. Just prior to flying the insects became very active, opening and closing their elytra, a little at first until at last they were fully extended. Then the wings were tried in motion, gently at first, and then, with a whirr the beetles were flying.

Unfortunately for the specimens studied their active flying life was short-lived. Of the 9 beetles reared, 6 ended up in my collection and the remainder in that of the Western Australian Museum.

The explanation of the high mortality rate in the larvae and pupae probably is that they had been damaged when they were cut out. Great care should be taken when splitting the timber, as

a sudden jar seems to injure the ereatures. I find a tomahawk better than an axe. It is also an advantage to wedge the timber as it is split.

A few of the pupae reaehed the adult stage, but when the elytra eommeneed to form they stuek together on the edge of the abdomen and shrivelled up. These partieular speeimens had been plaeed in small jars in the observation ease and it appeared that moisture forming in the jar may have damped the elytra, preventing their eomplete development. The sueeessfully reared speeimens had been plaeed in matehbox traps.

On January 30, 1951, I again eut open some more *Casuarina* trunks and obtained two very aetive female *Curis*. The tree had quite a number of larvae in it. They were a watery-white, with a blaek food streak showing down the abdomen. They were immature stages of the larvae I had obtained in the previous November and were only about one ineh in length. I take it they were the next generation of *Curis*.

A single free individual of *Curis* was seen on January 30, on the leaves of a paperbark tree. This may well prove to be the food plant of the beetle. Unfortunately the inseet was too quiek for me and my net missed it by inehes as it whirred away to freedom.

FROM FIELD AND STUDY

Red-winged Wren at Roleystone.—In view of reports of the apparent diminution of range of the Red-winged Wren *(Malurus elegans)* near Perth, I would like to record the observation of a male in full plumage at Roleystone on October 4, 1950. The bird was seen in tea tree thiekets in a swamp situation besides a small ereek running into the Canning River at Croydon Road, about 6 miles below the Canning dam. —A. NOTLEY, Roleystone.

Quokka Feeding on Introduced Snail and Stinkwort.—Quokkas *(Setonyx brachyurus)* at Rottnest Island have aequired a taste for many unusual things as may be seen by their foraging in the rubbish bins. In January 1950 I notieed two unexpected items in their diet. A group of these marsupials was being watehed in broad daylight and at elose quarters, so elose that one Quokka aeeidentally nibbled my thumb while eating a lettuee leaf I held for it. It turned from my thumb without hopping away and then ate from a bush elose by several white snails *(Helix pisana)*, all with mueh relish and eraekling. The next item of food was equally astonishing. They nibbled avidly at the dry stalks of stinkwort *(Inula graveolens* Desf.). —(Mrs.) RICA ERICKSON, "Fairlea," Bolgart.

Red-tailed Tropic-bird at Albany.—Though the most southern known regular nesting plaee of the Red-tailed Tropic-bird *(Phaethon rubricauda)* is at the Abrolhos, some individuals have been known to wander south and east as far as South Australia. On March 19, 1951, I saw a bird from the F.R.V. *Warreen* off Albany, ½ mile off the south-west side of Breaksea Island. The day was ealm with a

light breeze and a light swell, the bird approaehing us from the south-west. It proeeeded to the lee of Breaksea Island where it made several swoops down at the water elose to the edge of the roeks. It then flew baek out to sea, passing 200 yards ahead of the *Warreen,* the pink tail feathers being easily seen by several of the interested members of the erew.

—N. E. STEWART, Cottesloe.

Records of the Smoker Parrot.—On May 29, 1951, I observed a flock of about 15 Smoker Parrots *(Polytelis anthopeplus)* in a roadside eucalypt nearly a mile from Chidlow townsite. They remained quietly in the lower branehes of the tree and permitted of elose observation. Chidlow is well within the jarrah forest bloek, an area not usually frequented by this parrot.

—L. SEDGWICK, Wooroloo.

At the end of May while working on my holding I was surprised to see a floek of these birds settle in a blue gum tree. As far as I was able to eount there were 20 or more of them. A eolony of Magpies dispersed the parrots and upset the eount.

—T. B. DELAPORTE, Maddington.

On August 14, on the Northam road, 4 miles west of the Wundowie turn-off, two Smokers were seen feeding on spilled wheat at the roadside in company with two Common Bronzewings. A little further on 4 Twenty-eight Parrots were feeding similarly.

—D. L. SERVENTY, Nedlands.

Food Transference by Pallid Cuckoos.—On August, 14, 1951, about 1630 hours, we eneountered three or four Pallid Cuekoos *(Cuculus pallidus)* in part-eleared eountry by Wooroloo Brook. Two of these were kept under observation for perhaps 20 minutes. One bird flew down to the ground from an elevated pereh ealling "Peep-peep-peep" and proeured a long hairy eaterpillar. It then flew to a blaekboy *(Xanthorrhoea)* infloreseenee about 50 yards away and elung sideways to the spike for a short time before flying to a dead tree and presenting the eaterpillar to a bird whieh shortly afterwards uttered a harsh grating "Tweet." This bird was apparently the female of a pair.

The male then flew to some distanee and, after a pause, again uttered the "Peep-peep-peep" eall. The female flew to meet the male on a blaekboy spike and was presented with a large hairy eaterpillar. Flying to a dead tree, the female ate the eaterpillar while the male flew off and resumed the "Peep-peep-peep" eall after an interval.

When the male again flew towards the female, she deseended a few feet in the tree to meet him and reeeived a small striped hairy grub. The male then flew away and after a time resumed the "Peep-peep-peep" eall. It flew, hovered, pouneed on a eaterpillar, and flying to a bush, still ealling, ate the eaterpillar.

We then lost sight of one of the birds and broke off observations.

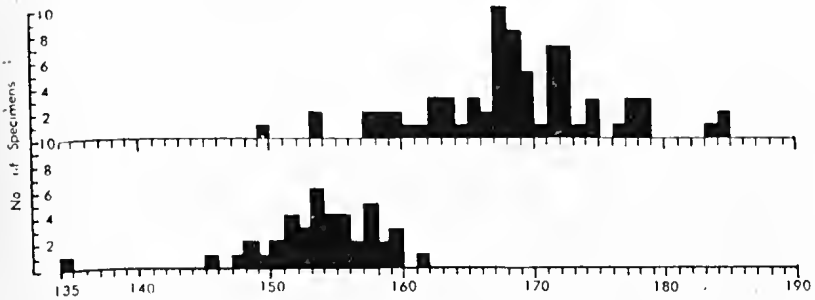
E.H.S. examined the supposed female through binoculars. In his opinion the bird was adult, a view supported to some extent by the comparatively early date. This bird had an unusually conspicuous white nuchal patch, otherwise the plumage was of the normal female type. The second bird was viewed closely by L.E.S. only and was considered comparatively uniform in coloration.

We suggest that what we saw was courtship feeding. E. A. Armstrong, *Bird Display,* quotes two cases of courtship feeding by extra-regional cuckoos.

—E. H. and L. E. SEDGWICK, Wooroloo.

A Note on the Western Tiger Snake.—In his paper, "The South Australian Reptile Fauna, Part 1 Ophidia" *(Rec. S.A. Mus.,* vol. ix, 1951, p. 554) Mr. F. J. Mitchell casts doubt upon the validity of my *Notechis scutatus occidentalis,* first described in vol. 1, no. 7, p. 139 of this journal. In the course of his remarks the author states, "a survey of the variation listed . . . indicates the body scale counts to be very variable and therefore of little diagnostic value."

Taking it for granted that Kinghorn's figures in his *Snakes of Australia* are incorrect, which seems more than probable, there does exist a definite difference between the numbers of ventrals of eastern and western forms. An examination of all records available to me comprising 112 specimens, of which 42 are Western Australian, gives the result shown in the figure below (upper graph, Eastern Australia; lower, Western Australia).



It will be seen that only one of the western snakes has more than 160 ventrals (162) and that but 7 of the others have less than 160. One of these, the one with 150, in the British Museum, may have come from this State though registered "Australia." The others are two each with 154, 158 and 159, which may also be Western Australian.

It is evident that a difference exists which cannot be lightly ignored. Coloration is admittedly unsatisfactory but one cannot fail to remark that not a single western specimen in the collection of the W.A. Museum shows the colours or the patterns of the eastern specimen in the collection or as shown in the illustrations of Kinghorn, McCoy and Krefft, or described by them.

As regards the *Notechis ater* of Krefft, the fact that intensive search in the type locality has failed to produce a single additional specimen suggests that this is not even a sub-species of *Notechis scutatus,* but merely an abnormality.

The examination of long series often reveals a remarkable variation in the head shields of a species.

—L. GLAUERT, W.A. Museum, Perth.

A Melanistic Kookaburra.—On November 10, 1950, after very stormy weather, Mr. Daryl Birch picked up a Kookaburra *(Dacelo gigas)* on the road near Mr. A. W. Gibbings' house in Coolup. This bird was delivered to me about 3 p.m. while still alive. It was a very dark specimen. Though very exhausted it attempted to "laugh" when handled—probably a shock reaction. It died during the night and was dissected and skinned next day.

The specimen, which is now in the Western Australian Museum, has all the underparts dark grey, tinged silver, caused by odd lighter feathers and silvery tips to some webs—all feathers having a dark base as in a normal specimen. The head, hind neck and back are silver-grey with similar markings to a normal specimen, but the dark brown line through eye appears more pronounced. Wings and tail similar to normal specimen, except the white patch on primaries, which has no green along the outer edge. It weighed 8 oz.; total length, 16⅜ in. Iris, dark brown; legs, greenish grey; beak, upper black, lower dirty white. Left testes, 1.31 x 0.82 cm.; vol., 0.45 ml.; right testes, 1.53 x 0.78 cm.; vol. 0.40 ml.

This bird was of great interest as Mrs. Gibbings, about June 21, 1950, had described to me a bird which was exactly like a Kookaburra, but black. On June 30 she phoned me to say the bird was around the house again. Though dinner was just served Mr. C. Young, who was staying with me, and myself decided to go over and see the strange bird. It was very quiet and easily observed at close quarters. Mrs. Gibbings' description of it was correct. It was a Kookaburra, but almost completely black. The only parts of the plumage which were normal were the blue spots on the wings, the white patch on the primaries and the upper tail feathers. The bird, which was perhaps a shade smaller than usual, appeared to have a red-brown iris.

This bird, according to Mrs. Gibbings, was usually on its own and over the next few months paid many visits to the house. It eventually mated with a bird of normal colour. There is little doubt that the specimen picked up was the same bird, as it was within the black bird's territorial limits and Mrs. Gibbings had noted that it was getting paler in colour. Also the black bird has not been seen since.

Though albinism is comparatively common in Kookaburras, melanism appears to be very rare. From the history of this specimen it would appear that it would probably have acquired normal plumage eventually.

—ANGUS ROBINSON, Coolup.

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SIMPLE SOCIAL BEES OF WESTERN AUSTRALIA

By RICA ERICKSON and TARLTON RAYMENT.

INTRODUCTION.

The small bees in the genus *Exoneura* appear to be more numerous in the eastern than in the western part of Australia, and while one of us (Rayment, 1951) has already published on the biology of several eastern species, yet the habits of the western bees have hitherto escaped observation, although several species have been collected over the years.

Since this is the first account of these bees in Western Australia, it is given in some detail, and because the investigation was contemporary with the celebration of the "Jubilee Year" of the Commonwealth, the authors deemed it appropriate to mark the occasion by naming the new species *Exoneura illustris*. The bees have hitherto been regarded as solitary wild-bees, but it is now known that they are social in habit, having affinities with the African genus *Allodape*.

LOCALITY.

The Darling Range forms the wall of the western plateau, running approximately parallel with the coast, and about 15 miles inland. It is a laterite-capped series of rugged hills about 1,000 ft. above sea level, with massive granite rockfaces and outcrops. The steep gullies are usually dry in summer, but may become rushing watercourses in winter. Better soils are present in some of the gullies, but the gravelly ironstone slopes have proved worthless for farming.

The Ranges were cut over for timber in the early days, and some mills still operate there, but the hills have retained much of their original state chiefly because they are unattractive for cultivation. Large areas are reserved for water catchments and are consequently sanctuaries for the fauna and flora.

FLORA.

The trees of the Darling Ranges are predominantly jarrah *(Eucalyptus marginata)*, interspersed with marri *(E. calophylla)*. Wandoo *(E. redunca)* occurs chiefly about the fringes, and swampy ground may be marked by paperbarks *(Melaleuca parviflora)*.

Flooded gums *(E. rudis)* flourish along some of the watercourses, but in typical jarrah country there are lesser trees, such as *Banksia,* native pear *(Xylomelum occidentale)* and sheoak *(Casuarina Fraseriana).* Scattered throughout the area are the tree blackboy *(Xanthorrhoea Preissii),* and the drumstick blackboy *(Kingia australis).* There are thickets of *Dryandra floribunda;* various Acacias and a Zamia palm *(Macrozamia Reidlei).* In this company the Slender Blackboys *(Xanthorrhoea gracilis)* flourish. The smaller plants include *Hovea, Grevillea, Leschenaultia,* poison plants, heaths, trigger plants *(Stylidium),* etc., so that no month of the year is entirely destitute of wildflowers.

Towards the end of December 1950, one of us (R.E.) was driving along the Perth-Albany Highway through the Ranges. About 40 miles south of Perth is an area of slender blackboys, plants which bear their crowns of "grass-leaves" near ground level. The slender flower-stalks are about four feet tall, and round the top for three or four inches is a dense "mat" of small creamy-coloured blooms, which are mostly evident in early sum-

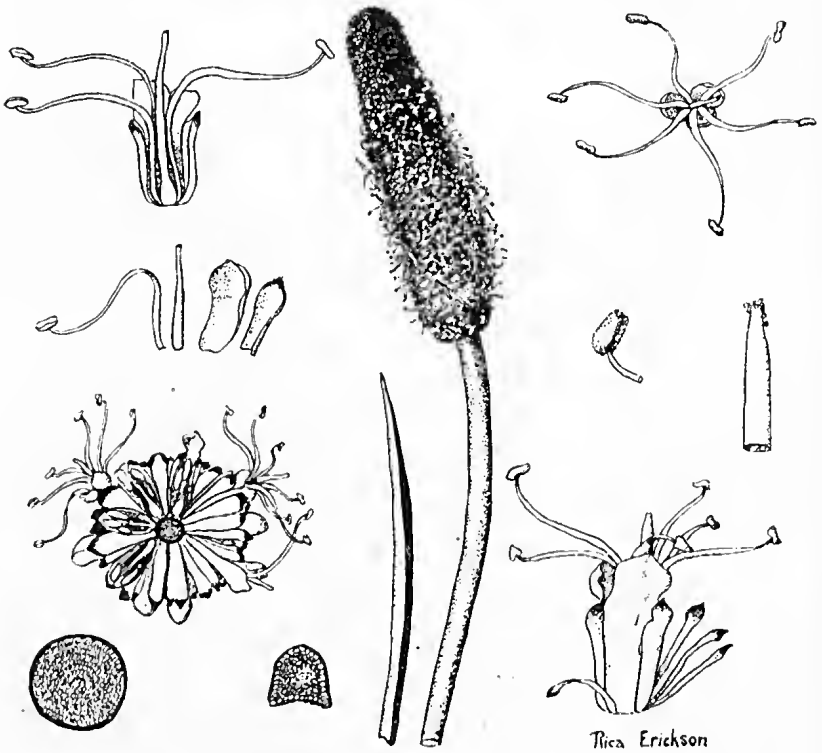

Fig. 1.—Slender Blackboy *(Xanthorrhoea gracilis* Endl.). In the middle, flower head and tip of leaf. On the left, from top downwards, longitudinal section of flower; stamen, stigma, petal and bract; section of the flower head; section of the flower stem; section of the leaf. On the right, from top downwards, a flower from above; stamen; stigma; side view of a flower.

mer. There is little to be gained by investigating the sappy stalks. One must turn to the dry sticks of the previous year, and which have lost their "heads." When the black angular seeds develop the heavy "head" breaks the thin support, and falls off, leaving the pithy interior exposed to the weather.

Most of the dry stems contained nests of small reddish bees of the genus *Exoneura*. As slender blackboys are widely distributed through the Ranges, it is possible that these bees are equally numerous, although they had not previously been studied. Evidence of this was obtained later in the day, when the Main Eastern Highway was being traversed, and we were again in the Ranges. It was easy to collect numerous nests in other similar "headless" stems of slender blackboy. On subsequent visits, more "nests" were taken at several different points along this road.

TAXONOMIC DIFFICULTIES.*

The integument of these small bees is soft, smooth and shining, and the excessively delicate tessellate sculpture is general, and sometimes subobsolete. The systematist is unable to construct a satisfactory dichotomous key to the species in the absence of contrasting characters for the usual couplets. The clypeus, mandibulae, labrum, antennae, metathorax and wings offer no real value to the taxonomist; the legs are of only slight assistance. The wings and their neuration are remarkably stable, and no mutation has been found in the thousand or more species studied by the senior author (T.R.).

Many of the females are extremely difficult to separate, and new species should not be described in the absence of the male and/or the larvae. The difficulty is very evident in females of the *E. angophorae* group. The female bees have very little harvesting-hair, nor is there much need for a larger harvest, since there is no storage of pollen in cells.

The males are easier to determine, for the ivory-coloured facemarks are evident and stable, but clypeal stripe, if any, of the females, is variable. Valuable characters are to be found in the number and arrangement of the spines of the genitalia, and the form of the abdominal sterna. The gradulus, a transverse line on the ventral plates, and also the genitalia, can be examined only after they have been dissected out, and mounted for study under the microscope. The males are usually much more hairy than the females; a condition unique in the Apoidea.

The basal segment of the labial palpus is the longest in all of the mouth-parts studied by us, and neither the attenuated glossa nor the maxillary palpus offer any characters of taxonomic value; there is, of course, no pygidial plate. It is evident that the work of the taxonomist is of a critical nature.

*The taxonomic section is by the senior author (T.R.), who is responsible for the new names proposed.

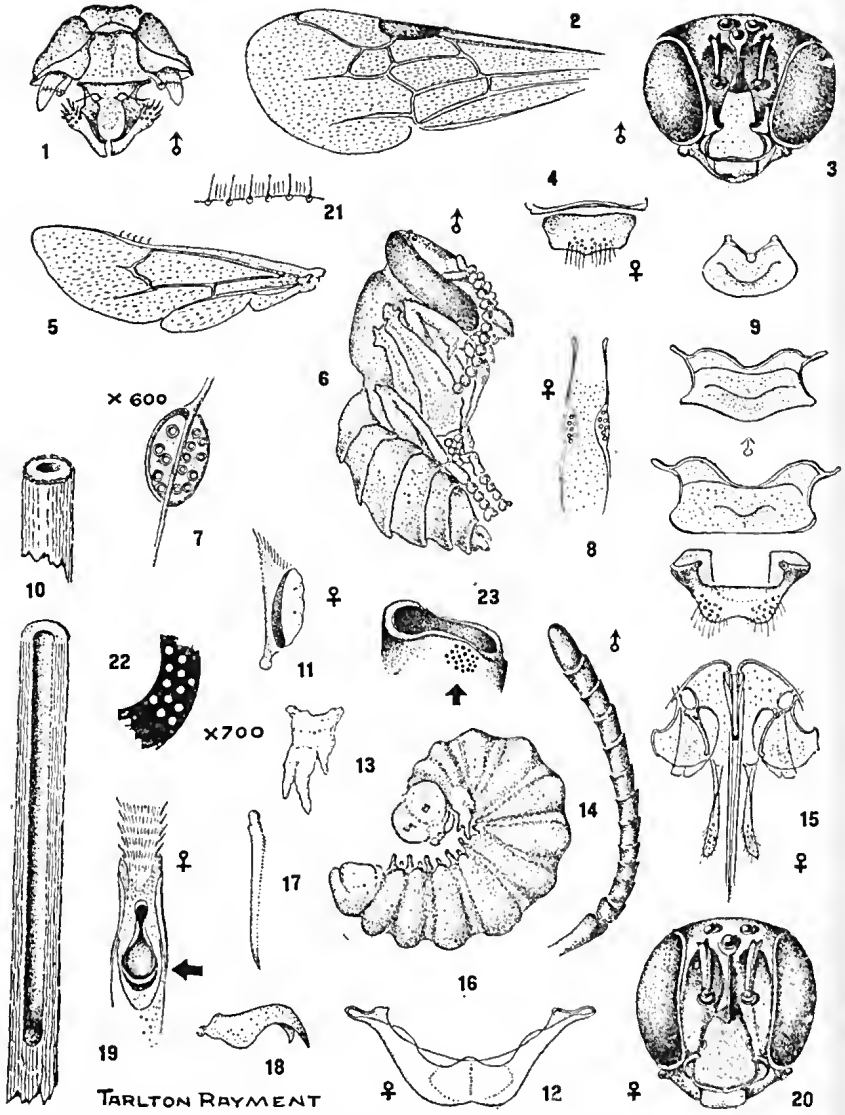

Fig. 2.—Details of Morphology of *Exoneura illustris* Raym. 1—Genitalia of male bee *Exoneura illustris* Raym. 2—Anterior wing of female; note absence of second recurrent nervure. 3—Anterior view of head-capsule of male; note the ivory-coloured clypeus and lateral marks. 4—Labrum of female. 5—Posterior wing of female. 6—Lateral view of male pupa, *E. illustris*. 7—Ducts of pharyngeal gland which secretes the "pap" for the young larva. x 600. 8—Pharyngeal rods showing the position of the ducts of the pharyngeal glands. 9—Three of the abdominal sterna and the apical tergum of the male. The transverse line on the former is the gradulus, which is a specific character in several genera of bees. 10—Section of flower-stalk showing the one communal chamber drilled out of the pithy interior. 11—Strigilis of antenna-cleaner of anterior leg. 12—Mesophragma of bees, thin and springy, connects the bases of the smaller wings, and appears to have some function in their

Division XYLOCOPIFORMES

Family CERATINIDAE

Exoneura illustris, sp. nov.

Type, female—Length, 6 mm. approx. Black, red legs and abdomen.

Head long, shining, an extremely delicate sculpture; frons with a strong carina surmounting a high ridge between the scapes (the sides of the face are deeply excavated, as in *E. excavata,* and this formation throws up the clypeus and supraclypeal area); clypeus has numerous evenly-spaced well-defined piliferous punctures; vertex with rather large ocelli; compound eyes converging slightly below; labrum ivory-colour; mandibles black, with a subapical ivory mark; antennae black, scapes with an ivory line in front; genae shining, with a few white hairs.

Prothorax not visible from above; mesothorax smooth, bright, an exceedingly delicate cancellate sculpture, 12 or so large punctures, parapsidal furrows conspicuous; tegulae shining, black, with amber margins; tubercles black, with a fringe of long dull-white hair; pleura smooth, a few punctures, and sparse white hairs; scutellum similar to mesothorax; postscutellum rougher; metathorax with the dorsum very large, shining, and a coarser cancellate sculpture; abdominal terga ferruginous-red, basal one black, apical segments darker, with some whitish and blackish hairs; ventral segments similar.

Legs red, coxae, trochanters and femora basally black; tarsi red, hind basitarsi with a few black hairs among the golden ones; hind calcar reddish; claws reddish; wings subhyaline; nervures brown; pterostigma amber; hamuli five. .

Allotype, male—Length, 5.5 mm. approx. Coloured like the female.

Head with more long white hair; face excavated as in the female; the entire clypeus ivory-coloured, and also two minute lateral marks which are pointed above; labrum ivory; mandibles ivory and amber; antennae black, an ivory stripe on the front of the scapes; the bulging compound eyes converge below, and the large ocelli are set in excavations in the vertex.

There is considerable white hair about the metathorax laterally; the sculpture of the mesothorax is similar to that of the female; the

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movements during flight. This appears to be overlooked in explanations of how the small wings are moved. 13—Larva appendage. 14—Antenna of male has thirteen segments. 15—Sting apparatus of female. 16—Larva before appendages are absorbed of *E. pictifrons* Alfk. 17—Calcar of posterior leg of female. 18—Claws of tarsus or foot. 19—The large salivarium, at the base of the glossa, is applied to the mouth of the larva when food is passed from the mother; the glossa being bent back over the head. 20—Anterior view of head-capsule of female. 21—Arrangement of hairs on distal margin of wing. 22—Within the thick dark base of the salivarium there is a group of pore-organs—indicated by arrow at 19. 23—Group of pore-organs on posterior coxa.

red of the anterior and median legs is pale-ferruginous, but the posterior pair is darker, almost black, with broad basitarsi and black hair. The femora basally have scopae of long white hair; thorax beneath has considerable white hair.

Locality—40 miles south of Perth, Western Australia, December 10, 1950.—Rica Erickson. Taken from a series of nests in stalks of *Xanthorrhoea* with a number of males and females.

Type and allotype, and "nest" series, in the collection of the senior author.

Allies.—Clearly close to *E. perpensa* Ckll. which is larger and the female of which has an ivory-coloured stripe down the clypeus. The structure of the ridge between the antennae is very different, and the basal segment of the abdomen is not black; the hind legs of *illustris* are darker; those of *perpensa* are not darker, being the same light colour as the others; the labrum is reddish-amber, and the clypeus has fewer punctures. The male *illustris* has very much more hair on the face and body than the male of *perpensa*. There is also a close resemblance to the male of *E. pictifrons* Alfk., which, however, has black hind legs.

Exoneura pictifrons Alfken.

Cockerell (1930) thought it remarkable that the genus was so poorly represented in Western Australia. He suspected that his female *E. angophorae occidentalis* was the other sex of *E. pictifrons,* thus leaving the State with only two species.

The senior author has been able to clear up Cockerell's doubts regarding the association of the sexes, and the junior author's collections, in 1950-51, demonstrated their true relationship. In a long series of females there is a considerable variation in the colours and the number of bands on the abdomen in specimens taken from the same "nest." The males often have a blackish band on each tergum.

The typical female has a bright-red abdomen, with a broad black band on at least each of the first three terga; the red of the abdomen may be ferruginous, with a band on each tergum; the scape may be red in front, or even dull-ivory, with the clypeus entirely black, or suffused anteriorily with an obscure reddish tint; the posterior legs are, however, very black; in only a rare specimen obscurely red.

The very dark terga of specimens from Rottnest Island show a more reddish margin, and Alfken regarded this form as a variety, *obscura,* of *E. pictifrons,* but it is distinct, and adequate structural studies show that it should be raised to full specific rank. The type locality of *obscura* is Mundijong.

Some of the females of *E. pictifrons* have only the basal segment of the abdomen black, and these are apparently Alfken's variety *lacta,* which then approaches *E. illustris,* but the variety has very black posterior legs similar to those of the species. *E. illustris* has red legs.

The type (female) of Cockerell's *E. angophorae occidentalis* was taken at Yallingup by R. E. Turner 1914. The type was compared by Meade-Waldo, at the British Museum, with *E. bicolor* Sm., and he reported: "Not *E. bicolor;* differs in colour of the legs."

In the author's preparations of the morphology of western *Exoneura,* the apical sternum of the males is more or less bidentate, and has some value as a specific character. Microscopical studies demonstrated that the two bees are very closely related, but are distinct, and nearest to the eastern species, *E. perpensa* Ckll.

The bees of the minute black species, *E. albopilosa* sp. nov., do not approach any other of the bees discussed in this paper, but appear to be related to the eastern species, *E. rufitarsis* Raym., which have similar red tarsi, but are larger, and more robust bees.

Exoneura albopilosa, sp. nov.

Type, male—Length, 5.5 mm. approx. Black.

Head quadrate, and very large for so small a bee; frons excavated deeply around bases of scapes, and up to level of lateral ocelli, shining; clypeus of a peculiar shape, with a well-defined longitudinal lineation, and long loose white hair; at sides of clypeus the integument is polished; supraclypeal area elevated, and rising to a ridge surmounted by a fine carina that reaches the median ocellus; the bulging compound eyes converging strongly below; labrum large and black; mandibulae simple, basally black, apical third amber; scapes black, flagellum amber beneath; the median ocellus placed on a flat area formed by the apex of the ridge on the frons; vertex long.

The whole of the shining integument has a delicate tessellate sculpture, with many long loose white hairs, except on the scutellum, where the hair is black; the sculpture of the metathorax is coarser and scale-like. The abdominal terga are narrowly amber on the posterior margins, and the apical segments are quite rough; long microscopically-plumose white hair. Tegulae and tubercles black; the pleura having much long white hair.

Legs black; tibiae suffused with reddish; tarsi pale-amber to ivory-colour; the hind basitarsi large, white hair; wings iridescent; nervures sepia, the first recurrent practically meeting the first intercubitus; second cubital cell very large; pterostigma brown; hamuli six, weak; calcariae finely serrated, golden yellow.

Locality.—40 miles south of Perth, Western Australia. Bred out of *Xanthorrhoea* stalks by Rica Erickson, January 1951.

Type and paratype in the collection of the senior author.

Allies.—This is an excessively small species, not a typical *Exoneura* and very distinct by the characters of the genitalia. It approaches *E. rufitarsis* Raym. (from Victoria), but not very closely. *E. rufitarsis* is a larger bee, with a small head and is almost nude on the head, thorax and abdomen; it has a yellow clypeal stripe, labrum and tubercles, but red tarsi.

Exoneura minutissima, sp. nov.

Type, female—Length 3 mm. approx. Black, polished, with reddish legs.

Head almost circular from the front, practically nude; face deeply excavated laterally; frons with a fine carina reaching the medium ocellus; clypeus with the carina extended nearly down to the labrum, practically impunctate; supraclypeal area with continuous carina; vertex with the delicate tessellation more evident; compound eyes converging below; genae with a few white hairs; labrum obscurely amber; mandibulae black, acute; antennae black, some obscure red on scapes.

Prothorax black; tubercles amber, with long white hair (black in *E. albopilosa*, ivory in *E. rufitarsis)*; mesothorax shining, almost polished, but excessively delicately transversely striate; scutellum similar; postscutellum rougher, with some white hair; metathorax with the dorsum depressed into a transverse channel, the tessellation is most evident on this part; abdominal dorsal segments shining, transversely striate, a few piliferous punctures, and white hairs; ventral segments with a few longer white hairs.

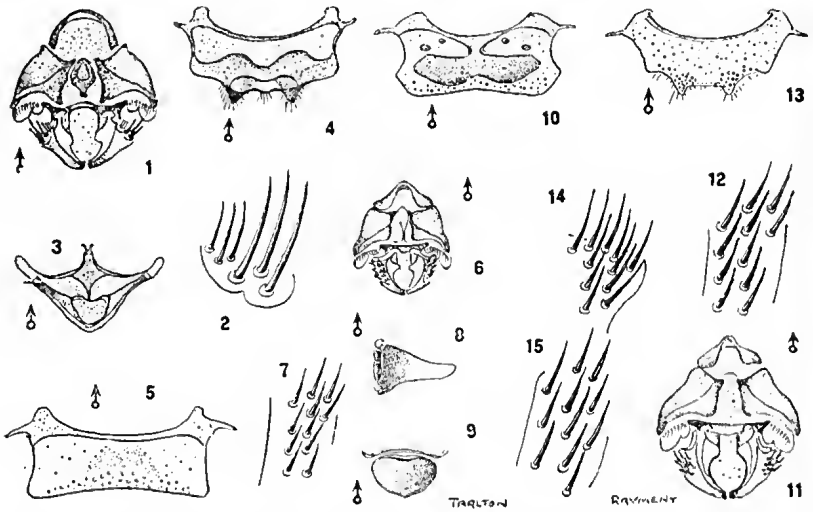

Fig. 3.—Details of male *Exoncurae*. 1—Genitalia of male *Exoneura obscura*, Alfken et Rayment. 2—Arrangement of spines. 3—Another view of gonobase of genital capsule. 4—The bidentate sternum of the male abdomen has value as a specific character. 5—Third sternum of the abdomen (compare with No. 9, Fig. 2). 6—Genitalia of male *E. albopilosa* Raym. 7—Arrangement of spines. 8—Mandibles are simple in males, and have no specific value. 9—Labrum is black, and not typical of the genus (compare with No. 4, Fig. 2). 10—Third sternum of male abdomen (compare with No. 9, Fig. 2). 11—Genitalia of male *E. pictifrons* Alfk. 12—Arrangement of spines. 13—Apical sternum of male abdomen. 14—Arrangement of spines of *E. perpensa* Ckll. 15—Arrangement of spines of *E. illustris* Raym. (The three genital capsules are drawn at the same magnification.)

Legs black, anterior tibiae red, others black basally, red apically; tarsi reddish-amber; claws reddish-amber; hind calcar straw-colour; tegulae black, with an amber spot; wings slightly dusky; nervures brown, first recurrent entering second cubital cell at its basal fifth; basal nervure strongly arched; pterostigma brownish-amber; hamuli five.

Locality: 90 miles north of Perth, Bolgart, W.A., 1951, leg. Rica Erickson.

Type in the collection of the author.

Allies.—In the *E. rufitarsis* group, but smaller even than *E. albopilosa* Raym., which has long white hair; face not excavated so conspicuously, pale-amber nervures, with the first recurrent meeting the first intercubitus, the second cubital cell much larger; flagellum amber beneath. The new species has its minute apical plate emarginate. The general facies is that of a very small *E. rufitarsis* Raym.

Division MEGACHILIFORMES

Family MEGACHILIDAE

Megachile gilbertiella silvestris, subsp. nov.

One of the grey stalks from the southern locality contained a very small female leaf-cutter bee, which was determined as a new subspecies of *Megachile gilbertiella* Ckll. It differs from the nominate subspecies by its smaller size, larger head, and blacker aspect; the clypeal teeth are practically obsolete; the punctures are largest at the sides, and grow progressively smaller towards the disc; the white hair is peculiar, being finely "crimped" like merino wool; the supraclypeal area is not defined; the red of the apical segments is darker, and much reduced in area.

The female was probably only sheltering in a cavity excavated by *Exoneura.*

The nominate subspecies was described from Cooktown, Queensland, but the senior author has typical females from the following localities:—Broken Hill, November 5, 1940, Royce C. Mew. Woy Woy, New South Wales, December 1934, John Willey.

These records add the species to the fauna of the eastern States.

NOTES ON ARCHITECTURE

The junior author's collections demonstrated that *Exoneura* are numerous in at least the South-west corner of the State, and the number of species will certainly be increased in the future.

The table below will indicate the density of the species in certain areas. A series of 15 flower-stalks of *Xanthorrhoea* was collected simply because each showed a 3 mm. aperture at the top. Almost every flower-stalk contained live bees.

Compared with the smaller greyish-coloured dry stalks favoured by *E. illustris,* those used by *E. pictifrons* were larger, averaging 8 mm. in diameter, and the colour was bright coffee-brown; the length of the communal chambers averaged 17 cm.,

but the bore was still only 3 mm. in diameter, the same as that of *E. illustris*. There was, therefore, a greater thickness of pith surrounding the chamber.

The brown flower-stalks were much tougher, but the differences in colour and structure were not investigated; they could have been due to age or chemical or ecological factors.

It was nevertheless interesting to discover these preferences in bees so closely related. The smaller chambers of *E. illustris* are excavated almost to the woody wall. In both the eastern and the southern localities, the 15 or so flower-stalks from each contained exclusively one species of *Exoneura*, except one stalk from the southern locality, which contained three adults and larvae of the excessively small black species, *E. albopilosa*, Raym. The nesting habits of the black species do not appear to differ from that of the red bees.

CONTENTS OF AUTUMNAL (April) STALKS.

No. of stalk	No. of adults	No. of pupae	No. of larvae
1.	1 mature female 1 mature male	1 male 1 female	nil
2.	3 mature females boring in pith	Nil	Nil
3.	3 mature females boring in pith	1 female	Nil
4.	No bees present. Chamber under construction	Nil	Nil
5.	Same condition as 4		
6.	2 mature females sheltering in old stem	Nil	Nil
7.	2 mature females	Nil	Nil
8.	2 mature females 1 callow female. All boring a new chamber	Nil	Nil
9.	No bees present. Chamber in course of construction	Nil	Nil
10.	2 mature females 1 callow female 1 callow male	1 female	Nil
11.	No bees present. Chamber in course of construction	Nil	Nil
12.	3 mature females	Nil	Nil
13.	1 female boring at the base of a very long chamber	Nil	Nil
14.	1 female in a very short chamber	Nil	Nil
15.	No bees present. Chamber newly constructed	Nil	Nil

The stalks collected in December contained numbers of pollen-puddings, eggs, larvae, pupae, and adults, for each tiny "colony" has then reached its maximum activity. There are probably only two generations for the season, and the chambers in the April stalks were being prepared for the spring generation.

PLANTS VISITED FOR POLLEN.

Fifteen pollen-puddings were removed from the stems and examined microscopically. It would appear that at least six species of plants were represented. The majority of the pollen-grains were triangular in shape, and probably harvested from two species of *Melaleuca;* these may be known as A and B. Two white kinds resemble minute footballs, one was much larger than the other, and there is little doubt that they were gathered from some leguminous plant; the symbols for the table will be C and D. Two other kinds also were triangular, and typical of the genus *Eucalyptus*. The surrounding forest was composed of marri and jarrah trees, but it is impossible to identify the species of pollen; E and F. will distinguish this group.

COMPOSITION OF PUDDINGS.

The following table gives the pereentages of the several kinds of pollen-grains:—

No. of Pudding	A	B	C	D	E	F
1	96	4	—	—	—	—
2	—	60	20	5	10	5
3	—	100	—	—	—	—
4	—	80	18	—	2	—
5	—	97	1	—	2	—
6	—	35	35	30	—	—
7	—	45	40	15	—	—
8	—	95	—	—	—	5
9	—	100	—	—	—	—
10	—	100	—	—	—	—
11	1	97	—	—	—	2
12	—	100	—	—	—	—
13	—	30	—	60	5	5
14	—	100	—	—	—	—
15	—	100	—	—	—	—

CONTENTS OF VERNAL (Oetober) STALKS.

On Oetober 20 1951, twelve dry flower-stalks of the smaller *Xanthorrhoea* were colleeted at the original site, the 40-mile post, and eleven eontained nests of *Exoneura illustris*. The stieks averaged 18 cm. in length, with a diameter of 6 mm. The bore was 3 mm. in diameter, but where the natural tube—i.e., not bored by the bees—exeeeded that measure, the entranee was eontraeted by the bees with a ring of wood-pulp. The contents of the stalks are given below:—

No. of Stalk		No. of Adults	No. of Eggs	No. Larvae
1.		2 females	—	—
2.		2 females	9	3
3.		4 females	A few pollen-grains	1
4.	Entrance contracted	1 female excavating pith	3	—
5.		3 females excavating pith		—
6.		2 females	14	—
7.	Contalned a very small 3mm. black spider with mlcroscopic white dots.			
8.		2 females	12	5
9.	Boring nearly completed, bat no bees were present.			
10.	No bees were present		2	—
11.		3 females	8	10
12.		2 females	5	7

The salient features of these spring nests are:—1. The nests are founded by two or more females (sisters). 2. The utter absenee of males; they had feeundated the females the previous autumn and did not survive the winter. 3. The larvae had only just hatehed from the eggs, which were laid "eriss-eross" at the base of the chamber. Smear preparations revealed pollen-grains in the larval mesenteron. 4. This brood would be matured for the summer generation.

THE EGG.

The opaque white egg, a mere millimetre or so in length, is slightly bowed, and "glued" on the lumen at the caudal end with a elear seeretion from the mueous gland in the apieal segments of the female's abdomen. The eggs are usually deposited in lines, but in eertain speeies laid just eriss-eross, loose, in the base of the lumen. This group provides a few pollen-grains among the larvae.

The ehorion of the egg splits at the eephalie end, leaving the baby larva projeeting out at right angles from the wall. The gluey

mueous fastening the egg is not brittle, but rather horn-like, for in walking up and down inside the tube the females of neeessity often press the larvae baek flat against the wall, but they quiekly regain their horizontal position.

LARVAL FOOD.

The larvae are fed with a milky "pap" seereted by the female, as has been shown by one of us in another plaee. The larvae have been observed to "suek their thumbs," so that the appendages are very probably exudatoria. It has been suggested that the males may return to obtain a lipoid from the larval appendages. However, longitudinal and transverse mieroseetions of the "arms" show a eanal and many fat-eells.

After 21 or so days, a small individual pollen-pudding, about 2.5 mm. in diameter, is gathered by the mother, and plaeed on the ventral surfaee of the larva, whieh is slightly eurved to hold the food up to the mandibles.

It has been amply demonstrated by one of us that the larvae are eapable of surviving weeks of fasting, and the period of larval growth is the longest of any bee known to the senior author, for it extends over several weeks (see table, *Australian Zoologist*, vol. 11, pt. 4, 1951, p 309). In an experiment 4 males and 18 females of *Exoneura pictifrons* Alfk. were imprisoned for over 100 days in 11 glass test-tubes (3 in.), whieh were elosed with loose-fitting plugs of eotton-wool. The hees were without food and drink for the entire period, and many survived that long fast. They were kept at a temperature of 10° C., but the experiment was not pressed

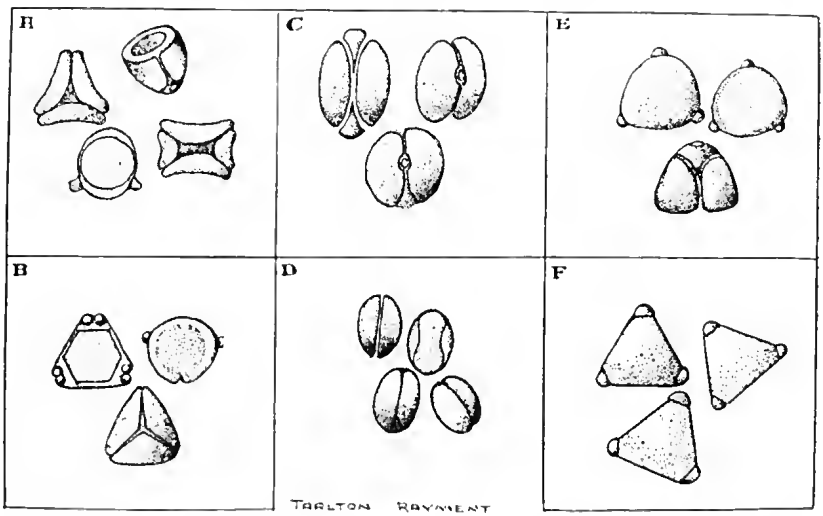

Fig. 4.—Pollen-grains harvested by soeial bee, *Exoneura illustris* Raym. A and B—Myrtaeeous, *Melaleuca* sp. ? (a few abnormal grains in this group were reetangular). C and D—Leguminous, but speeies unknown. E and F—Myrtaeeous, *Eucalyptus* sp. ? All the grains were drawn from glyeerine mounts.

beyond the 100 days to ascertain the extreme limit of endurance.

As in the Eastern States, the busiest period for the western bees appears to be November-December, when adult males and females, eggs, larvae, pupae and puddings are all present in the plant-stems. There are very probably only two generations for the season.

LARVAL DEVELOPMENT

The actual hatching of the egg is difficult to detect, but traces of segmentation within may be observed. The chorion of the egg is so excessively delicate that when it does split, at the cephalic pole, there is just a microscopic speck of skin attached to the larva.

The babies are meticulously "groomed" by the adult females, and stroked with the tarsal brushes of the front pair of legs; the "egg-shell" and any other debris is brushed off during these cleansing actions, which maintain the larvae in an immaculate pearly condition.

Ever and anon, one of the females will take the head of a baby between her jaws, as though sucking a lolly-pop, and then, bending her glossa right back under her head, brings a cavity, the salivarium, on the top of her tongue, over the mouth of the baby. The white soft "pap" then flows into the mouth of the larva. At the conclusion of the meal any surplus food is wiped away by another female.

The lateral appendages are very small at first, but as the larva grows the processes develop into "arms," with two or three "fingers" and a thumb. Several of the eastern species have only one "finger," but the larvae of the western bee have two "fingers" and a "thumb" on the main appendage. As metamorphosis approaches the appendages are absorbed.

The pupa is quite smooth, that is, it lacks the numerous nodules and spines which distinguish the pupa in fossorial bees in the Family Halictidae. It is interesting to learn that the pupae of many spheeid wasps (fossores) are similarly armed with fleshy spines on the scutella, abdominal terga, and legs.

The smooth pupa is typical of all the higher social families of the Apidae, and there is now no doubt that the *Exoneura* are highly developed bees; far higher, in fact, than any other of the solitary wild bees with which they have always been confused.

BEHAVIOUR OF THE INDIVIDUAL

At the mouth of every shaft there is usually one adult bee present, head downwards in the tube, possibly to guard the door against unwanted visitors. The oldest larvae are found nearer the top of the shaft, "mouthing" hungrily as they wait their turn to be fed. At the base are the eggs and also the youngest larvae, together with portions of the pollen-puddings.

Between the two groups an adult bee or two is usually stationed as though in attendance on the youngest babies. The bees come and

go from the stalks in a busy traffic. A returning female may have to jostle her way for many seconds at the mouth of the shaft, shoving against the abdomen of the "guard" bee. The latter will at last reverse, in what appears to be a peevish manner, to emerge head first, to fly away. This turning over can easily be accomplished in the diameter of the tube. Any other bees which may happen to obstruct the shaft are likewise jostled until they also reverse or turn about to fly off. The homing female is then able to descend unobstructed into the chamber.

When the bees are excavating a new shaft, in the soft pith of the stem, a fine "fluff" of white shavings covers them, giving a paler dusty aspect to the builders. The nature of their activities when hidden in the interior of the shaft may often thus be detected without destroying the nest.

As the larvae develop they become restless, and gradually work their way up the wall of the shaft in groups of two or three. The lower portion of the body is braced against the walls in a curve and thus maintains its position. The "arms" also are used to support the body, and appear to help it move upwards. When presented with a morsel of food on its "chest" it feeds with the mouth pressed voraciously to the tiny pollen-pudding, which the "arms" prevent from rolling away out of reach. When hungry companions are close alongside, the arm-like appendages are sometimes used to ward them off.

OLFACTORY ORGANS

Anatomists and physiologists agree that bees are able to distinguish one odour from another, but there is a divergence of opinion regarding which organs are olfactory in function. McIndoo (1914) claimed that 18 groups of pore-organs found on hive-bees are the true olfactory organs, but von Frisch (1919) carried out a series of experiments which indicated that other organs of the antennae also function in the detection of odours.

Although most of the above experiments were with hive-bees, yet it would appear, from the senior author's researches, that similar groups of pore-organs are present on wild-bees, and several have been identified on *Exoneura illustris* Raym. and on *E. albopilosa* Raym. There are conspicuous groups near the articulation on the posterior coxae; in the salivarium of the glossa, but we are unable to say whether or not this group is homologous with that found by Mr. McIndoo in the mouth cavity of the honey-bee. Pore-organs are present on proximal and distal ends of trochanters; proximal ends of anterior tibiae; inner margins of prosternal sclerites; proximal end of posterior femora; first segment (pedicel) of flagellum; proximal end of posterior coxae; bases of wings. The organs are perhaps common to all bees.

Under the microscope, pore-organs appear as circles of light enclosed by a dark rim; sections show a dome-like structure under the epidermis, with a slender extension of a sense-cell (Snodgrass, 1925).

Dr. W. H. Thorpe, Cambridge University, reviewing the extraordinary experiments of Prof. K. von Friseh on the honey-bee's ability to orientate itself, suggested that the pull of gravity is presumably pereeived by the proprioeeptive sense organs at the limb and abdominal artieulations.

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INTER-SPECIFIC COMPETITION ON SMALL ISLANDS

By D. L. SERVENTY, Nedlands.

A eharaeteristie of the distribution of some members of the native fauna on the islands around the Western Australian eoast is that a speeies of a elosely related group may be found on one island and another speeies on another. But the two do not exist together on the one island, though all of the speeies eoneerned oeeur on the mainland in the same general geographieal area. The faets are best known in the ease of the marsupials and the reptiles.

The Quokka *(Selonyx brachyurus)* is found on Rottnest Island and Bald Island on the south eoast. The Tammar *(Macropus eugenii)* oeeurs on East and West Wallaby Islands in the Abrolhos, on Garden Island and on eertain of the islands of the Arehipelago of the Reeherehe (North Twin Peaks and Middle Islands). The Roek Wallaby *(Petrogale lateralis hacketti)* inhabits Mondrain, Combe and Salisbury Islands in the Reeherehe.

Among the snakes the Carpet Snake *(Morelia variegata)* is found on the Wallaby Islands and on Garden Island. The Dugite *(Demansia nuchalis)* is found on Rottnest Island and the Tiger Snake *(Notechis scutatus)* on Carnae and Garden Islands.

All these islands were formerly joined to the mainland and the fauna now represented on them is the survival of that whieh existed there before the islands were isolated. To aeeount for the present distribution, some ingenious theories have been put forward. J. R. Clarke ("Notes on Natural History of the Quokka," *Journ. Roy. Soe. W.A.*, vol. 33, 1948, p. 141) explains the oeeurrenee of the Quokka on Rottnest and of the Tammar on Garden Island by invoking a theory of inter-speeifie eompetition whieh is unaeeeptable on modern ecologieal views.

A more reasonable explanation of the distribution phenomena on these islands may be found in the applieation of what is eoming to be known as "Gause's Law," after G. F. Gause *(The Struggle*

for Existence, 1934) who experimentally demonstrated a prineiple long familiar, in effeet, among field naturalists that two speeies with similar ecology eannot eo-exist in the same habitat. In a normal mainland environment a diversity of similar animal speeies ean oeeur, eaeh eharaeteristie of a partieular eeologieal niehe or else differing in food preferenees. A small island, however, eannot maintain a variety of habitats of suffieient effeetive area and there must eome a point in the reduetion of an island, varying for different speeies, where distinetion between eeologieal niehes is no longer a real faetor. The formerly non-eompeting forms are no longer so and Gause's Law eomes into operation. Whieh speeies survives may depend on fine differenees in the reaetions of eaeh to the partieular insular environment, or perhaps, be entirely fortuitous.

David Laek *(Genetics, Paleontology, and Evolution,* 1949, p. 302) has referred to the subjeet in his study of the finehes of the Galapagos, stating: "The reduetion in the number of speeies and of eeologieal niches, even in the same general type of habitat, on islands as eompared with eontinents, and on small as eompared with large islands, seems widespread in birds, and should be studied further." Ernst Mayr *(Advances in Genetics,* vol. 2, 1948, p. 215) quotes Stresemann in pointing out that "there is some eorrelation between the number of eeologieal niehes in a given region and the number of sympatrie related speeies that ean be aeeommodated. The poverty of island faunas is partly due to this faetor. Speeies whieh on mainlands live side by side may be strietly allopatrie on islands."

Rottnest Island has an area of 4,726 aeres, Garden Island, 2,790 aeres and Carnae Island, 43 aeres. These islands appear to have been redueed to an area whieh is signifieant for the limitation of numbers of speeies of moderately-sized vertebrates. For insects and other invertebrates the eritieal threshold area may not have been reached.

The bevelling out of effeetive differenees between eeologieal niehes on small islands, and the eonsequent simplification of the ecologieal pieture, means that only *one* speeies of a group with rather similar habits will, in general, survive. The eonsequent removal of inter-speeifie eompetition may result in the single surviving species oeeupying habitats in which it would not normally be found on the mainland. The removal of brakes to population increases by the elimination of inter-speeifie eompetition may also result in the individuals oeeurring in mueh greater eoneentration than is ordinarily found on the mainland. There may be a poverty of speeies on small islands but often the abundanee of indivíduals is very great. Western Australian examples are striking, namely the Quokka on Rottnest, the lizard *Egernia kingii* on Pelsart and Eelipse Islands, and the Death Adder *(Acanthophis antarcticus)* on some of the Reeherche Islands. In Bass Strait some islands, notably Chappell, carry a population of Tíger Snakes whieh has made them notorious.

BAG SHELTER CATERPILLARS AND THEIR HABITS

By Mrs. M. B. MILLS, Merredin.

To anyone taking a walk in the bush in the Wheatbelt in the early part of the year it will not be an uncommon experience to come on many silken bags hanging from jam or wattle trees. Most people know that these are the constructions of the Processionary or Bag Shelter Caterpillar, but the details of the very interesting life history are little known. There are other similar caterpillars which live in shelters on the ground at the butts of jam and wattle trees. I have reared the larvae of both and have submitted them for identification by the Division of Entomology of the C.S.I.R.O. at Canberra. Mr. I. F. B. Common has replied as follows:—

"The two moths are, as far as I know, the one species, *Ochrogaster contraria* (Walker) (Family Notodontidae). This is an extremely variable species and the specimens forwarded come within the range of variation in the specimens at present included under this name. The species is the well-known bag shelter caterpillar of the inland portion of the Eastern States, and causes damage to numerous native trees including several Acacias, such as boree, brigalow, etc. The larvae usually form a bag shelter by webbing together leaves and twigs of the host tree, within which the larvae live gregariously, emerging from the shelter at night to feed. Sometimes the larvae live gregariously in a webbing shelter against the base of the tree. As far as we know the two kinds of larval behaviour are exhibited by the one species."

Though taxonomists include the two types of caterpillars as one species I have found it possible to distinguish between them and, as the following notes show, though their activities may at times confuse each other, the arboreal types keep separate from the terrestrial ones. In the description of life history behaviour in the following account I have found it convenient to restrict the use of the name "Bag Shelter Caterpillar" to those with shelters in trees whilst those with shelters at the butts of trees are referred to as "Ground-nesting Caterpillars." Some details of the life history of the latter were given by me in the *W.A. Naturalist,* vol. 2, 1950, pp. 84-87. The present contribution deals mainly with "Bag Shelter Caterpillars" proper.

On January 1, 1950, at Merredin, a small, almost round, straw-coloured object was seen on the slender branch of a jam tree. It was soft to the touch. This was the first small beginning of what would later become a large silken bag suspended in the jam tree: the shelter of the Bag Shelter Caterpillar *(Ochrogaster contraria).*

The female moth settles on the branch or at the fork of a tree, usually on a slender twig of a jam or wattle tree and lays her eggs there. The eggs remain on the twig, apparently stuck on with a sticky substance from the moth's body. The eggs are covered with fawn or light coloured fluffy scales from her body. The scales covering the eggs are "packed" into a round shape,

from which, usually after a short period, the eggs hatch and the tiny caterpillars begin their life.

For about 9 days there was no noticeable change, then tiny holes appeared all over the small bag shelter.

On January 10, a hot day with the temperature over 100° F. at 2.15 p.m., a number of small hairy caterpillars about ¼ in. in length and grey-greenish in colour, were moving about on the shelter, with half a dozen in single file proceeding along a jam branch. The caterpillars were not seen out on the following days, until January 17 at 7.30 p.m. when they were found grouped on a leaf feeding. After feeding they proceeded in single file along the branch to their shelter, entering it through the small holes. There were 21 caterpillars in the line. After that they were not seen out for a few days; east skins were adhering to the bag.

On January 22, at 7.30 p.m., 6 caterpillars were out to feed and returned to the bag. Usually a fine white silken thread is left hanging to the leaf as it is fed on; the caterpillars also leave a fine silken trail on the tree branch leading to and from the bag. That evening was stormy and cool, with light showers; the rain did not disturb the caterpillars.

The following day was very hot. At 7.30 p.m. 26 caterpillars were moving along a branch a short way from the bag, in search of food; they settled on the jam leaves to feed, returning to their shelter 45 minutes later.

The caterpillars were not seen out again for about a week, but some east skins were showing out of holes in the bag. The largest hole in the bag had been closed with silken threads.

On February 1 many leaves had been eaten from the branch of the tree, skins and "dirt" adhered to the bag; one caterpillar

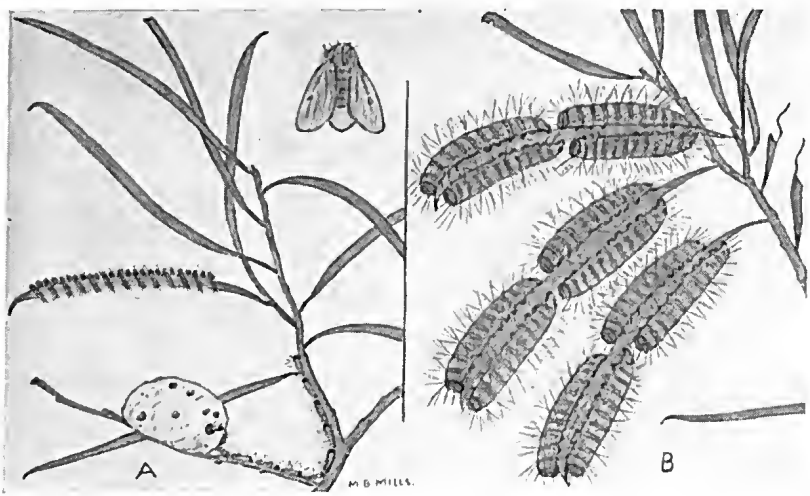

Fig. 1—A—Young caterpillars emerging from the shelter to feed while others rest on either side of a leaf feeding. Female moth at upper left-hand corner. B—Caterpillars feeding. Half natural size.

was seen in a hole in the bag. That evening at 7.30 the caterpillars came out to feed, clustering on the leaves. Ten minutes later they returned to the bag, and on arriving there they crowded on top, in a round, hairy mass, seeking the holes, and one by one disappeared within. In doing so loose cast skins were pushed aside from the holes to blow away in the wind.

The next evening was cool with strong winds. At 7.15 the caterpillars left the bag and set off in single file along the branch to the leaves.

On February 3 at 6.15 p.m. the caterpillars were returning from feeding. They had moved along the branch in the opposite direction seeking a new branch on which to feed, the previous one being almost bare of leaves. When they reached the bag they spent a short time weaving silken threads over and about it, and to the fork of the tree, closing all but two holes in the bag.

February 5.—The caterpillars returned from feeding at 7.30 p.m. They had gone further along the branch in search of a new feeding place.

Next evening they set out to feed at 7 o'clock, returning 45 minutes later. While they were feeding on the leaves, it was interesting to watch three caterpillars at a leaf clinging to a thread, swinging in mid-air several feet above the ground; the thread was an inch long and looped, two caterpillars were upside down, but had a fast grip, the heads and some legs were loose. They moved along the silken thread and on to the leaf.

The next three evenings the caterpillars were not seen out at the usual time; one large hole in the bag was threaded over. The bag was increasing in size, neat and covered with shining silken threads.

On February 10, at 7 p.m., 17 caterpillars emerged to feed, coming out of one hole in the bag. The day had been hot and cloudy with strong winds; at evening it was calmer, but stormy. The caterpillars returned from feeding at 8.15 p.m. Next day there were some cast skins on the bag.

On February 12, at 7.15 p.m., 24 caterpillars were out to feed; half an hour later they returned to the bag. Then for five days the caterpillars were not seen, although each day there were newly-cast skins on the bag.

On the morning of February 18, at 11.45, the caterpillars moved to another branch on the same tree and had made a new bag shelter. Silken threads led from the old bag down the tree branch to the butt, then across a fork, up another branch to near the leaves. There in a fork a slightly larger bag had been made.

Next evening the caterpillars were grouped on leaves feeding above the new bag; they returned to it half an hour later.

All the next week the caterpillars were not seen, but emerged again on February 27 at 6 p.m., and at the same time again next evening, returning over an hour later to the bag. The weather was very hot, over 100° F.

On March 1, at 7.25 p.m. two caterpillars were out of the bag, one was weaving silken threads about the top of it, while the other

caterpillar was resting a short way up the branch. They remained there for almost an hour. Next evening, at 7 o'clock, a number of caterpillars were massed on the bag weaving silken threads about it; shortly afterwards they set off to feed, returning at 9 o'clock.

For the following days there was no change in their habits. Then on March 7 and the four following days they were not seen out feeding, but may have come out very early in the morning or late at night, as the branch was becoming bare of leaves. The bag was neat and well threaded over with shining silken threads.

On March 12 the caterpillars emerged from the bag between 7.15 p.m. and 7.55 p.m. At 7.55 p.m. they were up on the leaves feeding or seeking food. The leaves had been eaten from the branch, leaving almost bare twigs. The caterpillars moved about quite a lot seeking leaves; one apparently lost the group and returned towards the bag.

Early next morning the caterpillars left their shelter and proceeded down the branch in single file. They were intercepted by small black ants, which made angry darts at the caterpillars, halting them for some minutes. When the ants left off attacking them, the caterpillars moved off again down the branch to another forked branch lower down from the bag. Ants had been swarming on the bag for almost a week.

On March 14, at evening, the caterpillars were out feeding on a new branch.

There were now many silken trails leading up and down the jam tree, some of them having been made by the Bag Shelter Caterpillars; but a number of the heavier or more clearly defined trails had been made by a nest of hairy caterpillars described here as Ground-nesting Caterpillars, which hatched out in a light coloured fluffy nest under an upturned sheep trough near the butt of the jam tree. There was a large number of caterpillars in the nest (195) and as they travelled about the tree to feed, soon left many silken trails.

The trails of the Ground-nesting Caterpillars seemed to confuse the Bag Shelter Caterpillars and as they returned to their shelter, would often take the wrong trail, and spend a while getting back to their bag. One caterpillar was found apparently lost and almost dead, with ants attacking it, at the butt of the tree.

On March 15 at 7.15 p.m. the Bag Shelter Caterpillars were moving down the branch, which forked at the butt of the tree. They then crossed over, ascending another branch. Two of these, which appeared lost, were found moving along the edge of the upturned sheep trough, under which the Ground-nesting Caterpillars had their nest 18 inches away from the jam tree. The two Bag Shelter Caterpillars may have followed a silken trail down the tree, along the ground and to the Ground-nesting Caterpillars' nest. The two caterpillars were placed back with the group on the branch.

Early next morning the caterpillars ascended a branch to the leaves and grouped there; then commenced to weave silken

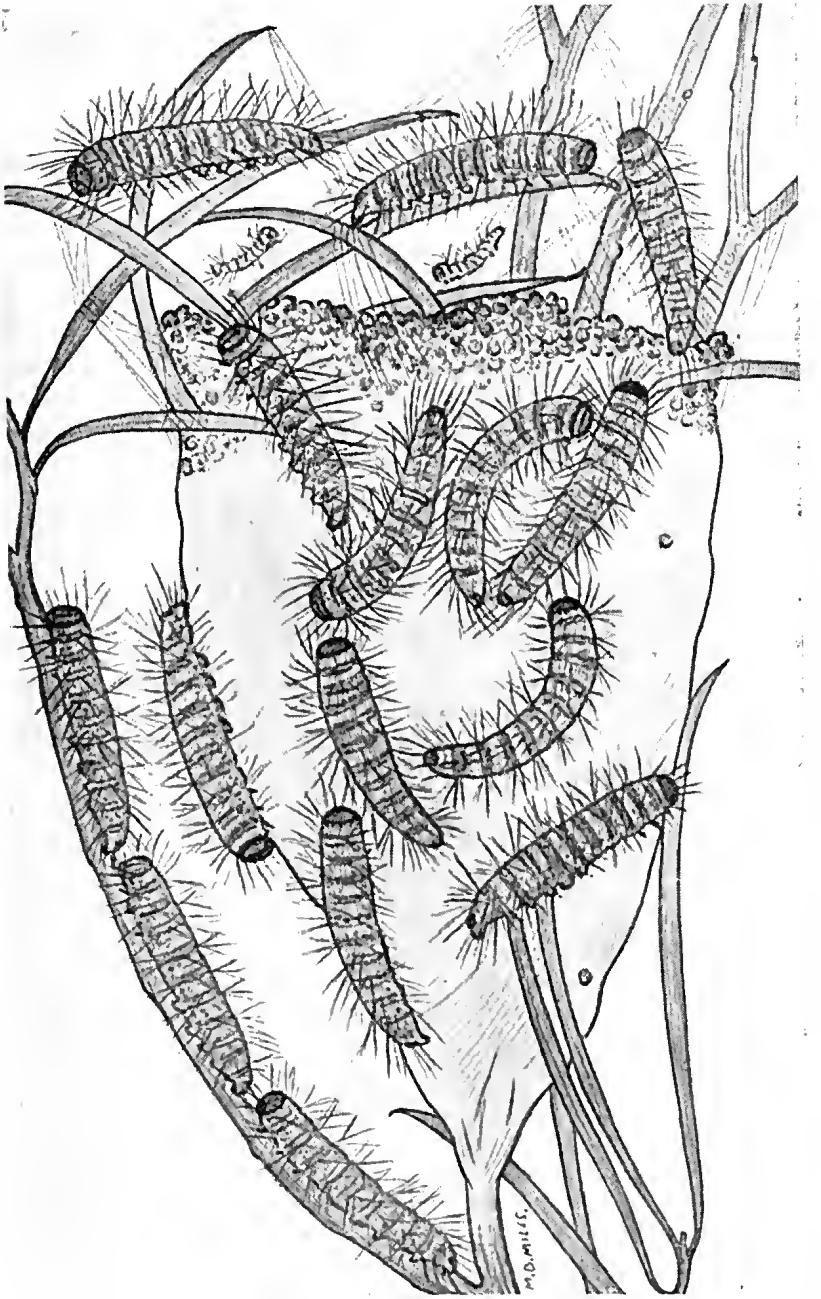

Fig. 2—The silken bag shelter with almost fully grown caterpillars weaving silken threads about the bag; some caterpillars ascending a branch to feed. Nearly natural size.

—Mrs. M. B. Mills del.

threads about a small fork in the branch and to leaves in a circular manner. Later they moved into the rather frail, transparent new bag shelter.

The following day was spent working on the new bag, the caterpillars' bodies looking like a round fluffy ball as they weaved silken threads. At evening they left the bag to feed on the leaves. For five days they continued in this way, setting out each evening, but one, to feed.

Then a week passed and the caterpillars were not seen out. A search was made about the tree; the new bag slightly opened, but it was empty. The bag from which they had previously moved contained some caterpillars. Once again, the many trails leading up and down all the branches of the tree may have confused the caterpillars, causing them to lose their trail back to the new bag, and finally, in a maze of trails had made their way to the other bag.

On March 29 the caterpillars left the bag to feed. It was found later that they did not return to it; there was no trace of them on their own or at nearby trees. They had completely disappeared.

On March 30 a further search was made for the missing Bag Shelter Caterpillars, and at evening they were found in the nest of the Ground-nesting Caterpillars near the butt of the tree. At 7.30, as the Ground-nesting Caterpillars emerged from their nest under the sheep trough and began to ascend the tree to feed, a number of Bag Shelter Caterpillars were also travelling along in the processionary line in a normal manner.

Although the two lots of caterpillars closely resembled each other it was possible to distinguish between them by colour, size and hair length. The Bag Shelter Caterpillars were rather orange coloured above and hairy, but the hairs appeared to be shorter and sparser than in the Ground-nesting ones; they were also smaller in size, 1½ in. as against 2 in. and over in the Ground-nesting Caterpillars, which were grey in colour with longer hairs thickly covering their bodies.

As the caterpillars emerged from the nest under the trough they came in this order: A line in single file of Ground-nesting Caterpillars, then two Bag Shelter Caterpillars, followed by several Ground-nesting ones, with 8 Bag Shelter Caterpillars at the end of the line. After feeding, all returned to the ground nest.

On March 31 at 7.30 p.m. the Ground-nesting Caterpillars emerged from their nest and began to ascend the tree to feed, there was such a large number of slow moving caterpillars that it was over an hour before all were clear of the nest and had ascended the tree to the leaves. Some of the Bag Shelter Caterpillars were among the last ones at 9 p.m., 13, in two lots of 5 and 8.

The same thing occurred next evening, with a number of Bag Shelter Caterpillars climbing the tree with Ground-nesting ones.

On April 2 at 7.30 p.m. the Ground-nesting Caterpillars emerged to feed; at 9 p.m. the long line extending several feet was still moving out from the nest, 17 Bag Shelter Caterpillars being in the line.

Next evening the caterpillars did not leave the nest. The four following evenings the caterpillars again ascended the tree to feed. On one evening, 18 Bag Shelter Caterpillars were counted; there were also others up feeding on the leaves. A change took place next evening, a silken trail was found leading from the nest under the trough away from the jam tree, turning in a northerly direction.

The Ground-nesting Caterpillars had now left the nest and sheltering, uncleared land and set off to travel over cleared, cultivated land to find suitable places to bury into the soil to pupate.

The following days were spent in an attempt to find the Bag Shelter Caterpillars, a number of them having disappeared when the Ground-nesting Caterpillars had abandoned their nest. Then, one morning at 10.30, three Bag Shelter Caterpillars were found ascending the jam tree. Late that night they were still up the tree, grouped in a fork. They were not seen next morning, but a Bag Shelter Caterpillar was found under leaves and chips several yards away from the tree.

On April 14 the abandoned nest of the Ground-nesting Caterpillars was opened and two Bag Shelter Caterpillars were found in it. Another one was hidden in a small hole in the ground, under sand at the butt of the jam tree, with a dead one nearby.

In all, a small number of Bag Shelter Caterpillars were collected and shut in an old meat safe, in which dry leaves and soil had been placed, as well as green jam leaves for food. The caterpillars were restless and moved about the meat safe, finally two of them escaped and were found in rooms of the house. One, crawling on the floor and the other on the ceiling of a room. Both were recovered. As soon as it was possible, a box with gauze-wire sides was made in which to keep the caterpillars under observation. Clean sand was put in the bottom of the box and some green jam leaves for food. At first the caterpillars were restless in their new surroundings, but after a few days settled down, some of them buried themselves under the sand and began to make a rough silken cocoon.

A number of Bag Shelter Caterpillars on other jam and wattle trees were under observation as well; one lot, after a heavy storm in May, were busy repairing a bag shelter. They were high up in the tree and there appeared to be a large number of them; they usually came out late at night, about 10.30, to feed and strengthen the bag. Later, when they abandoned it, no trace of them could be found.

During May many caterpillars apparently left their bag shelters to seek suitable places on the ground in which to pupate. However, one line of 13 caterpillars was found proceeding over a newly cultivated paddock.

A BUNKETCH BIRD LIST

By DON REID, Wembley.

INTRODUCTION

The following notes were compiled between November 24, 1950 and January 18, 1951 while the writer was employed on the wheat bin at Bunketch, a siding on the northern spur of the Kalannie-Bonnie Rock railway. Bunketch is 175 miles from Perth and 42 miles north-east of Wongan Hills, a locality made classic ornithologically by reason of the pioneer observations there by John Gilbert in 1842.

Most of the following notes were compiled during a number of excursions on foot through the thick scrub surrounding the bin. Other observations were made on the roads to Kalannie, Burakin and Pithara. Certain farmers in the district also helped by reporting occurrences of various birds on their properties. The bush immediately behind the bin was examined every day and most of the scrub within about two miles radius was visited once a week.

THE ENVIRONMENT

Bunketch is a typical locality in the marginal wheatbelt. The country is undulating and the siding lies in the middle of a shallow valley trending east and west. To the north Kalannie, 5 miles away, is 100 feet above Bunketch siding and Burakin, 6 miles to the south, is at the same altitude. A salt-water creek runs along this valley and is 500 yards south of the wheat bin. The flow is intermittent and after heavy rains it empties into some salt lakes 7 miles to the north-east. The vegetation consists of belts of Salmon Gum, York Gum and *Acacia*, with a lower storey of such plants as *Banksia* and *Calothamnus*, separated by wide belts of Sheoak *(Casuarina)* and other elements of sand-plain flora. The area is in the outer wheatbelt and is only now being again opened up. As a consequence about 75% of the country is still relatively untouched, but rabbits, foxes and feral cats are widespread in the bush.

North of Kalannie is a long chain of salt lakes culminating in Lake Moore, the largest salt lake in the State. Unfortunately, no observations were possible in their vicinity.

WEATHER

During observations the weather was mostly very hot, but in the last week, namely from January 10 to 16, an unusual series of thunderstorms occurred. The days were mostly muggy and, at about 4 p.m. each day, a heavy thunderstorm brought a great amount of rain for that time of the year. For instance, Kalannie, which received 8 points of rain from January to May in 1950, had received 185 points up to January 16 of this year.

The effect of this rain was quite noticeable with several species of birds. The Thornbills seemed much more lively than usual, as did the Twenty-eight Parrots. However, the writer could

not continue observations longer to find out whether attempts at breeding were made by any species.

THE BIRD LIST

Emu *(Dromaius novae-hollandiae)*.—This bird is common, though retiring, and ranks with kangaroos, rabbits and galahs as a major pest on growing wheat crops.

Mallee Fowl *(Leipoa ocellata)*.—There are birds scattered throughout the district. Several farmers know the location of nesting mounds, but keep their knowledge secret, for fear of despoliation.

Common Bronzewing *(Phaps chalcoptera)*.—Very common throughout the district, though keeping to the bigger timber.

Banded Plover *(Zonifer tricolor)*.—This bird is common on the cleared land in the district, and can often be heard calling at night.

Painted Snipe *(Rostratula benghalensis)*.—A bird of this species was flushed from the side of the Bunketch-Kalannie road on the afternoon of December 18. Although no detailed plumage marks were observed, the sandpiper shape of the bird was clearly noticeable and the general plumage colours clearly identified the bird. The plumage had the following colours generally:—Head and front parts, brown; back and wings, green, wings with a brownish tone; tail, grey. Length of bird estimated at approximately 10 inches. According to the *Handbook of Birds of Western Australia* this is the fifth record of this snipe.

Black Duck *(Anas poecilorhyncha)*.—One or two are seen at times on the various dams in the district, but only one was noticed by the writer, it having been shot on a dam about 5 miles away.

Spotted Harrier *(Circus assimilis)*.—Is occasionally seen beating across the fields, but does not appear to be numerous.

Wedge-tailed Eagle *(Uroaetus audax)*.—Pairs are scattered throughout the district.

Whistling Eagle *(Haliastur sphenurus)*.—This is the commonest bird of prey in the district.

Kestrel *(Falco cenchroides)*.—This hawk appears to be definitely uncommon. Only one bird was seen in eight weeks of observation.

Red-tailed Black Cockatoo *(Calyptorhynchus banksii)*.—Quite common but, as usual, only met with in small groups.

Major Mitchell *(Kakatoe leadbeateri)*.—This bird is very locally distributed. There was a little group of four birds at a water tank near the bin, and two more were seen near Kalannie, but they were reckoned rare by the farmers.

Galah *(Kakatoe roseicapilla)*.—Very numerous and is a major pest, feeding on bagged wheat and on crops.

Smoker Parrot *(Polytelis anthopeplus)*.—Common, but keeping together in several large flocks.

Twenty-eight Parrot *(Barnardius zonarius)*.—The commonest parrot in the district, but not considered a great pest.

Red-backed Kingfisher *(Halcyon pyrrhopygia)*.—Only one bird was seen, half-way between Bunketch and Burakin.

Tree-Martin *(Hylochelidon nigricans)*.—This species was fairly common. One nest was found in late November containing 2 half-fledged nestlings.

Fairy Martin *(Hylochelidon ariel)*.—This species was also fairly abundant. Several nests, found in late November, contained half-grown young.

Willy Wagtail *(Rhipidura leucophrys)*.—Common throughout the district.

Brown Flycatcher *(Microeca leucophoea)*.—Definitely rare. Only one bird was seen, in late November.

Golden Whistler *(Pachycephala pectoralis)*.—This bird was only seen and heard once, again in late November. The *Handbook* gives the distribution of this bird as "inland to Wongan Hills" and as Bunketch is approximately 40 miles north-east of this locality, an extension of range is indicated.

Rufous Whistler *(Pachycephala rufiventris)*.—Apparently uncommon, as only one bird was seen or heard, in early December.

Western Shrike-Thrush *(Colluricincla rufiventris)*.—Only a few birds were seen, but as they appeared very shy, this scarcity of birds may have been more apparent than real.

Magpie Lark *(Grallina cyanoleuca)*.—A pair was in almost constant attendance at the bin, this being most likely accounted for by the fact that there was an open tank only a few hundred yards away, although the closest dam was over 3 miles distant.

Crested Bell-bird *(Orcoica gutturalis)*.—Common. Birds could be heard and seen singing most of the day.

Black-faced Cuckoo-Shrike *(Coracina novae-hollandiae)*.—A common bird, although keeping to the belts of thicker timber.

Weebill *(Smicrornis brevirostris)*.—Common, again keeping to the timber.

Brown Thornbill *(Acanthiza pusilla)*.—Commonest in the mallee, though pairs can be seen foraging over the lower scrub.

Chestnut-tailed Thornbill *(Acanthiza uropygialis)*.—The commonest thornbill, one meeting with noisy flocks all day. It is often found associated with the Spotted Scrub-wren.

Yellow-tailed Thornbill *(Acanthiza chrysorrhoa)*.—Very plentiful, but keeping together in compact, noisy flocks which do not mix with other species as does the Chestnut-tailed Thornbill.

Spotted Scrub-Wren *(Sericornis maculatus)*.—This species is one of the commonest small birds in the district. In the *Handbook of the Birds of Western Australia* this bird was recorded only as far inland as Wongan Hills, and an extension of range is thus indicated.

Shy Ground-Wren *(Hylacola pyrrhopygia)*.—Common amongst the stratum of low scrub in the belts of Salmon and York Gum, where it was more often seen than heard. The bird was easily called up, although always contriving to remain partly obscured, except when darting along the ground from one bush to another.

The range of the bird as given in the *Handbook* is inland to Wongan Hills, so that the distribution is somewhat extended.

Black-faced Wood-Swallow *(Artamus cinereus).*—Common, and usually to be seen perching on the telegraph wires, or hawking over the bigger timber at evening.

Pied Honeyeater *(Certhionyx variegatus).*—One bird only, a male, was seen. It was very shy and was only identified after prolonged stalking.

White-eared Honeyeater *(Meliphaga leucotis).*—The commonest honeyeater in the district. It appeared that breeding had just finished, as several small family parties of two adults and one or two young were noticed. One party, in particular, was particularly tame and could be approached to within one or two yards before any movement was made.

Yellow-throated Miner *(Myzantha flavigula).*—The birds are fairly common, but are definitely restricted to the taller timber, and are rarely seen elsewhere.

Red Wattle-bird *(Anthochaera carunculata).*—This species was only seen twice, on November 25 and 28.

Little Wattle-bird *(Anthochaera chrysoptera).*—A bird which may have been of this species was seen on January 15. The identification was, however, doubtful, as although the bird had neither wattles nor yellow belly-patch, the patch of reddish-chestnut on the wing was not seen in the failing light of the evening on which the observation was made. On the other hand, its call seemed to label it as the Little Wattle-bird. If so, its distribution has been extended by a considerable distance, namely from inland of the Midland Railway to this locality.

Spiny-cheeked Honeyeater *(Acanthagenys rufogularis).*—A fairly common honeyeater, but was more often seen than heard.

Australian Pipit *(Anthus novae-hollandiae).*—Very common, and can be flushed on any of the cleared land.

Raven *(Corvus coronoides).*—A very common bird, keeping together in flocks of about 30 individuals. Identification was positive, as several bodies brought in by various farmers were examined and the dusky-grey bases of the body feathers were quite evident.

Western Magpie *(Gymnorhina dorsalis).*—Common. Every stretch of timber had its flock, the number of individuals in each flock observed being in the vicinity of 8 or 9.

SUMMARY

Observations of 43 species of birds were made and also one possible record. Nesting was over for most species but nests, in use, of both Martins were found.

Extension of known range of the Painted Snipe, Golden Whistler, Spotted Scrub-Wren, Shy Ground-Wren, Raven and possibly the Little Wattle-bird was recorded. This does not necessarily indicate real shifts of distribution but rather lack of previous observations in such areas.

FROM FIELD AND STUDY

Natural Propagation of Rainbow Trout in Western Australia.—Since the first introduction of trout into Western Australian waters by Mr. C. A. Glew in 1930 and in later years by the Pemberton hatchery, there have been many plantings in local streams, north to the Gingin Brook, of hatchery-raised fry and older fish. However during all these years no evidence was forthcoming that natural propagation was taking place.

Natural spawning was first proved on August 29, 1951, through the finding by Mr. Charles W. Brown, of Dwellingup, of small Rainbow Trout fry at Davis Brook, just below Holyoake. Davis Brook is a tributary of the Murray River and larger fry were observed in the Murray itself, at Caraholly, by Mr. H. Birmingham about the same time. No fry had been liberated in the Murray system this year and the occurrences reported are conclusive of natural spawning.—A. J. FRASER, Fisheries Department, Perth.

Nesting Sites of Yellow-tailed Thornbill.—On July 4, 1948, at Caron, I found a pair of Thornbills, *Acanthiza chrysorrhoa*, constructing a nest in the side of a Raven's nest of the previous year. The thornbills were making frequent visits with building material. On one occasion two birds were present at one time and entered the nest in succession. The nest appeared to comprise a cup, i.e., the dome of the egg-chamber and the upper cup still remained to be completed.

When I revisited the nest on July 18 the two birds were still engaged in building, but on August 1 I found the Raven's nest on the ground under the tree, having been blown down, in all probability, by high winds on July 30. The Raven's nest was shallow with little lining and was constructed of sticks one-quarter to one-half of an inch in diameter. The Thornbill's nest was an unusually neat one, dimensions being approximately 5 in. high by 4 in. in width. There was no perceptible cup nest. Lining material included feathers of the Port Lincoln Parrot. The egg chamber contained one egg intact and the remains of what was probably one other fresh egg.

On September 1 I located another Thornbill's nest under the base of an old Butcher-bird's nest 18 ft. from the ground in a York Gum *(Eucalyptus foecunda)* and 100 yards from the locality of the nest mentioned above. On September 6 the Thornbills were lining their nest. When I was again able to visit the area, which was not until October 24, there was no activity at this nest.

A third Thornbill's nest was, however, located, this time in the base of a Squeaker's nest which had been built during September and deserted. This site was 60 yards from the one mentioned above.

As all three nests were built within a distance of 160 yards, and as each was built into the base of a large stick nest, it appears possible, even likely, that the three nests were built by the one pair of birds with a preference for this type of nest site.

—ERIC H. SEDGWICK, Wooroloo.

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THE VISIT OF SYDNEY WILLIAM JACKSON TO WESTERN AUSTRALIA IN 1912 IN SEARCH OF THE NOISY SCRUB-BIRD

By Major H. M. WHITTELL, O.B.E., Bridgetown.

Sydney William Jackson (1873-1946) was a well-known ornithologist in New South Wales and was much experienced in field-work, having spent most of the earlier years of his life in making a collection of birds' eggs and later collecting on behalf of the late H. L. White of "Belltrees," Scone, New South Wales, whose large collection of bird-skins and eggs, the "H. L. White Collection" (which includes Jackson's original collection), is now in the National Museum, Melbourne. Jackson, in 1898, was the first to collect the eggs of the Rufous Scrub-bird *(Atrichornis rufescens)* of eastern Australia and, in 1910, he again collected the eggs on behalf of H. L. White. So, when in 1912 he was sent by H. L. White to Western Australia to search for the Noisy Scrub-bird *(Atrichornis clamosus)*, of which no specimen had been obtained since 1889, he was well-fitted to undertake the search. Certainly he was new to conditions in south-western Australia, but he had a good knowledge of the habits of the Rufous Scrub-bird to guide him in his search for the closely related western form.

Jackson had a good practical knowledge of natural history and collected almost everything of interest that came his way—he was, however, primarily an ornithologist, with a strong leaning towards botany and land mollusca. The diaries, six small notebooks, which he kept while in Western Australia, are in the possession of Mr. J. S. P. Ramsay of Sydney, and in the following pages I give notes recorded by Jackson on some species of birds he came across during his visit. I take the opportunity of expressing my thanks to Mr. Ramsay for entrusting the diaries to me and for permitting the use of them for the purpose of this paper.

Except for an illustrated article by Jackson in the *Sydney Mail* of June 18, 1913, entitled "In the South-west of Australia: Some Experiences of a Naturalist," no account of his visit to Western Australia has been published, and that account contained few references to the birds he encountered.

On arrival at Albany on October 9, 1912, Jackson was met by Mr. F. Lawson Whitlock, who was then living at Tudor Siding to the west of Albany, and who was able to give him advice regarding local conditions. Mr. Danny Myers was engaged to accompany Jackson during his visit, and the two went into camp at the Bow River, a small winding stream 50 miles west of Albany and which runs into Irwin Inlet. There they remained, except for a visit to Nornalup Inlet from December 8 to 22, and for a trip to Mt. Frankland, until they finally left for Albany on February 19, 1913, without having been successful in finding the object of their search. Every effort was made to locate the Noisy Scrub-bird both by tramping the bush in all directions and by listening for notes which might be attributed to the bird, but completely without result.

The following remarks by Jackson on 9 species of birds he met with afford interesting information; altogether over 60 species are, from time to time, mentioned in the diaries.

EMU *(Dromaius Novae-Hollandiae)*

In our *Systematic List of the Birds of Western Australia,* 1948, Dr. Serventy and I accepted two races of the Emu—one, *Dromaius novae-hollandiae woodwardi* Mathews 1912, the northern form, and *Dromaius novae-hollandiae rothschildi* Mathews 1912, the southern form, the latter being darker in colour and shorter in the leg than the northern race. The Emu that is to be found in the Karri areas of the lower South-west is undoubtedly very dark in colour; within the last few months at least two observers with whom I have been motoring between Bridgetown and Nannup when Emus have crossed the road in front have commented on the black colour of the birds. This is also well illustrated by the notes left by Jackson. Writing in his diary on January 19, 1913, he noted: "Came across 2 fine Emus, on a long grass plain & they were quiet, & with stretched necks came up close to us where we stood & then walked up past us & then ran off towards the sea-coast. The birds had very dark & almost black plumage & darker than I have ever noticed on any of these birds in N.S.W. or Queensland. The clump of tail feathers which were also dark & nearly black were shorter than I have frequently noticed in the birds in east Australia & here in amongst the burnt black trees the birds were most difficult to detect. The dark plumage of these two birds was most striking to me after the lighter colour in the eastern species which is claimed to be the same as this western form. This pair of birds today were noticed inland only 3 or 4 miles from the sea."

Six days later (January 25) he recorded seeing "3 black emus again today and they were walking about with their beaks open owing to the hot day." Previously (December 20, 1912) he noted the finding of an old nest with egg shells among the sandhills within 250 yards of the sea. "Emu droppings I often met with & found large lumps of charcoal in some of them. When ripe, a fruit here

known as the wild plum & which grows on a small shrub about 5 ft. high, is eaten by the Emus, and is known as the Emu Berry or Plum, the seed is outside the blue & peculiar shaped fruit. Its native name is known to the aborigines as 'Con-dor-un,' & the Emu is known as 'Weteh.'" The scientific name of this shrub is *Podocarpus Drouyniana.*

CRESTED TERN *(Sterna bergii)*

On December 8, 1912 Jackson visited Nornalup Inlet and records that "At Gull Rock, a granite rock about 90 ft. long by 85 ft. across, beside Snake Island, I collected eggs of *Sterna bergii.*" This is a breeding locality for the Crested Tern additional to those recorded by Dr. Serventy and myself in our *Handbook of the Birds of Western Australia,* 2nd edn., 1951, p. 131. It is possible that there was also a nesting site in Irwins Inlet as Jackson records under date December 26, that he saw "*Sterna bergii* on rocks on the northern side of Inlet."

GROUND PARROT *(Pezoporus wallicus)*

On December 7, 1912, Jackson "Saw Grass parrakeet (like *formosus)* in the long tassel top Kangaroo grass on a plain or swamp (bog). Failed to shoot it."

FAIRY MARTIN *(Hylochelidon ariel)*

In our *Handbook* Dr. Serventy and I have recorded that this species is not found, except sporadically, in the area south of Gingin and west of the Great Southern Railway. It is therefore interesting that Jackson "saw mud bottle nests of Fairy Martin in a grotto or eave of hardened sand on west bank of Frankland River," about two miles from the mouth, on December 22, 1912. This is the only entry he has in his diary regarding the bird.

WHITE-BREASTED ROBIN *(Eopsaltria georgiana)*

October 15, 1912. "Saw some Grey-breasted Robins in scrub at likely spot for *Atrichia.* One note it utters is sharp & shrill & very like single alarm note of *Orthonyx & Atrichia rufescens* of N.S.W. When I heard the note first I thought I had come across *Atrichia clamosa* & the scold or alarm note was so very like that of *A. rufescens.*"

October 17. "Nest & two eggs Robin, *gularis.* Nest in Whip stick Wattle scrub, placed 12 ft. up."

October 18. "Heard harsh *Atrichia*-like warning note uttered by Grey Robin *(gularis)* again."

October 21. "Saw Grey Robin and it again uttered its single shrill note as I heard a few days ago & which resembled the shrill warning note of *Atrichia* of N.S.W.

October 22. "Noticed another Grey Robin make its peculiar *Atrichia*-like warning call notes. These robins are shy and soon disappear."

October 23. "Watched Grey Robin feeding under a dense bush in whip stick scrub. No nest could be found."

November 11. "New looking nest of Pale Robin in fork of whip stick Wattle up 14 ft.; neatly made of Bull Oak needles & lined with bark. Nest smaller than that of Yellow-bellied Robin here and not decorated with any lichen. . . . Found new nest of Grey Robin 14 ft. up in whip stick Wattle beside big Karri. Nest again built on piece of fallen Karri bark & found 3 more old grey Robins nests built in W.S. Wattles up about 12 ft. & each *on* a piece of fallen Karri bark hanging from a fork."

November 12. "Noticed yesterday that the Grey Robin in the W.S. scrub makes two & not only one scolding note like the *Atrichia* of N.S.W. This Robin confines itself to the scrub, while the Yellow-breasted one loves the more open parts in Jarrah forest etc. The nest of the Grey scrub Robin is smaller than that of the Yellow-bellied species here & is constructed of much the same kind of material & is devoid of lichen decoration & the perpendicularly suspended pieces of bark, being plain and bleached looking in construction & resembling some debris caught in the fork of a whip stick Wattle. One nest found yesterday was built chiefly of the long dry flat & narrow leaves of the Peppermint Ti *(recte* Tea) tree here which grows on edges of the W.S. scrubs."

November 14. "Saw a Grey Robin & it made its *Atrichia*-like note."

November 16. 'Saw a male Grey Robin feeding female in whip stick scrub. . . . Visited Grey Robin nest, but no eggs yet."

November 25. " . . . the Grey Robin . . . had . . . deserted . . . new nest in whip stick wattles found over two weeks ago. . . . the Grey Robin's was decorated on outside with thin pieces of curled Karri bark. The old nest of Grey Robin close by . . . was likewise built on a fallen piece of Karri bark which had fallen & caught in a fork of a whip stick wattle. Altogether I have found upwards of a dozen old nests of this sp. here & all were built on fallen pieces of Karri bark in whip stick wattles in the dense whip stick wattle and karri. I think most of the birds have bred in Sept. & Oct. & they thus miss the bush fires which so frequently occur later on."

Twenty years later, in 1932, Jackson published in *Bank Notes (Commonwealth),* vol. 14, no. 11, November, p. 13, a photograph of "The very rare nest of the White-throated Robin *(Eopsaltria leucogaster),* discovered by Mr. Jackson in the immensely dense Whip-Stick Wattle Scrub at the Bow River which runs into Irwin's Inlet, about sixty miles due west of Albany in Western Australia. The bird is rare and shy, and lives in a secluded and very densely-timbered locality. The nest was built about eight feet from the ground."

SHRIKE-TIT *(Falcunculus frontatus)*

In our *Handbook* Dr. Serventy and I observe that this species does not venture far into the heavy Jarrah forest areas. During his stay in the heavy Jarrah and Karri timbered country Jackson made a number of records of the bird which go to show that, like the Western Whipbird, it penetrates into the narrow corridor of elements of mallee vegetation along the south coast. In reading Jackson's notes it should be remembered that in his time the Shrike-Tit occurring in southern Western Australia was known as *Falcunculus leucogaster*. Nowadays it is considered a race of the Australia-wide distributed *frontatus* and is the subspecies *Falcunculus frontatus leucogaster*.

October 10, 1912. "Saw & heard White-bellied Shrike Tit in Jarrah tree near camp. Note very like that of *F. frontatus*, but very feeble."

November 5. "Heard Shrike Tit on Tingle Tingle mountain near Eagle Hawk Creek. Note is a slow Coo-coo-ee. The Coos in same key, the ee higher key."

November 24. "Saw a specimen of *Falcunculus leucogaster* rendering its Coo-coo-ee notes" and, the next day "Heard *Falcunculus leucogaster* in top of Karri again today. They do not appear very local in their habits."

December 3. "Heard *Falcunculus leucogaster* rendering its Coo-coo-ee, they are hard birds to get close to & keep high up in the Karri trees."

January 2, 1913. "Heard *Falcunculus leucogaster*. This sp. is hard to see and keeps high up in the big Karri trees as a rule."

January 5. "Saw *F. leucogaster* high up (100 ft. or more) in a large Karri."

January 20. "Followed a specimen of *Falcunculus leucogaster* for some hours & failed to shoot it (they are rare here) as it kept high up (100 ft. or more) in the tall Karri trees. Its note is not very loud and is a Coo-Cooee Coo-cooee. The bird is most difficult to detect in the tall trees, even after it calls out several times."

February 5. "Heard a *Falcunculus leucogaster* rendering its feeble Coo-coo-ee but could not find it. It was in a tall Karri tree. I have not yet heard one in a small tree, they keep to the Karri trees and these are generally large."

WESTERN WHIPBIRD *(Psophodes nigrogularis)*

Jackson records under date October 23, 1912, that he "Saw bird like Black-throated Coach Whip at dense entangled part of whip stick scrub—note was loud chop chop." At some later time he crossed out the words "bird like" and so made the statement definite: "Saw Black-throated Coach Whip." There is no further reference to the species in the diary. This is a later record for the south coastal districts than that of A. W. Milligan in 1901. See *Handbook*, p. 276.

WHITE-BROWED BABBLER *(Pomatostomus superciliosus)*

This species belongs to the group of Eyrean birds associated with the dwarf eucalypts (mallee) of the southern portion of Australia, and is one of the species which have penetrated along the south coast of south-western Australia in the corridor of open heath country, containing elements of mallee vegetation. A few isolated colonies of the bird occur at Denmark, the area of the lower reaches of the Warren River, at Pemberton (where I have personally encountered them) and at Busselton. Otherwise it does not occur in the South-west of the State much west of Toodyay, Williams and the Great Southern Railway.

Jackson first observed the species on October 21, 1912, to the west of his camp on the Bow River: "Saw 3 Babblers (small) with white eyebrows, in the thick whip stick scrub. Note different to any others I have heard. They were shy & I could not get a shot at them. The scrub was studded with Jarrah trees." On the same day he: "Found 4 old stick nests of Babblers in Bull Oaks on edge of whip stick scrub & giant Jarrah forest." The next day he: "Found 3 more old Babblers nests in Bull Oaks outside edge of whip stick scrub." Again the following day (23rd) he: "Found 2 Babblers nests (old) in Bull Oak in w.s. scrub." On November 11 he: "Found Babblers nest in Bull Oak up 24 ft. in dense w.s. scrub. These birds I have only seen in w.s. scrub so far and also their nests. They keep away from the open forest here."

Jackson then records that "on 16th Novr. in whip stick scrub west of the Bow River," he "shot three (the whole flock) small *Pomatorhinus* which were hopping up the trunk of a standing and coal black Bull Oak *(Casuarina)* & from which they were picking food. They hopped up the trunk after the manner of a *Climacteris*. The note of this bird is most peculiar & **different** to any of the species which I have previously heard." He then records detailed measurements of the three birds (2 females and 1 male). The skins are in the "H. L. White Collection." The colour of the legs was entered up as "black."

The last record of the bird in Jackson's diary is an entry on November 28 when he wrote: "Saw 2 Babblers near a nest in dense whip stick scrub. The nest was placed up 30 feet in a green Bull Oak which had a trunk as black as charcoal for 26 feet up, result of some recent bush fires. The nest was empty and built chiefly of small Karri sticks. The birds are rare here."

SQUEAKER *(Strepera versicolor)*

Jackson has recorded some interesting field-notes on this species.

October 11, 1912, at Denmark: "Saw *Strepera plumbea* for the first time, they utter a peculiar squeak call."

[*plumbea* was the specific name given to a bird from South-west Australia by Gould in 1846; it is now employed subspecifically as *Strepera versicolor plumbea*.—H.M.W.]

October 16. He records that the "Note of *Strepera plumbea* is rather a harsh squeak; usual call is 4 notes uttered quickly—2 first notes being in a higher key than the second 2 (Ding Ding—Dong-Dong) & quite unlike *Strepera graculina* of N.S.W."

October 22. "*Strepera plumbea* rather common and their peculiar harsh calls can plainly be heard."

October 30. "Found nest of *Strepera plumbea* at extremity of long horizontal limb of a green Jarrah & up fully 70 feet. Bird sitting and was flushed. Impossible to climb to."

November 4. He "Saw *Strepera plumbea* feeding young in a saw-leaved Banksia; noise of young like that of young *Gymnorhina tibicen.*

November 22. "Found nest of *Strepera plumbea* today placed up 60 or 70 feet in a Jarrah tree and contained 2 young, well feathered. Found another in a tall Tingle Tingle on big hill and bird sitting. Nest about 80 ft. up & unprocurable owing to its position."

December 2. "All the *Strepera plumbea* which were common here until 2 weeks ago have disappeared. I expect they have gone inland now that they have finished breeding in this hilly country. About two weeks ago I saw a flock of about 14 of these birds in a belt of giant Tingle Tingle trees on a big ridge or hill and they were chasing one another and making a great row and peculiar noises. This was the last I saw of the birds & they suddenly all disappeared. One seen today was silent and was the first one noticed for two weeks."

December 3. "Very few *Strepera plumbea* about and utter no call notes lately. Some weeks ago they were very noisy. They are a big bird."

December 6. "Saw few *Strepera* about; they have become very silent lately."

December 9. "Saw large green *Bulimus* shells (2 inch long) fastened to the trunks of thick Hazel trees (6 inch thick) & 20 feet up from ground & also the small striped *Bulimus* on like places & on long blades of sword grass, etc.* The *Strepera* pick these shells from the trunks of these trees and eat them and their remains (shells in bits) are often to be found in their droppings. The large green snail or *Bulimus* these birds bash against a stone or stick to break them in order to enable them to remove the snail from the inside and they do not swallow so much of the shell as is the case with the smaller tree climbing *Bulimus* which has a much softer shell and can be easily crushed up by the birds. These smaller snails also climb the Karri (smooth tree) & feed upon here (Nornalup Inlet) as well as at the Bow River scrubs & the *Strepera plumbea*

*Jackson's collection of land molluses was dealt with by Tom Iredale in "A Review of the Land Mollusca of Western Australia," *Rec. W.A. Museum,* vol. 2, pt. 1, 1939 (also *Journ. Roy. Soc. W.A.,* vol. 25, 1939, pp. 1-88). These two species appear to be, respectively, *Bothriembryon fuscus* Thiele and *B. jacksoni* Iredale.

sit on the peeling & loose bark & pick out any of these snails that may be resting down in the bottom where the dead bark meets the tree."

December 13. On coast opposite Chatham Island: "*Strepera* numerous."

December 15. "*Strepera plumbea* . . . noisy again."

December 25. "*Strepera plumbea* calling and about camp."

December 26. "Saw *Strepera plumbea* in a large Xmas tree feeding large young which were able to fly, the cry of these young when being fed is like the notes uttered by the young of *Gymnorhina tibicen* of N.S.W."

January 13, 1913. "Saw several young *Strepera plumbea* about today & well feathered & able to fly & feed about. They cry like a young magpie *(Gymnorhina tibicen)* when being fed by parents & even when able to fly about."

January 16. "Found nest of *Strepera plumbea* about 60 feet up in a yellow Tingle Tingle tree *(Eucalyptus)*, nest large stick structure."

THE NESTING OF THE MANED GOOSE, OR WOOD DUCK, ON THE WARREN RIVER

By A. D. JONES, Manjimup.

Having learned that Maned Geese or Wood Ducks *(Chenonetta jubata)* were to be found some 20 miles south-east of Manjimup, I visited the locality on October 7, 1950 in the hope that the birds had nested in the vicinity and that I might procure some young ones for my sanctuary at Middlesex.

Two pairs were seen on cleared country through which the Perup River meanders to its junction with the Tone nearby. The country is open and well grassed with scattered bracken and an occasional ring-barked gum. These were the first specimens of this water fowl I had seen. Mr. Shirley Muir, the owner of the property, assured me that later in the season they were to be seen here in great numbers.

The locality was evidently excellent duck country. No less than five different batches of Black Duck *(Anas poecilorhyncha)* were noted on a river frontage of not more than 400 yards, three of them within 100 yards of the homestead, sufficient evidence of Mr. Muir's policy of not allowing anyone to molest his wild life.

I could not, however, discover anything to suggest that the Wood Ducks had any young with them.

Some days prior to this visit a young scout had reported that while repairing a fence near the Wilgarrup River, some miles north of the previous position, his dog had captured and brought to him what he believed to be a young specimen of the Wood Duck. How-

ever, he did not think there were others as the parents had not since behaved as though there were ducklings about. He had located what he considered the nesting site which he agreed to show me at some future date.

On October 8 my sanctuary was visited by Major H. M. Whittell, to whom I reported the above incident. He was most interested and indicated that any definite proof that the Wood Duck nested in these areas would be most pleasing to him.

Accordingly on October 11 I called on the owner of the property who permitted me to explore the river frontage, and with my young scout as guide we set out for the nesting site. This proved to be a venerable gum standing within 60 feet of the water, with a large lower limb broken off close to the trunk 20-odd feet from the ground. Pieces of down could be seen clinging to the rough edges and a search in the undergrowth beneath revealed several pieces of shell, whitish and stained and several soiled membranes, indicating that many eggs, approximating the measurements supplied in *Birds of Western Australia* for this species, had been hatched there.

We proceeded down river as quietly as possible under the circumstances, as although the area to one side of the stream was cleared and pastured to within a chain or so of the water, the actual bank on both sides was littered with fallen timber, flood debris, growing timber, undergrowth and sword grass.

The male bird was seen on the water approximately 200 yards from the nesting site, but the female was not in sight, which led me to believe that possibly a batch of young was nearby. As the male bird had made off up the opposite bank of the river we crossed and carefully explored the area, eventually flushing the female from a clump of sword grass 20 to 25 ft. from the water. There were no ducklings with her but perseverence discovered them 6 or 8 ft. away in country we had previously looked over. They scattered immediately they realised they had been discovered, and after the confusion which followed we agreed that 9 to 11 ducklings were about. After some tumbles and scratches we secured three individuals. They were well grown, almost completely feathered, and would be from 6 to 8 weeks old.

They were released in an enclosure with some young Black Duck which had already settled down and quickly adjusted themselves to the changed diet and conditions.

One of the ducklings died, apparently through being injured by some other inmate of the "home." The two survivors are apparently well content and doing well at the moment of writing (November 14). They make quite good subjects, adapt themselves readily and have none of the furtiveness of the Black Duck. This latter, I find, is far more difficult to approach than anything else in my collection. The Chestnut Teal ducklings, although not so long with me, are not nearly so furtive and shy.

DINOSAUR FOOTPRINTS NEAR BROOME

By L. GLAUERT, W.A. Museum, Perth.

In 1945 Mr. Walter Jones of Broome reported that whilst searching for shells at extreme low spring tide near Point Gantheaume Lighthouse he had noticed some impressions in the solid sandstone shaped like gigantic emu tracks approximately 13 inches in length. There were several sets of tracks as though creatures had been walking to and fro.

The importance of this discovery being realised Mr. Jones was asked to take impressions so that the tracks might be studied. Mr. Jones did this and on December 11, 1945 Mrs. Jones delivered at the Museum an excellent reproduction in cement of one of the footprints (G10328). Mr. Jones also supplied a rough sketch of the area showing the distribution of the tracks.

The impression, which suggests a rather fleshy foot, enabled the following measurements to be taken:—

Total length, 14⅞ in. (375 mm.).

To tip of left toe, 11½ in. (290 mm.).

To tip of right toe, 11¼ in. (282 mm.).

Length of middle toe, 9¾ in. (245 mm.).

Length of left toe, 6⅞ in. (173 mm.).

Length of right toe, 6⅜ in. (160 mm.).

Width of middle toe at base, 3 in. (75 mm.).

Distance between the tips of outer toes, 12⅜ in. (313 mm.).

Each toe ended in a stout blunt claw and seemed to consist of three phalanges, though this is a matter of doubt.

Efforts made to obtain additional material that might give a clue to the age of the beds were unsuccessful until recently when Captain B. E. Bardwell of Broome found plant remains in the associated strata. These on examination proved to be *Ptilophyllum pecten* (Phillips), a cycadophyte of almost worldwide range in Jurassic times, although it also occurs in the Cretaceous, having been recognised in the Maryborough and Burrum series of Queensland. In Western Australia the plant has been recorded from beds underlying the Cretaceous greensands at Gingin, where it is regarded by Walkom as being of Jurassic age.

Dinosaur footprints have been found in the Jurassic coal measures of Queensland on the Lanefield colliery.

Like the Gingin beds those containing the dinosaur footprints are considered to be of lacustrine origin. Although so recently brought to our knowledge the tracks have long been familiar to the aborigines, who have given them the name of warragunna, and who have a legend to account for their origin. The story is that a native walking along the beach noticed the tracks and at once began to

follow them. Suddenly a very large bird was seen trying to get across the bay in a southerly direetion. When the bird turned and came towards him the native fled, not stopping until he reached "Willy's Creek," where his footprint can be seen.

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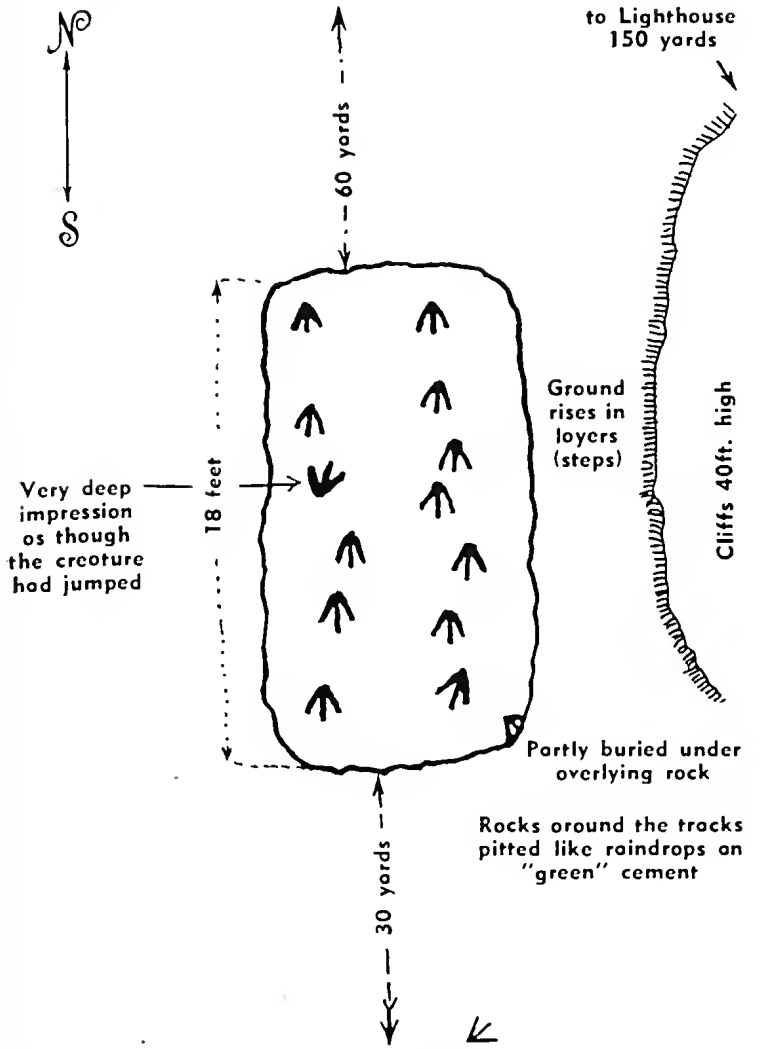

Copy of sketeh by Mr. Jones; the arrows at the top and bottom point to footprints away from the main oceurrence.

BAG SHELTER CATERPILLARS AND THEIR HABITS*

By Mrs. M. B. MILLS, Merredin.

PART 2

On May 26, 1950, I decided to collect a small number of bag shelters and attach them to trees nearer the house, as, so far, I had not been able to observe the caterpillars leaving the bag shelters on the trees to descend to the ground to find places in which to pupate. Once they left the trees no trace of them could be found, apparently very little silken thread was used when leaving the trees. On the other hand in the case of the Ground-nesting Caterpillars a clearly defined silken trail is left, shimmering in the sunlight, and by following it carefully one may find the caterpillars if it leads over soft earth.

Although I had watched and waited patiently I had not yet seen the Bag Shelter Caterpillars leave their bags, and now, as rain was threatening, I renewed my efforts.

Ths sky was dark and overcast as I set out with a companion, taking with us a length of rope and a long pole. I knew where there was a large bag, having kept it under observation for some time past; it contained a large number of well-grown caterpillars. Unfortunately, it was high up in a jam tree, on a slender branch about 15 ft. from the ground, but after some difficulty it was brought to the ground without harm.

The rain was falling heavier now, and we lost no time in collecting two other small bags within easy reach on a jam tree. There was a rather large third bag on a jam tree almost bare of leaves 5 yards away; from it a thick silken trail led down the tree across the ground and up the other tree, where two new bags had been made.

The caterpillars had apparently been leaving the defoliated tree for some time to seek food on the tree nearby, travelling to and fro on the silken trail, finally, perhaps, dividing into two lots and making new bags.

Later, at home, I examined the large and heavy bag to see its contents. The silken threads of which it was made were very strong and tough, a sharp knife being necessary to make an opening. It was packed with east skins and "dirt," but instead of the large number of caterpillars I expected to see, there was only one large one, which vainly tried to hide under skins and dirt. It was caught and put into the box with the others. The caterpillars had left the tree on which this bag had been, leaving no noticeable silken trail.

The other two bags collected contained a number of caterpillars, which could be seen without cutting the bags open.

**Ochrogaster contraria* (Walker). The author's use of the vernacular names, Bag Shelter Caterpillars and Ground-nesting Caterpillars, is explained in vol. 3, no. 3, p. 61.

The bags were transferred on to jam trees near the house, being tied on to branches with twine. The caterpillars settled down in their new surroundings, coming out to feed at evenings, although the weather was turning cold.

On May 29, at noon, a bitterly cold day with showers, some caterpillars were gathered outside on the bags. June 1 at 9.50 p.m., the caterpillars at one bag ascended the branch to feed on the leaves. The following day was warm and sunny with the caterpillars clustered outside the bag in the warm sunshine.

On the evening of June 4 the caterpillars spent some time weaving silken threads about the bag, setting off at 9 o'clock to feed on the leaves. Next morning, which was sunny, the caterpillars were again building up the bag; that evening at 9.30 they ascended the branch to feed. The four following days and evenings were spent in the same manner.

Light, continuous rain was falling with little wind on the evening of June 10. The caterpillars came out to feed, climbing the wet branch to the leaves, which were wet and heavy with droplets of water, but it made no difference to the feeding caterpillars. Next evening was cold and frosty, the caterpillars remained in the bag. Then for eleven evenings the caterpillars left the bag to feed, usually between 9.30 p.m. and 9.50 p.m. They were fine specimens, varying in size, with some just over 2 inches in length.

On June 23, after rain, and the evening clear and frosty, the caterpillars remained in the bag. Next morning a heavy frost had fallen.

On June 25, at midday, some caterpillars were out on the bag weaving silken threads about it. They were not seen out on the leaves that evening. The following evening at 7.30, 17 caterpillars were just leaving the bag, starting to ascend the tree. The weather was warm and calm and it continued to be so for 3 more evenings. The caterpillars came out as previously to feed.

But on June 30 when there was a very heavy frost the caterpillars remained in the bag, coming out at 2 o'clock in the afternoon; the day was very cold with a bitter south wind. The caterpillars ascended the tree in the sunshine to feed. That night another heavy frost fell and the caterpillars did not come out.

On July 2 it was very cold, and some caterpillars came out at noon; in sunshine to feed; none ventured out at evening, which was frosty. The following day the weather changed from severe frosts to warm rainy weather; the caterpillars then emerged at 7.30 p.m. to feed, apparently not minding the warm showers. On July 4 and 5 the weather continued to be warm and showery, with the caterpillars coming out to feed as usual.

July 6 was a clear, cold evening; the caterpillars stayed in the bag; in the morning a severe frost had fallen. Again the caterpillars ascended the tree at noon to feed. The next two evenings were very cold, the caterpillars were not seen out then, but ascended the tree in afternoon sunshine to feed. On July 8 at 7.30 p.m. with

the evening chilly but not frosty, the caterpillars set off up the branch to feed. The following evening was cloudy and warm, with a promise of showers. At 7.30 the caterpillars were gathered on the bag weaving silken threads; a few minutes past 9 o'clock they ascended the tree to feed.

Until July 23 the caterpillars kept up the routine of leaving the bag at about 7.30 p.m. to spend almost an hour weaving silken threads about it, then setting off up the branch to feed, returning between 9.30 p.m. and 10.45 p.m. The weather during this period was mild and dry, with only a few light showers and two light frosts followed by sunny days.

After that the caterpillars apparently abandoned their bag. They were not seen again, nor did they leave any trace of their departure.

Other Bag Shelter Caterpillars kept in a box together with their bag, appeared to be doing well. On a day early in June the caterpillars came out of their bag and gathered on top of it, as if enjoying the lovely sunshine which slanted across the top of the box and on to their bag. They moved about weaving silken threads over the bag. The box was kept in a sheltered position and each day fresh jam leaves were put into it for the caterpillars to feed on. Usually they came out of the bag at evening to feed if it was not too cold or frosty. If the evening was very cold the caterpillars would come out to feed during the daytime.

It was late in September before the caterpillars had all vacated the bag and buried under sand in the box, making a rather rough silken cocoon.

Usually the Bag Shelter Caterpillars abandon their bags during April or May, to seek suitable places on the ground in which to pupate, but occasionally a few bags may be found containing caterpillars until later in the year. The reason for this is unknown to me.

In November moths began to emerge from the cocoons and clung to the gauze-wire sides of the box.

On November 22 at 7.15 p.m. two female moths, which had emerged the previous evening and were placed in a small container, began to lay eggs which were surrounded by fluffy scales from their bodies. For the small size of the moths there was a considerable amount of fluffy scales to cover the eggs. After the eggs were laid the moths were released, and shortly afterwards flew away.

The female moth measures approximately 1¾ inches across the wings when fully expanded. The body is shorter and stout, just over ¾ inch in length. The head, tufted with fine hairs, and the wings with a small white spot on them, are a light fawn to silver grey in colour. The body is dull brown, segmented, and covered with fine short hairs. Encircling the end of the body is a band, approximately ¼ in. in width, of tightly packed fawn-coloured scales, which are freely disengaged as the eggs are being laid, covering them in a compact fluffy mass.

Of the Bag Shelter Caterpillars kept in the box in clean sand without dry leaves and the box left in a sheltered place, all but two out of about 30 caterpillars emerged as moths.

Ground-nesting Caterpillars kept in a box with soil taken from a fallow paddock with dry jam leaves added, were less successful. Of 10 caterpillars placed in the box only five emerged as moths. The other five died before reaching the moth stage. Some had begun making cocoons; weevils were present in other fully-formed cocoons, with a hole made into the bodies of the caterpillars; one caterpillar was infected with a white patch of fungus spreading over its body. The fungus was also present on some dry leaves in the box. The box had been left out in all weathers, protected only from frosts and rain or hot sunshine.

Other Ground-nesting Caterpillars, in a gauze-wire cage built around a jam tree under natural conditions, had not fared so well either. About half their number emerged as moths.

Of a large number of Bag Shelter and Ground-nesting Caterpillars under observation in natural surroundings well covered with jam and wattle trees the following notes were made:

There appeared to be about equal numbers of small, light coloured compact masses of shelters on twigs or in forks of jam or wattle trees, as there were small, light coloured fluffy nests at, or near to, the butts of these trees.

Close observation over a long period of the caterpillars which hatched out of eggs laid on twigs or in the fork of a tree and those that hatched from eggs laid on the ground near or at the butt of the tree and their later habits give me reason to think that although both lots of caterpillars are very similar in appearance and habits, they are not quite the same.

For instance: It was noted that at no time from the period of hatching to the time of pupating, did the Bag Shelter Caterpillars make any kind of a ground nest at, or near to, the feeding trees. When they abandoned the bag shelter it was to disappear entirely. Only one lot, already mentioned, was found about a hundred yards from their bag shelter travelling in single file away from sheltering trees and bush on to cultivated land.

Some experiments were also made as well to supplement the observations.

Early in the year (February 15, 1950) a bag shelter was removed from a tree and placed on the ground at the butt of another tree. This was done to see if the caterpillars would carry on life as the Ground-nesting Caterpillars do.

Next morning, silken threads led from the bag shelter up the trunk of the jam tree. On February 17 the caterpillars were not to be seen. The following morning, on looking into the bag it was found to be empty of caterpillars. Then on a branch several feet up in the tree a bag was seen in a fork. There was no bag on the tree previously. In the new bag shelter 27 caterpillars were

counted. They continued living in the bag and feeding on leaves until vacating the bag to pupate.

On February 20 another small bag shelter was collected and left on the ground at the butt of a jam tree. That evening the caterpillars in it ascended the tree but did not return down the silken threads left by them to the bag. They remained up the tree grouped in a fork. Later they were fiercely attacked by small black ants. I then removed the bag from the ground and secured it at the fork with twine, and soon afterwards the caterpillars moved into it, using it from then on.

Yet another bag shelter was tried out. This was tied to a jam tree about a foot up from the ground. During the morning 13 caterpillars came out to feed, feeding on a few leaves placed near the bag. Later they ascended the tree and then returned to the bag. Next morning the caterpillars left the bag and ascended the tree, where they grouped in a fork. The following day they did not return to the bag, but remained gathered at the fork. The morning after they were still in the fork apparently making no effort to return to their bag shelter near the ground.

The bag was then removed from this position and secured to the fork about an inch from the caterpillars. Within five minutes they ascended the short broken jam stick to the bag, moving about on it as though seeking an entrance, and finally disappearing into the bag through some small holes. As the days passed the caterpillars weaved silken threads about the bag, apparently settling in.

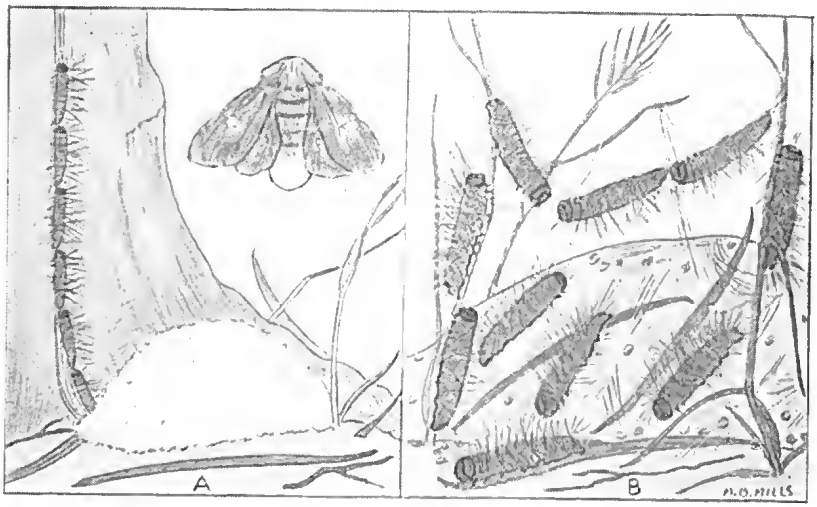

Fig. 1—A: Young Ground-nesting Caterpillars emerging from their fluffy nest at the butt of a jam tree to ascend the tree and feed on its leaves. Inset: Female moth. B: Ground-nesting Caterpillars, about half-grown, building up their nest by attaching silken threads to the nest, grass and leaves. Half natural size.

Later they left the bag, dividing into two lots and made two new bag shelters above the old one in the same tree.

During my observations I have removed many bag shelters from jam or wattle trees to trees nearer my home, and providing the bags were seeured to a braneh near the top of the trees the eaterpillars appeared to settle down and aecept the new positions.

Of the Ground-nesting Caterpillars, they apparently make a ground nest exclusively and the eggs, eovered with light eoloured fluffy seales, are laid at the butt of, or near to, jam or wattle trees. After the eggs hateh the tiny eaterpillars make their way up the tree, usually at evening to feed on the leaves, later they return to the ground nest, following the fine silken threads whieh they leave as they proeeed in single file.

As time goes by and the eaterpillars grow bigger they eontinue to aseend the tree to feed and spend a part of their time building up the ground nest, weaving silken threads about it and to grass or leaves at the nest. At times as they work a number of eaterpillars will hang suspended by silken threads in mid-air, as they attaeh other threads to grass heads. If there are a large number of eaterpillars in the nest it beeomes very big, sometimes up to 14 inehes in diameter and raised several inehes from the ground. "Dirt" and east skins from the eaterpillars' bodies litter the nest.

Ants often intereept and attaek them while they are ascending or deseending the tree, the caterpillars then form into a group, remaining massed until the ants beeome tired of darting at the hairy mass and leave them. Spiders prey on them and will at times destroy a whole nest of tiny eaterpillars.

About the months of April and May when the eaterpillars are fully grown, they abandon the nest, setting off in a long proeessionary line seeking a plaee in which to pupate. After travelling awhile in single file, a eaterpillar may braneh off with others following, making a seeond proeessionary line (Fig. 2).

I have seen a single line of eaterpillars braneh off into as many as 23 other lines of eaterpillars. As they pass vegetation, one, or a small number of eaterpillars will drop out from the line and move in underneath the grass tufts or nettles to bury themselves under leaves and soil. If the silken trails left by the caterpillars are elosely followed up, they gradually beeome less distinet and eventually disappear. This is due to individual eaterpillars dropping out from the proeessionary lines to hide under vegetation and soil or eontinuing on alone. As many as a dozen eaterpillars may be travelling alone, parallel, a few yards apart. Some of them ean be found, alone, or in small numbers under vegetation, a distanee from the abandoned nest. The furthest ones whieh I found were 185 yards from the nest, with others near that distance.

After they bury under the soil the caterpillars apparently remain there, later to begin making a rather loose silken eoeoon, from whieh the moths eventually emerge (usually in November in eaptivity).

The females are large, handsome brown moths, the males being smaller. The female measures approximately 2½ inches across the expanded wings (the specimen had dried very brittle, making exact measurement difficult), wings folded against the body, from head level, 1 7-16 inch; stout body, 1¼ inches in length. Head tufted and hairy, brown with a sprinkling of light brown hairs. Wings, deep glossy brown, veined, with a distinct white spot on each upper and lower one. Orange and brown segmental body ending in a distinc-

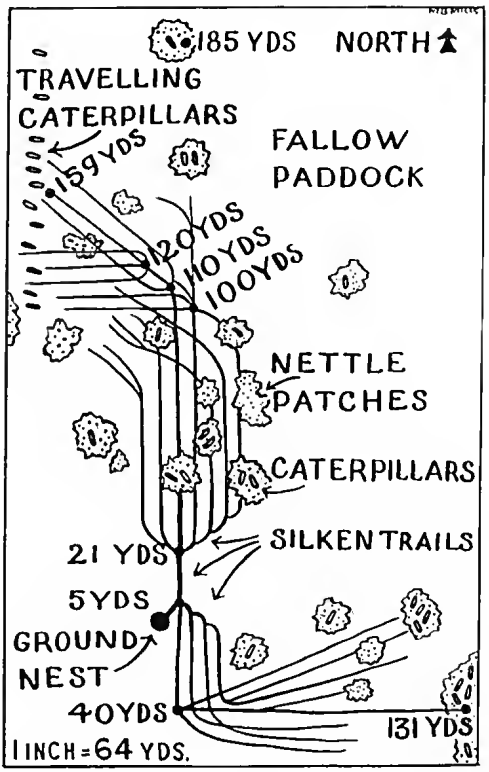

Fig. 2—Chart showing how the Ground-nesting Caterpillars travel after leaving their nest to find suitable places in which to pupate.

tive very light fawn to white colour. Under part of the body hairy, brown with a touch of orange. Encircling the end of the body is a band, approximately 0.3 in. wide, of tightly packed white to light fawn-coloured scales. These are disengaged from the body as the eggs are laid, covering them in a fluffy mass. The male moth is small and brown with white or silver marked wings; there is no light colour at the end of the body.

Of the many nests of the grey hairy caterpillars which I have had under observation over a long period, with notes made from day to day, at no time have I found the Ground-nesting Caterpillars

attempting to build a bag in a tree; they made their nests on the ground from the time of hatching to the time of pupating. The caterpillars appear to be more hairy than the Bag Shelter ones, while their female moth is much larger and of a different colour.

Since the above notes were written I kept a number of Ground-nesting Caterpillars in captivity, in a roomy box fitted with gauze-wire sides. After being placed in the box (two lots from different nests) they first hid under dry jam leaves and sand on the bottom of the box. Later, at evening, they set off in single file about the box and ascended the sides. After a short time they settled down and fed on fresh jam leaves; when satisfied they chose a place under the dry leaves and sand, massing there completely hidden from sight. From then on, each evening the caterpillars emerged from under the leaves between 6.30 and 7.30 to feed.

Leaves were kept fresh for them by placing them in a small jar of water, the small branches were firmly bound around with cloth to avoid the possibility of caterpillars falling in the water when descending the branches. A small forked stick was left leaning against the jar and on to the branches. It was interesting to find that the caterpillars usually ascended the stick to the branches and then up to the leaves. They were very easy to keep in the box. At times the door was not securely fastened, but no attempt was made to escape. After a time cast skins littered the nest and the caterpillars appeared to be contented.

While in captivity no attempt was made by the Ground-nesting Caterpillars to build a bag in the branches. After each evening meal they returned to their nest now threaded over with silk under the leaves on the bottom of the box.

When fully fed they buried under the sand; later in the year, in November, to emerge as moths.

Eggs laid by the females while in captivity were always deposited on the sand at the bottom of the box, in, or near a corner. The eggs were covered with fluffy scales.

In comparison to the caterpillars above, a small silken bag containing about 43 caterpillars collected on a big, old gum tree, and placed in a roomy gauze-wire cage, were most difficult to keep in captivity, even the smallest holes had to be attended to as the restless Bag Shelter Caterpillars continually moved about the cage. Little time was spent on the bottom of the cage, the caterpillars continually attempting to climb upwards. Their bag was fixed in a branch in the cage; at times they settled in it, but finally abandoned it altogether.

After several days the caterpillars grouped up on the leaves (not remaining at all on the bottom of the cage) and commenced to build a frail silken bag, later moving into it and at last appearing to settle down.

Each time fresh leaves were placed in a tall bottle in the cage the bag shelter, full of caterpillars, was carefully removed from

its nesting place among the stale leaves and fixed in a fork in a branch with fresh leaves.

After a time, usually at evening, the caterpillars emerged from the bag to spend some time weaving silken threads about it and on to leaves; later they moved off up the branch to feed on the gum leaves, afterwards returning to their bag shelter.

Two other bags of almost fully grown Bag Shelter Caterpillars collected from gum trees and kept in captivity were very restless, continually moving about the box. After a few days caterpillars from each bag began to build silken bags on the highest parts of the box, one on the side, the other on the top, under the lid of the box. Finally they moved into their new bag shelter. After a time they abandoned the bag shelters and buried under sand in the box.

In November moths began to emerge. Eggs laid by the females while in captivity were deposited high up on to the sides and top part of the box. The scales covering the eggs were "packed" into round, compact masses. The eggs and scales were stuck on to the box with some sticky substance.

FROM FIELD AND STUDY

Further Observations on the Irruption of Budgerygahs *(Melopsittacus undulatus).*—On July 28, 1951 a flock of about 30 Budgerygahs was seen at Claekline.

—J. A. L. WATSON, Nedlands.

On December 8, 1951 Budgerygahs were seen as we drove along the road between Bejoording and Northam. At about 24 miles west of Northam a group of four or more Budgerygahs was seen; and a few miles nearer Northam two more at different places about a mile apart were seen.

—(Mrs.) RICA ERICKSON, Bolgart.

Narrow-billed Bronze-Cuckoo's Egg Embedded in Silvereye's Nest.—After E. McCrum and I had the nest of a Silvereye *(Zosterops australasiac)* under observation at Bassendean and after the young had been successfully fledged, I collected the nest. This was taken on June 16, 1951, and it was not until January 12, 1952, after the nest had been handled and inspected on several occasions, that I discovered the egg of a Narrow-billed Bronze-Cuckoo *(Chalcites basalis)* embedded in its floor. The nest was of unusual depth, the lining of the floor being so thick that it made the actual nest cup quite shallow. The cuckoo's egg was almost wholly embedded in the lining, only a small portion protruding, though this portion probably had become uncovered during handling. The egg measured 17.4 x 12.9 mm., and was white sparsely marked with light red, or more correctly pink, around the larger end.

—D. N. CALDERWOOD, Claremont.

Little Falcon Hawking for Insects.—The Little Falcon *(Falco longipennis)* is not uncommon in this district but is seldom seen in numbers. In most cases one only gets a fleeting glimpse of a single bird or at the most a pair, and then they are usually in pursuit of some small bird. However, on January 29, 1952, between sundown and dark, I was surprised to find five birds flying over the edge of a swamp. They were diving in and out just like swallows, apparently very interested in some very small insects invisible to me. Every now and then a bird would pause in flight, clutch at something with its claws, and transfer it to the beak as it flew along. It would appear that four of the birds were probably a family party while the other was an intruder attracted by the abundant insects. The intruder (?) was chased off a number of times. When this happened an aggressive call was uttered. A. J. North, in *Nests and Eggs of Birds Found Breeding in Australia and Tasmania,* vol. 3, p. 274, mentions this species hawking for insects in the evening and states that large winged ants and dragonflies are procured in this manner.

—ANGUS ROBINSON, Coolup.

Encounter With Native Cat.—On August 23, 1951 I had an interesting encounter with a Native Cat *(Dasyurus geoffroyii),* this being my first meeting with the animal. My wife and I were awakened in the early hours of the morning by a loud scuffling noise in the kitchen, and a hurried investigation by torchlight revealed what we at first thought was a large rat. We eventually cornered the animal and succeeded in capturing it in a box, when we were amazed to find it was a native cat. It had evidently come into the house in search of food and failed to find its way out again.

Observed while kept in captivity during the following day it was seen to be about the size of a small domestic cat, with rather short legs. Nose square cut at the end of the pointed snout, and of a light tan colour as were the pads of the feet. Nostrils large. Eyes wide and round. Ears smallish but rather cat-like. The body colour was a curious admixture of greenish-yellow and blackish-brown, conspicuously marked with white spots. The tail, on which the hair was very coarse, was dark brown in colour with tip white.

A dead Silvereye, picked up in the garden, was placed in its box which had been covered with a bag to exclude the light, and in a very few minutes every vestige of this had been cleaned up. The Silvereye was followed by the body of a Magpie which had been found dead on the ground some days before. In 30 minutes half of this had been devoured, the animal opening it up and eating the internal organs first. Watched surreptitiously it was seen to crouch along the body of the bird while at its feast. It is worth note that in the excrement of this animal pieces of red skin, obviously from the seeds of *Macrozamia,* were conspicuous.

When released in the evening it went off without undue hurry.

—G. F. PARTON, Kalamunda.

Birds Eating the Fleshy Outer Coat of Zamia Seeds.—During their time of fruiting one often finds the showy red-coated seeds of the zamia *(Macrozamia Reidlei)* pulled out of the cones and scattered about, some of them with the fleshy outer layer partly or completely eaten off. Divested of their outer covering, numbers of the seeds are found also where they have been left lying on the tops of stumps and logs. Formerly I had thought that this was exclusively the work of one or more of our small native animals, but recent observations have revealed that some birds include the coat of these seeds in their diet, and that one species at any rate carries them about.

In June 1951 Mr. W. Smith, of "Aldersyde," Bickley, told me it had given him some pleasure to discover one of the channels by which the cleaned seeds reach the situations mentioned, when he observed a Raven *(Corvus coronoides)* eating the flesh from one on the top of a stump. The bird was holding the seed down in its foot, and carried it off in its bill when disturbed.

Mention of this by Mr. Smith led to a watch being kept, Mr. and Mrs. G. F. Parton in particular giving close attention in this respect to the birds about their home, where many zamia palms were fruiting. Corroborative evidence was soon obtained in regard to the Raven. In addition it was found that numbers of Silver-eyes *(Zosterops australasiae)* were knocking round the spilled seeds and greedily eating the layer of flesh. Many pieces of red skin from which the flesh had been cleaned were invariably found where these had been feeding. Subsequently Mr. Parton found that a small band of Western Rosellas *(Platycercus icterotis)* were also regularly feeding on the outer layer of the seeds.

One wonders if the Squeaker or Grey Bell-Magpie *(Strepera versicolor)* does not also avail itself of this source of food supply.

—W. H. LOARING, Bickley.

Letter-winged Kite Recorded for Western Australia.—Owing to the absence of positive records from Western Australia, Major Whittell and I excluded the Letter-winged Kite *(Elanus scriptus)* from a formal place in our *Handbook of the Birds of Western Australia,* and the species was believed to be restricted to the inner arid regions of central and eastern Australia. However during a recent visit to the North-west I was surprised to observe this beautiful hawk on two separate occasions and subsequently received a specimen from a third locality.

On October 28, 1951 I saw an individual at the homestead of Hooley Station, north of the Forteseue River. It was instantly recognisable by the black under wing band extending from the body around the bend of the wing. The upper parts of the body were darker than in the Black-shouldered Kite *(E. notatus).* On October 31 I saw another Letter-winged Kite right in the town of Roebourne, where it perched on a telegraph pole.

Mr. Roy Parsons, of Coolawanyah Station, on the Forteseue, undertook to obtain a specimen for me, if an opportunity pre-

sented itself, to confirm this most interesting record. He was able to do so almost immediately, for on October 31, the day after I left Coolawanyah, two Letter-winged Kites appeared at the homestead. One was collected and the wings and tail were forwarded to me and have been given to the Western Australian Museum. The wing measurement was 314 mm. and the tail, 161 mm. Mr. Parsons recorded the total length in the flesh as 14½ in., the wing span as 2 ft. 9 in., and the weight as 8½ oz. The iris was red-brown. Sex not recorded.

Remarkably enough, very soon afterwards a specimen was collected much nearer Perth. Mr. L. Glauert informed me that on December 14, 1951 the W.A. Museum received a male Letter-winged Kite from Mrs. H. L. Jarvie, of Miling (110 miles north-east of Perth), on whose property it had been shot.

Mr. I. C. Carnaby, of Wooroloo, has informed me of his observation of the Letter-winged Kite at Exmouth Gulf in 1943, but owing to the absence of other records in the State he was diffident about putting the record forward. He has prepared the following note:

"During a 10 months' residence at Learmonth, Exmouth Gulf three pairs of a hawk suspected of being *Elanus scriptus*, were noted. Whilst wind-hovering the letter-like markings on the under surface of the wings showed very clearly. One pair appeared to be nest building but the nest was abandoned early in August 1943. Later two nests were located further afield and birds were seen brooding. These nests were both on the ends of branches about 25 feet high, at right angles from the trunk, and overlooking dried water courses. They were too difficult for closer observation."

A previous published record by A. F. Crossman ("Birds Seen in and Around Broome, North-Western Australia." *The Emu*, vol. 10, 1910, p. 111), who baldly stated that the species was "not uncommon," has not been accepted in the absence of other evidence of occurrence. The record was also suspect as he made no mention of the presence of *Elanus notatus*.

—D. L. SERVENTY, Nedlands.

Bird Notes from Esperance.—These notes are based on observations made during November 1-6, 1950 and February 24-27, 1951 and are additional to those recorded by E. H. and L. E. Sedgwick (*W.A. Naturalist*, vol. 2, 1950, p. 111) during the summer of 1949-1950. My notes are not inclusive and several species covered in the previous article are not mentioned as no new information was obtained.

Brush Bronzewing *(Phaps elegans)*.—Four pigeons were flushed in the Pink Lake area, where fresh water springs at its edge are a great attraction to the birds. Shooters visit the area at night and obtain many of them. This seems to be the common species in the district.

Hoary-headed Grebe *(Podiceps poliocephalus)*.—On Webster Lake there were about 2-300 of these grebes.

Silver Gull *(Larus novae-hollandiae).*—The large numbers reported by the previous observers did not come under notice, 30 individuals being seen one day and 50 on another.

Pacific Gull *(Gabianus pacificus).*—On the first visit 6 mature and 11 immature individuals were observed. On the second over 50 birds were present, no sectional counts being made. The increase is possibly due to breeding birds having moved in from the islands.

Banded Stilt *(Cladorhynchus leucocephalus).*—On Webster Lake 2-300 birds were seen.

Avocet *(Recurvirostra novae-hollandiae).*—There were 80 birds in association with the Stilts.

Little Stint *(Erolia ruficollis).*—About 500 were seen on Webster Lake. Small parties of up to a dozen were noticed on the sea beaches.

Australian Bustard *(Eupodotis australis).*—One bird was flushed from the side of the road in the sand plain country some 15 miles from Esperance.

Mountain Duck *(Tadorna tadornoides).*—20 were seen on Webster Lake.

White-tailed Black Cockatoo *(Calyptorhynchus baudinii).*—A flock of over 200 was seen in the sand plain country west of Esperance, on the second visit.

King Parrot *(Purpureicephalus spurius).*—Two birds were seen.

Pallid Cuckoo *(Cuculus pallidus).*—One bird was heard calling on the first visit.

Narrow-billed Bronze Cuckoo *(Chalcites basalis).*—Seen and heard calling during the first visit.

Welcome Swallow *(Hirundo neoxena).*—A nest with 3 eggs was found in a limestone cliff during the first visit.

Hooded Robin *(Melanodryas cucullata).*—One bird was seen some 15 miles north of Esperance.

Brown Song-Lark *(Cinclorhamphus cruralis).*—One bird was seen calling in the aerodrome area.

Tawny-crowned Honeyeater *(Gliciphila melanops).*—A pair were seen about one mile inland from the beach at the first visit. From their behaviour it would appear that they were nesting, as one bird was carrying food.

Yellow-throated Miner *(Myzantha flavigula).*—The absence of this bird from the Sedgwicks' list comes as a surprise, as it proved to be one of the commonest honeyeaters on both visits. However, the period covered was one of exceptionally heavy rainfall and doubtless the flowering period was both long and fruitful. It indicates, however, that in the more arid areas fairly continuous observation over a period of years is necessary before valid conclusions on the presence or absence of a particular species may be made.

—V. N. SERVENTY, Subiaco.

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A CRATER-LIKE DEPRESSION NEAR MINGENEW, WESTERN AUSTRALIA

By M. CARRIGY, A. MAIN and B. MARSH.

INTRODUCTION.

While inspecting a series of aerial photographs of the Mingenew district taken for the Lands Department, one of the authors, B.M., was struck by the occurrence of an isolated circular depression showing on the photographs of Pintharuka, Run 10, Nos. 5058 and 5059 (see Fig. 1). Impressed by the symmetry of the depression, the rim (which showed clearly when viewed with a stereoscope), and the fact that other similar depressions did not occur in the vicinity, the discoverer tentatively suggested that the feature owed its origin to the impact of a large meteorite.

Although the photo discovery was made in 1950 no opportunity of visiting the area presented itself until March 14-15, 1952 when the writers were able to make a brief visit to the site.

The depression is located on the property of Mr. A. Ewers, about 18 miles east and 1¾ miles south of Mingenew on south boundary of Location 2016.

On our arrival Mr. Ewers visited "the swamp," as he called it, with us, and explained that in very wet winters the depression was filled to a depth of 4 feet with standing water which collected from the surrounding drainage area of several square miles. The water, however, did not persist but drained away by "soakage" within a few weeks. This first view of the area in the company of the owner clearly showed that the depression was not caused by a meteor for the rocks of the country, where exposed, were not tilted or shattered and the remainder of the rim was of a red sandy soil lightly covered with scrub.

Unexpectedly, the rock exposed here was limestone and this coupled with the local drainage pattern would seem to indicate a cause and effect relationship with the "crater", the prevailing winds contributing to the formation of the "rim" of sand which is about 5 feet above the level of the surrounding plain.

Fig. 1.—Pintharuka, Run 10, No. 5058.

Vertical aerial photograph of the depression. Note the contrast in the density of the vegetation inside and outside of the depression.

This photo is reproduced by courtesy of the Chief Draftsman, Lands Department, Perth.

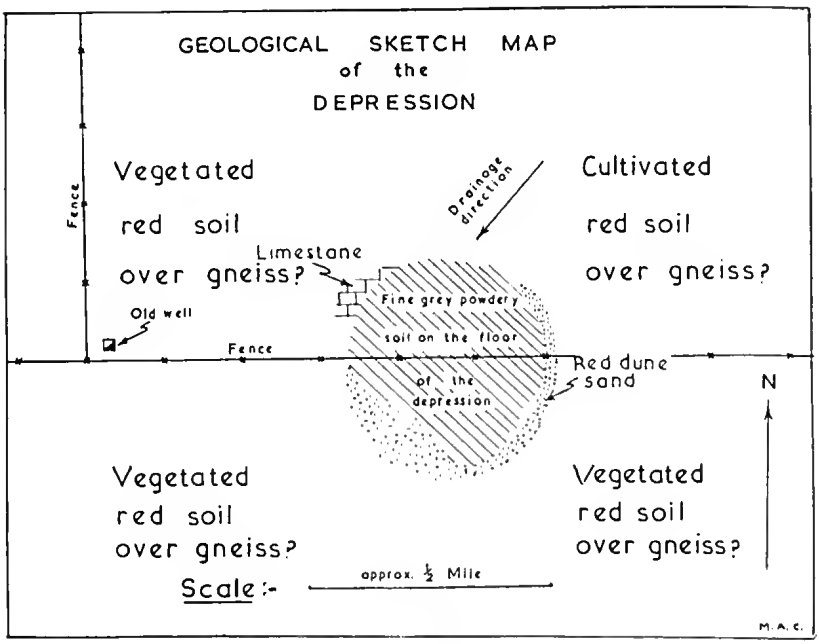

Fig. 2.

PHYSIOGRAPHY

The area lies within the 16-inch rainfall belt, most of which falls in the winter months. The depression under discussion lies in a shallow saucer-shaped basin. The general topography is of a subdued mature nature. From a distance the depression appears as a slight rise, this is because the only tall vegetation in the area *(Eucalyptus rudis)* occurs within the depression and the tops of these trees show appreciably higher than the surrounding shrub of *Acacia sp.* and occasional mallees. The rich red soil of the plains is underlain by gneiss, kaolinised to varying depths, and other easily eroded rocks, with a few resistant ridges of quartzites and silicified conglomerate and some mesas and buttes capped with ferruginous "plateau beds." The regional drainage is to the west.

GEOLOGY

Fortunately during our geological reconnaisance we had access to a mosaic of aerial photographs of the area, which Mr. Ewers had purchased from the Lands Department.

The area was surveyed in 1910 by W. D. Campbell of the State Geological Survey who had been mainly concerned with the sedimentary basin to the west and paid little attention to the Pre-Cambrian areas with which this paper is concerned. The geology of the surrounding country is masked by superficial soil deposits and outcrops are widely scattered. However, Mr. Ewers kindly drove us to the critical outcrops and with the help of mosaics we were able to interpret the geological structure in general terms in the following manner:—

A series of closely folded metasediments (silicified conglomerate, quartzites, phyllites, etc.) and gneiss, having a north-south strike with the folds possibly pitching to the north.

These rocks are undoubtedly Pre-Cambrian in age and can perhaps be correlated with the Jimperding series of Clarke (1930). The northern continuation of the great Darling Fault can be clearly seen on the mosaic 2 to 3 miles west of the depression. This fault separates the older Pre-Cambrian to the east from younger Pre-Cambrian, Permian, and later sediments to the west. These extend to the coast and are the southern part of the beds of the Irwin Basin (Clarke, *et al,* 1951). Traces of a possible fault parallel to the main fault approximately two miles to the east of the depression can be made out in the mosaic but it is obscured on the ground by cultivation and proof of existence required much more time in the field than was available. The older kaolinised gneiss is overlain in this area by a thin bed of limestone already mentioned in the introduction. The resistant hills are capped with iron-rich plateau beds.

The important rock from our point of view is the thin bed of limestone. It is only a few feet thick and is a calcareous "B" horizon of the soil. An old well put down half a mile to the west of the depression is said to have passed all the way through limestone

to a depth of 60 feet where good water was obtained. Much foul air was encountered in cavities in the rock as this well was being sunk. The rock from this well, now lying on the surface, consists of limestone and some fragments of kaolinised sheared gneiss.

TENTATIVE EXPLANATION

As has already been mentioned in the introduction the depression receives the drainage from a large catchment. The difference in altitude within the catchment is very slight, consequently the run off passes by as a series of ill-defined watercourses to the lowest part of the depression. This is the circular depression with which this paper is concerned. This water drains from the central depression by soakage and in doing this has probably dissolved the limestone basement so deepening the depression. While water drains underground the central depression will continue to grow in size. The depression itself is floored with a fine grey powdery soil, and limestone outcrops on the north-western rims (see Fig. 2). Three-quarters of the margin consists of vegetated sand dunes. A study of the quartz fraction of the dune sand shows a high percentage of well-rounded frosted grains. These could only have been formed by wind abrasion while passing through a long series of erosion cycles, and are therefore not modern. A theory accounting for the origin of this depression is that a standing body of water accumulating from a drainage basin of several square miles has dissolved out a depression in the underlying limestone and a series of dunes have been built up around the water by wind. Similar depressions are common on the great plains of Kansas (Frye, 1950).

SUMMARY AND CONCLUSIONS

Since there are no tilted or shattered rocks (Lobeck, 1939) there is no evidence of a meteorite having formed this depression. The writers believe the origin to be the result of the surface and underground drainage pattern eroding a circular depression in the thin limestone bed by solution; wind has then formed dunes around the edge.

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THE OCCURRENCE OF THE QUOKKA IN THE SOUTH-WEST

By S. R. WHITE, Government School, Morawa.

The interesting scrub-wallaby of the South-west, known in the vernacular as the Quokka *(Setonyx brachyurus)*, has in recent years suffered a great eclipse in abundance. Unfortunately it has been so neglected by field naturalists in the past that a misleading impression of mainland rarity, contrasted with extreme plentifulness on some island outposts, such at Rottnest, has gained currency. This situation even lead one recent writer to suggest that in past times the "physically inferior" Quokka was "driven by larger macropods from the richer land round the Swan River estuary to the poorer coastal sandhills" and so forced to the promontory which was later cut off as the islands off Fremantle (Clarke, *Journ. Roy. Soc., W.A.*, vol. 33, 1948, p. 141).

Apart from the fact that the "larger macropods" referred to, evidently the Grey Kangaroo *(Macropus giganteus)* and the Brush *(M. irma)*, occupy quite distinct ecological niches and would not ordinarily enter into competition with the Quokka, the evidence points to the Quokka having been, until quite recently, an abundant creature in the fertile, thickly scrubbed coastal country from which Clarke would exclude it as a common denizen.

The first field observations on the Quokka were made by John Gilbert who worked in the South-west between 1839 and 1843. His notes were summarised by Gould *(The Mammals of Australia,* vol. 2, 1863): "Mr. Gilbert states that besides meeting with it at King George's Sound, he found it abundant in all swampy tracts which skirt nearly the whole of Western Australia at a short distance from the sea, and that at Augusta, where its native name, Quak-a, is the same as at King George's Sound*, it inhabits the thickets and is destroyed in great numbers at the close of the season by the natives. . . . Mr. Gilbert adds, that he had not heard of its being killed to the eastward of the Darling range."

The mainland distribution of the species has been only vaguely defined. Glauert *(Journ. Roy. Soc. W.A.*, vol 19, 1934, p. 32) states that it extends from the Moore River to the south coast. Troughton *(Furred Animals of Australia,* 1946, p. 199) gives Esperance as the south-eastern limit.

My earliest contact with the Quokka was as a schoolboy at Yarloop. The animals were so numerous among the low tangled scrubs adjacent to the old government railway pump house on Logue's brook that we were able to stampede them by shouting and running and jumping through the scrub from a cleared roadway, and watch the Quokkas bouncing across the open tract into scrub on the other side.

Older boys frequently referred to Tammars which were also supposed to have been plentiful in that area but I cannot recall

* The name from Perth was recorded as Ban-gup by Gilbert and Bungeup by Shortridge.

having ever seen one there. Quokkas were certainly still plentiful in this area until 1926 when I left the Yarloop school.

In 1929 I again became acquainted with Quokkas in numbers at Busselton and along the coast between Cape Naturaliste and Cape Leeuwin. As recently as 1931 it was possible to find Quokkas in numbers at any time in the low scrub between the coastal dunes and the Vasse estuary. They extended all through the low lying scrub country from the coast to the Marri and Jarrah fringes. In 1933 I camped at Canal Rocks where they were particularly numerous at that time. Four years later they were still present but not so noticeably and within a few years they had almost disappeared.

It is now some years since I saw Quokkas or heard of them having been seen in the areas where I previously knew them so well. They were remarkably fearless and curious little animals frequently moving about the scrub during the day but rarely emerging into the open places until dusk.

I have heard their sudden virtual disappearance on the mainland ascribed to the spread of foxes, to competition with rabbits and to the destruction of habitat through clearing and bushfires, but many bushmen who knew the animal well consider that these factors were probably supplementary to a rapid decline resulting from disease. It is significant, however, that on Rottnest Island the animal still occurs in very great numbers.

Between 1904 and 1907 G. C. Shortridge made an extensive collecting trip in the State on behalf of the British Museum and in his report *(Proc. Zool. Soc. London,* 1909, p. 813) he gives no indication that the Quokka was a disappearing species at that time—as was the case with the Tammar. He stated that the Quokka was "very plentiful among the coastal thickets and swamps of the South-west, not extending inland."

Quokka *(Setonyx brachyurus)* photographed at Rottnest Island.
—Photo, V. N. Serventy.

Mr. W. H. Loaring, of Bickley, has given me the following notes: "In our old days at Margaret River, 1907-10, I was quite familiar with the Quokka, which was very numerous in the coastal country at that time. Also earlier, 1902-3, when we first went down there. I never saw Tammar in the Margaret River country, but we understood that they were present at Cape Naturaliste in those years. In the hill gullies south and east of Bickley the Quokka were particularly plentiful in the early 1920's, when their narrow and often covered runways went in all directions through the few chains of thick scrub bordering the streams, to which areas they confined themselves. The rabbit began to appear at that time, and the fox followed, and they dwindled away. From my notes I find a few were still present in the gullies as late as 1933-34. But it is many years now since I have seen any. In notes during a visit to the Margaret in 1933 I have one or two mentions of tracks being seen, but they were far less plentiful at that time than earlier. It is a good many years since I have been to the Margaret, but I understand they have vanished from there also.

"They appeared to shed a great deal of fur towards the end of winter, and my early notes mention the use of this by birds to line their nests, a note of August 14, 1921, on a nest of the New Holland Honeyeater being typical: ' . . . lined with Zamia wool with a covering of wallaby fur which is strewn plentifully about the ground amongst the creek-side tangles at the present time.'

"That the Quokka could swim strongly was demonstrated to us on one occasion at the Margaret River when one of the little animals, wounded in the foot and pressed by dogs, plunged into the waves and swam straight out to sea. In a few moments one of the dogs went after it and was to be seen treading water when on the crests of the waves in an endeavour to sight its quarry ahead of it. It eventually brought the unfortunate little wallaby back from a hundred yards out. Quokkas were snared and shot for food in those days, and were excellent eating."

COMMUNAL NESTING AMONG WHITE-WINGED TRILLERS AND OTHER BIRDS

By S. R. WHITE, Government School, Morawa.

One of the distinctive features of the bird nesting season in the Morawa district is its short duration. During a brief period, following the first fall of sufficient rain, life flourishes. Blossom and insects are abundant and when optimum conditions prevail the bird population is astounding in its density and in the high tempo of its activity. Then with surprising suddenness all declines.

A remarkable characteristic of the local bird population during the breeding season is the manner in which birds, not only of the same species but of different species, appear to congregate in small communities. There appears to be a tendency for birds to nest in proximity to one another. Such recognisable islands of mixed bird population have been observed to include Crimson and

White-fronted Chats *(Epthianura tricolor* and *E. albifrons),* White-winged Trillers *(Lalage sucurii),* Red-capped Robins *(Petroœca goodenovii),* Willy Wagtails *(Rhipidura leucophrys),* Brown Flycatchers *(Microœca leucophœa),* Magpie Larks *(Grallina cyanoleuca),* Black-faced Cuckoo-Shrikes *(Coracina novæ-hollandiæ),* Zebra Finches *(Poephila castanotis)* and Black-faced Wood-Swallows *(Artamus cinercus).*

It is possible that aggregations of this kind may be caused by lack of suitable foraging territory, by the distribution of food supply or by the limitation of suitable nesting sites, but the writer feels that it may also have some relationship to climatic control. In this area only during the months of July and August may a "water-surplus" be expected (Gentilli, *W.A. Naturalist,* vol 1, p. 123). With abundant food supplies available over such a limited span it is necessary that birds should initiate and conclude their breeding cycles in synchronisation with optimum conditions.

Evidence collected by some observers (Fraser Darling, *Bird Flocks and the Breeding Cycle,* 1938) indicate that community-nesting birds, by mutual mass-stimulation, achieve a shorter and better synchronised nesting cycle than pairs nesting alone or in small groups, which usually have a protracted nesting. E. Armstrong *(Bird Display and Behaviour,* 1947, p. 345), states, concerning the presence and activities of other birds and their effect on the breeding cycle, "Evidence from the study of birds displaying socially or breeding colonially supports the view that birds are stimulated sexually by being amongst their fellows, hearing their calls, and perceiving their display performances. They may even be excited sexually by the presence of other species."

In many species of birds the communal nesting habit is characteristic. Local birds such as the White-headed Stilt *(Himantopus himantopus)* and Avocet *(Recurvirostra novæ-hollandiæ)* which feed on the aquatic life of the salt-lakes might be included in this category. The period over which their breeding season may extend is both limited and hazardous for it depends not only upon local rains but upon inland falls which might link the lake system and cause a flow. Local birds of both species are usually to be found nesting together and in small groups of from two to a dozen or so pairs.

All four species of swallows nest locally. Fairy Martins *(Hylochelidon ariel)* have only been observed in the usual compact nesting associations. Tree-Martins *(H. nigricans)* have only been recorded in groups, the main nesting area being under the eaves of the Morawa Hotel. Welcome Swallows *(Hirundo neoxena)* and White-backed Swallows *(Cheramœca leucosterna)* have been found nesting both singly and in small groups. Any attempt to explain the social nesting habit of swallows must be closely related to food supply, but from general observation it is apparent that water is also a very important direct requirement. It is necessary to both the mud builders (Welcome Swallow and Fairy Martin); it is also probable that before the White-backed Swallow can form its nesting tunnels there must be some moisture to bind the

gravel soils which it seems to prefer here. Precipitation has been observed to stimulate nest building activities among the local Tree-Martin population *(W.A. Naturalist,* vol. 2, p. 141).

Other species occurring in my notes as showing a distinct tendency to form nesting groups are the White-fronted Chat, Crimson Chat, White-fronted Honeyeater *(Gliciphila albifrons),* Black Honeyeater *(Myzomela nigra)* and White-winged Triller.

The habit is widely recognised in the White-fronted Chat (Wheeler, *Emu,* vol. 50, p. 81; Sharland, *Tasmanian Birds,* 1945; Cooper, *Wild Life,* vol. 12, 1949, p. 131). The same feature has been recorded for the Crimson Chat (White, *W.A. Naturalist,* vol. 2, 1950, p. 49).

The two species of Honeyeaters are both, significantly, characteristic "dry area" birds. Optimum food conditions would be closely associated with climatic factors and the duration of the favourable nesting period fairly rigidly limited. Cooper (*Wild Life,* vol. 15, February, 1952, p. 164) says of the White-fronted Honeyeater, "Generally two or more pairs are found nesting in one area, and then a gap to the next birds." Other observers have noted somewhat similar tendencies in the Black Honeyeater.

A remarkable feature of the nesting groups of Black Honeyeaters and the nesting communities of birds associated with them, was the apparent preference for contact with other birds. The habitat consisted of widely-scattered mounds of higher land extending across salt pans and samphire flats some two miles in width. These low ridges sparsely clothed in woody shrubs up to 12 feet in height, and grasses, were typically identical. One might have expected to find the bird populations more or less uniformly scattered throughout, but this was not so, either during the 1950 or 1951 seasons. At both times concentrations of breeding birds appeared in one section only, while other adjacent and apparently similar habitats were ignored. The centres of concentration during each of the two seasons were separated by almost two miles.

My field notes covering a three year period in the Morawa district indicate that here the White-winged Triller usually forms nesting groups.

FIELD NOTES ON THE COMMUNAL NESTING OF TRILLERS

1949.

The discovery of three occupied nests within a radius of 30 yards and a report from a school boy of four other nests closely grouped, suggested a more intensive search for Trillers' nests in the 1950 season.

1950.

A special effort was made to locate and watch all Trillers settled on territories in and adjacent to Morawa townsite. Sixteen nests were recorded in three distinct communities. Another community was the subject of observation by one of the senior school girls, Jennifer Rogers, and its details were described by her in *Bird Study, Gould League Notes, W.A., 1951-52,* 1951, p. 5.

Group A. Five nests, all in York gum trees. Heights, 8-20 feet above the ground.

September 18, birds brooding on three nests.

October 6, birds brooding on five nests.

October 21, only one nest still contained young.

The habitat consisted of open York gum with grasses and scattered salt-bush below. The greatest distance from any one nest to the nearest adjacent nest was 21 yards and the most closely situated nests were 8 yards apart.

Group B. Six nests in York gum trees and a similar habitat to A. All nests were over 12 feet high.

October 15, birds were brooding on all six nests. The greatest distance from any one nest to the next nearest was 56 yards and between the two nearest, 25 yards.

Group C. Five nests known but it is possible that there were others. This habitat consisted mainly of Salmon gum. All nests were over 15 feet high, and no measurements were taken between nests.

Group D. (Data collected by Jennifer Rogers). Seven nests. Greatest distance from any nest to its nearest neighbour 50 yards, and the least distance 12 yards.

1951.

Groups A and B of 1950 did not re-occupy their nesting territories again. An association of 12 nesting pairs was found about midway between the old sites of A and B, and were scattered over a distance of about 150 yards. By October 15 five of the nests at one end of the group had advanced to a stage where four of the broods had flown, and young in the fifth nest appeared to be almost ready to leave. The seven nests at the other end of the colony all contained eggs.

MIXED NESTING ASSOCIATIONS

In addition to the nesting associations of several pairs of birds of the same species it is not uncommon to find several different species of birds nesting together in one small sector of an apparently uniform habitat.

Such communities often include a single pair of Magpie Larks, Black-faced Cuckoo-Shrikes, Willy Wagtails and Brown Flycatchers. Crimson Chats, White-fronted Chats, Black-faced Woodswallows, Zebra Finches and White-winged Trillers may be present in numbers.

Two birds mentioned in these associations, the Magpie Lark and Willy Wagtail, have been widely mentioned and discussed as frequent nesting associates and the Scissors Grinder *(Seisura inquieta)*, a species not recorded by me here, often selects an adjacent site. A. H. Chisholm *(Bird Wonders of Australia*, 1948, chapter X) suggests protective strategy as a probable reason. If this is so, then the theory could no doubt be applied to the mixed species associations mentioned in these notes, but the writer feels that the explanation may bear some relationship to mutual stimulation and its survival value.

THE BIRDS OF THE MOORE RIVER GORGE COUNTRY

By W. H. LOARING, Bickley, and D. L. SERVENTY, Nedlands.

Close on 50 years ago Mr. F. Lawson Whitlock investigated the bird-life of the Moore River, in the vicinity of Mogumber, 70 miles north of Perth *(The Emu,* vol. 4, 1905, p. 132). As this is a tract of country which has been little visited by naturalists in the intervening years and is an area which constitutes a frontier zone in the distribution of certain species, it seemed worth while to pay it a visit and to determine if any notable changes had occurred in the avifauna since Whitlock's careful survey in October-November, 1903.

The opportunity to do so presented itself in August 1950 when a week was spent there. Through the courtesy of the Native Affairs Department we were able to live in the temporarily unoccupied homestead of Shanaway Farm, 15 miles west of Mogumber and 24 miles west-south-west of New Norcia, and now a portion of the Moore River Native Settlement. It was of interest that Mr. Whitlock himself had stayed at Shanaway, during part of his 1903 survey, as the guest of the then owner, Mr. Finucane. The old homestead still stands, some chains to the west of the present building.

The whole of the area worked was in the Darling "Range" peneplain, though the country rock was of Mesozoic sediments lying between the Hill River fault and the Darling fault line. This latter fault line, the boundary between the sedimentary rocks and the granite, runs just east of the railway line. We came on the contact in the vicinity of Mogumber railway station, about a quarter of a mile upstream in the east branch of the Moore River. The valley in the granite country is shallow and unimpressive. During its passage through the area of the sedimentary rocks, however, the Moore has carved a narrow gorge, which is a rather striking feature of the topography from Mogumber to Regan's Ford, where the river enters the coastal plain at the Hill River fault scarp. This scarp is quite an insignificant feature compared with the Darling Range scarp further south.

The gorge varies in width from about 100 to 300-400 yards and in depth from about 100 to 150 feet. The sharply defined rim forms a breakaway above a steep talus slope into the floor of the valley, along which the Moore forms a succession of extensive pools, separated by narrows which are easily fordable.

There are two main bird habitats in the gorge area: the heavily timbered gorge itself and the sand heath of the plateau or peneplain. Along the edge of the gorge, however, there is a fringe of lightly wooded country which resembles the Swan coastal plain in type.

The principal tall trees of the gorge are river or flooded gum *(Eucalyptus rudis)* and marri *(E. calophylla)* and along the frontage are thickets of paperbark *(Melaleuca parviflora).* Other common trees in the association include stinkwood *(Jacksonia)* and banksia of several species, *Banksia grandis, B. Menziesii,* and *B. prionotes* being represented, although they are not all generally distributed.

Blaekboys *(Xanthorrhoea)* and zamia palms also oeeur, with pateh es of braeken fern and a diversity of shrubs. At the time of our visit the gorge in plaees presented delightful roek gardens with vivid drifts of a pink everlasting and a variety of orehids, the genus *Caladenia* being that ehiefly represented. The wooded fringe on the plateau eonsists mainly of banksia, marri, Christmas tree *(Nuytsia floribunda),* woolly bush *(Adenanthos sericea),* holly-leaved dryandra *(Dryandra floribunda),* with oecasional glades of wandoo *(Eucalyptus reduncа),* and, farther out on the plain, stunted sheoak *(Casuarina)* and odd trees of eoast blaekbutt *(Eucalyptus Todtiana).*

Most of the bird life was met with in the gorge and the wooded fringe on the edge of the plateau, particularly in the dryandra thiekets. Out on the plain, however, one might wander for miles without eoming on a bird.

The sand plain is the southerly termination of the vast plain whieh extends northwards to the Murehison River (see C. A. Gardner, *W.A. Nat.,* vol. 1, 1947, p. 1) and in this distriet it eontinues some 12 miles south of the Moore River. We were too early to witness the peak of the flowering of the sand plain flora. Smokebush *(Conospermum)* was eonspieuously budded, and a lambertia with pink flowers and a white-flowered grevillea were in bloom. We eame on patehes of flowering winter bell *(Blancoa canescens)* and blaek kangaroo paw *(Macropidia fuliginosa)* in bud. Others noted ineluded hovea, daviesia, blue tinsel lily *(Calectasia cyanea),* hibbertia, dryandra, and aeaeia, but the host was still to bloom. The striking dwarf mallee *(Eucalyptus macrocarpa)* was sparsely represented in one or two localities but was not in flower. Stunted blaekboys were a dominant feature on some parts of the plateau.

To the east, in the granite, the eountry is a wandoo and jam *(Acacia acuminata)* woodland.

Despite the faet that some of the eountry in the vieinity of the gorge was taken up for settlement a long while ago there has been relatively little alteration of the environment. When Whitlock visited the distriet there were two holdings on this seetion of the river, at Shanaway Farm and in the vicinity of Regan's Ford where a Mr. Bandy farmed a property. Now, though there are extensive elearings at both loealities, with pasture paddoeks, neither is under resident oeeupation. In 1918 the Moore River Native Settlement was established 7 miles west of Mogumber, but the elearings here are restrieted.

LIST OF SPECIES OBSERVED

Emu *(Dromaius novae-hollandiae).*—An adult, with a brood of young ehieks whieh immediately seattered, was eneountered on the edge of the sand plain 10 miles west of Mogumber. Two of the ehieks made away together for some distanee along the traek. Another was eaptured for inspeetion. When released it ran off, setting an even paee, and following as nearly as possible an undeviating line out into the serub. Meanwhile the adult had circled round and vanished.

Common Bronzewing *(Phaps chalcoptera)*.—No pigeons of any kind were seen in the immediate neighbourhood of the Moore River, but a Bronzewing was flushed from the roadside near Wannamal.

Little Pied Cormorant *(Phalacrocorax melanoleucos)*.—Single individuals were occasionally disturbed from the larger pools in the gorge section of the Moore River. Fresh-water cobblers *(Tandanus bostocki)* and a species of crayfish *(Cheraps)* occur on which they may subsist.

Darter *(Anhinga rufa)*.—One bird was seen in a pool a mile east of Shanaway Farm.

Banded Plover *(Zonifer tricolor)*.—Noted at Mogumber and also at Shanaway, where at least three pairs exhibited nesting behaviour near the farm-house. The nest of one pair, discovered by W. R. Serventy on August 30, contained three chicks which were promptly moved by the adults after discovery and were not again found. Several other pairs haunted the pastures farther to the west. The nesting birds were seen driving off other species that frequented the pasture, and their restless calls were heard at night.

Australian Bustard *(Eupodotis australis)*.—Two birds were seen flying low over the sand plain 12 miles west of Mogumber, and another flying over the river gorge at the Native Settlement. Two more came under notice 6 miles west of Mogumber. One of these landed about 300 yards from us and walked round in full view, majestic and dignified, and was later joined by the second bird, the pair of them eventually moving off on foot.

Straw-necked Ibis *(Threskiornis spinicollis)*.—Not seen in the vicinity of the Moore River, but 9 were noted in the grazing fields 6 miles north of Bindoon on our outward journey.

White-faced Heron *(Notophoyx novae-hollandiae)*.—Only two individuals were seen, one flying over the Shanaway paddocks and the other at the swampy section of the track 3 miles west of Mogumber.

Black Swan *(Cygnus atratus)*.—None were noticed on the Moore River but several were present on Lake Wannamal, 5 miles south of Mogumber. This was the only water-bird seen on the lake.

Wedge-tailed Eagle *(Uroaetus audax)*.—One bird was seen 2 miles west of Shanaway.

Little Eagle *(Hieraaetus morphnoides)*.—A pair, identified by the under-wing pattern and wing contour, were soaring over the gorge in the vicinity of Shanaway on one occasion.

Square-tailed Kite *(Lophoictinia isura)*.—A pair were regularly present near the farm, soaring over the gorge and surrounding countryside, and the quick quaver and yelp making up their characteristic call was heard from time to time. When perched one of the birds clearly revealed a sub-crest on the back of the head.

Brown Hawk *(Falco berigora)*.—This hawk was fairly plentiful along the wooded fringe on the plateau and was noted on the

sand plain, where one was occasionally seen flying low or perched at the top of a small banksia.

Nankeen Kestrel *(Falco cenchroides).*—Occasional birds were seen over the sand plain near the river gorge.

Other hawks were seen on frequent occasions but were not identified, and a number of nests, obviously the work of the larger species, came under passing notice in the taller eucalypts of the gorge region.

Boobook Owl *(Ninox novae-seelandiae).*—A bird was calling near the farm-house from the river gums in the gorge each night, and once at least, into earliest dawn.

Purple-crowned Lorikeet *(Glossopsitta porphyrocephala).*—None were seen in that section of the Moore River which we worked intensively; the nearest was a flock heard at Lake Wannamal and another at New Norcia.

White-tailed Black Cockatoo *(Calyptorhynchus baudinii).*—The largest aggregation was a flock of about 25 seen opposite the Mogumber railway station. In the gorge country occasional smaller parties were encountered and in a tract of wandoo pairs and a group of four, possibly nesting birds.

Galah *(Kakatoe roseicapilla).*—About 6 birds used to roost in the river gums at Shanaway and two or three individuals were constantly about. Another small party of 8-10 was seen at Mogumber. Whitlock did not meet with this species, which has notably extended its range southwards since his time. A nesting colony has recently established itself near Gingin and a few birds appear now and again at Marbling Brook, Lower Chittering.

Smoker Parrot *(Polytelis anthopeplus).*—Not very plentiful in the area we were investigating and small parties of up to 8 birds were seen occasionally. Whitlock did not meet with the species, which is another of those which has spread southwards and increased in numbers in recent years. Mr. Eric Schmidt informs us that it is now to be found throughout the year at Lower Chittering.

Western Rosella *(Platycercus icterotis).*—The mellow call-notes of this species were twice heard in the gorge but it did not come under direct observation.

Twenty-eight Parrot *(Barnardius zonarius).*—The common parrot of the district and very plentiful. Most of the birds seen had the yellow band across the lower breast. One bird collected, however, was a typical specimen of the race *B. z. semitorquatus,* with entirely green under-parts and a bright red forehead band. Another had an ill-defined yellow band and a smaller rufous-red forehead band. Both birds had marri seeds in their crops and many capsules nibbled around by these parrots were found under the trees. No typical "twenty-eight" calls were heard, the birds here calling in a series of high-pitched single notes. At Lower Chittering birds giving an intermediate thin double call were heard.

Kookaburra *(Dacelo gigas).*—Met with in the timbered gorge from Mogumber to Regan's Ford. This introdueed bird had not, of eourse penetrated as far north in Whitloek's time. The Moore River probably represents its limit of distribution in this direetion.

Saered Kingfisher *(Halcyon sanctus).*—None were eneountered at the Moore River itself but one bird was heard ealling (the "ki-ki-ki" notes) at Lake Wannamal on August 26—an unusually early reeord. It was heard in Perth on September 3, a date also ahead of normal sehedule.

Pallid Cuekoo *(Cuculus pallidus).*—Calling insistently throughout the distriet in the timbered areas. A female (spotted plumage) was heard uttering its harsh "ehurr-ehurr" eall from *within* a tree on the floor of the gorge and was attaeked by a male Searlet Robin and later by a Willy Wagtail. A male Pallid was also ealling not far away. The time was 11 a.m. On another oeeasion we saw a male Pallid on a blaekboy spike on the sand plain at the edge of the wooded belt. Another euekoo, probably a female (its plumage eould not be observed in detail), flew to the spike and after aeeepting a caterpillar from the first bird, flew off. During its flight it was ehased by a Willy Wagtail.

Fan-tailed Cuekoo *(Cacomantis pyrrhophanus).*—A bird was heard trilling in the depths of the gorge in the vieinity of Shanaway Farm on more than one oeeasion.

Narrow-billed Bronze Cuekoo *(Chalcites basalis).*—Heard ealling on several oeeasions in the timber in the vieinity of Shanaway. One evening we saw two birds (attributed to this speeies from the ventral pattern) running on the ground in one of the farm paddoeks in the manner of pipits, and aseending fairly high into the air, pipit-fashion, when disturbed.

Golden Bronze Cuekoo *(Chalcites lucidus).*—The more eommon of the two bronze euekoos and heard throughout the distriet, from Regan's Ford to Mogumber.

Weleome Swallow *(Hirundo neoxena).*—A pair had eompleted building a nest under the verandah of the farm-house at Shanaway but had not laid eggs up to the time of our departure (August 31). Other individuals were seen at the Native Settlement.

Tree-Martin *(Hylochelidon nigricans).*—A floek of some 50 birds was to be seen about the Shanaway paddoeks. A party of about 12 was seen at New Noreia. There was no sign of the presenee of the Fairy Martin.

Grey Fantail *(Rhipidura flabellifera).*—Heard singing throughout the gorge eountry from Regan's Ford to the Native Settlement and present at Mogumber, where a dead bird was pieked up in the river-bed.

Willy Wagtail *(Rhipidura leucophrys).*—Plentiful and widely distributed. A pair near the farm were exhibiting nesting behaviour.

Restless Flyeateher *(Seisura inquieta).*—Uneommon. A bird was noted in the tea trees fringing Lake Wannamal and another in the river gums at Regan's Ford. This bird was uttering two

distinct calls—the "grinder" note and a more pleasant, whistling "kheer kheer," given forth from a high perch. In 1903 Whitlock found this species to be more plentiful than the Willy Wagtail.

Brown Flycatcher *(Microeca leucophaea)*.—Whitlock found this bird "fairly common all along the course of the river," but we found it decidedly rare. We first came on it four days after our arrival, a pair in the valley floor east of Shanaway, and next day we saw a single bird near some of the farm out-buildings. Our only other record of the species was of a single individual near New Norcia.

Scarlet Robin *(Petroica multicolor)*.—A surprisingly plentiful species in the gorge country above and below Shanaway, and the neighbouring timbered belts on the plateau. We did not meet with it near Mogumber where Whitlock found it fairly common in 1903, but perhaps it was overlooked. A nest placed 5 ft. 8 in. from the ground and containing one egg was found in the fork of a banksia in the river gorge 9 miles west of Mogumber. At Shanaway a pair were feeding three young birds recently out of the nest.

Golden Whistler *(Pachycephala pectoralis)*.—Whitlock recorded this bird as being "far from plentiful." Apart from one doubtful record at Mogumber, the only bird met with by our party was a brightly plumaged male seen by W. R. Serventy near Shanaway Farm.

Rufous Whistler *(Pachycephala rufiventris)*.—Mostly found in pairs with males singing strongly. Its habitat did not appear to extend beyond the confines of the river valley where it was fairly numerous, particularly in the vicinity of Shanaway. In a small thicket of tall scrub in the gorge a mile west of the farm buildings a male was surprised in a demonstration that included a great deal of quick short flight from place to place near the ground, bobbing displays, and spirited song. There was another bird in the thicket but it was not seen clearly.

Western Shrike-Thrush *(Colluricincla rufiventris)*.—Heard only once, at Mogumber.

Magpie Lark *(Grallina cyanoleuca)*.—This species has expanded in range and abundance since Whitlock's visit. He recorded it as "distinctly rare; and only seen on the upper portions of the river, near to and beyond New Norcia." We met with the bird in the gorge country from Shanaway to Mogumber, and also at Lake Wannamal. At least two pairs were present in the neighbourhood of the Shanaway farm-house and the nest of one was found in a large marri. The old nest of another pair was noted some distance away.

Crested Bell-bird *(Oreoica gutturalis)*.—The characteristic "pan-pan-panella" song was heard in the sand plain 4 miles west of Mogumber. We followed the ventriloquial call but the bird eluded us. The species was not met with by Whitlock.

Black-faced Cuckoo-Shrike *(Coracina novae-hollandiae)*.—Fairly plentiful throughout the wooded gorge country, and about

the trees and fences at Shanaway; also noted at Lake Wannamal. Not infrequently in pairs and one group of four seen together.

White-winged Triller *(Lalage sueurii).*—A male was singing vigorously in the tea tree thickets of Lake Wannamal on August 26, a rather early record for the species in the South-west.

White-fronted Chat *(Epthianura albifrons).*—Only observed once, three birds seen by W. R. Serventy west of Shanaway. We did not encounter the Crimson Chat *(E. tricolor)* met with by Whitlock on the sand plain west of Mogumber.

Western Warbler *(Gerygone fusca).*—Heard singing throughout the district wherever there were trees, from Regan's Ford to Mogumber and at Lake Wannamal. Pairs were engaged in intricate courtship-chases. One of the most plentiful of the Passerines.

Weebill *(Smicrornis brevirostris).*—Similarly distributed to the preceding species and exceeding it in abundance.

Western Thornbill *(Acanthiza inornata).*—Found from Mogumber westwards. On three of the four separate occasions on which the species was logged the birds were either in pairs or singly and on the fourth the birds were still in the winter flock, at least five individuals comprising it. A bird in one of the pairs, at Mogumber, was carrying nesting material.

Brown Thornbill *(Acanthiza pusilla).*—Whitlock found this species only "near the source of the river," apparently above New Norcia. We met with it only once within our sphere of operations when a single bird was seen in the gorge 9 miles west of Mogumber. Its sparseness locally is a rather puzzling circumstance as the habitat appeared to be suitable.

Yellow-tailed Thornbill *(Acanthiza chrysorrhoa).*—Prevalent in the lightly timbered country within and alongside the gorge. We found two pairs building, one in a banksia (7 ft. from the ground) and the other at much the same height in a *Jacksonia.*

Striated Field-Wren *(Calamanthus fuliginosus).*—A pair were encountered on the sand plain 11 miles west of Mogumber, and we had several "not certain" records when birds were flushed by our vehicle on the track through the sand plain between Shanaway and Mogumber. The species was not recorded by Whitlock.

Banded Blue Wren *(Malurus splendens).*—We found this wren prevalent throughout the area in thickets and woodland from Mogumber to Regan's Ford with its stronghold in the river gorge, where it was particularly plentiful. It was present also at Lake Wannamal. Birds encountered included males in full plumage, three of these being present in one family-party; adult males in eclipse plumage with black bills and an extent of blue colouring in the wing, one of these was about to re-don the bright plumage as indicated by patches of blue appearing on the cheeks; and young males distinguishable from the females only by the dark blue colouring on some of the flight feathers.

Blue-and-white Wren *(Malurus leuconotus).*—A party of females and a male in full plumage was met with in the sand plain

11 miles west of Mogumber. Whitloek also found it oeeurring "very sparingly and loeally" in this area.

Blaek-faeed Wood-Swallow *(Artamus cinereus).*—Our experienees with this speeies aeeorded with Whitloek's who did not find it eommon. We eame on it on a few oeeasions on the sand plain.

Red-tipped Diamond-bird *(Pardalotus substriatus).*—Common throughout the gorge eountry in the euealypts. One bird was seen earrying nest material.

Silvereye *(Zosterops australasiae).*—Whitloek found this bird "eommon, and breeding throughout the eourse of the river," whieh suggests a greater degree of abundanee than we found. We logged the speeies only four times in the gorge eountry.

White-naped Honeyeater *(Melithreptus lunatus).*—Sparsely found in the gorge in the lofty gum trees where attention was attraeted to it by its piping notes. It was observed on three oeeasions, in the vieinity of Shanaway.

Spinebill *(Acanthorhynchus superciliosus).*—This speeies was first eneountered in the gorge 9 miles west of Mogumber and then again at Shanaway. This is probably the inland limit of the speeies' distribution in this region and it is of interest that Whitloek first met with it 10 miles downstream from Mogumber and thenee westward.

Tawny-erowned Honeyeater *(Glieiphila melanops).*—We found the bird sparingly distributed in the sand plain south of the gorge where Whitloek remarked on its absenee during his visit.

Brown Honeyeater *(Gliciphila indistincta).*—Singing vivaeiously everywhere in the wooded areas and undoubtedly the most numerous Passerine in the distriet.

Singing Honeyeater *(Meliphaga virescens).*—Met with at Lake Wannamal and on the sand plain, and at the edge of the gorge, but only loeally and somewhat sparingly. Whitloek did not reeord it.

New Holland Honeyeater *(Meliornis novae-hollandiae).*—Only met with in the tea tree thiekets at Lake Wannamal.

Red Wattle-bird *(Anthochaera carunculata).*—Present at Lake Wannamal and heard ealling on most days in the gums in the vieinity of Shanaway Farm, but not very numerous.

Little Wattle-bird *(Anthochaera chrysoptera).*—Noted at Lake Wannamal, in the gorge between Shanaway and the Native Settlement, and on the borders of the plain where, in groves of the holly-leaved dryandra *(Dryandra floribunda),* it was loeally numerous. A nest plaeed 8 ft. from the ground in a dryandra and eontaining one egg on whieh a bird was sitting, was found on the edge of the sand plain about a mile north-east of Shanaway.

Australian Pipit *(Anthus australis).*—Our reeords were: a pair regularly in the paddoeks alongside Shanaway farm-house, a eouple of pairs near the Native Settlement, and oeeasional single birds seen on the sand plain.

Raven *(Corvus eoronoides).*—Odd birds were met with through-

out the gorge and the sand plain in its vicinity. Most were near the Native Settlement where the largest group, 13 birds, were seavenging at a rubbish heap. No specimens were actually examined and the identification is based on the characteristic call. In no case did we come on any indication of the presence of the other two species.

Grey Butcher-bird *(Cracticus torquatus).*—Heard occasionally in the timber around Shanaway, but the species was not plentiful.

Black-throated Butcher-bird *(Cracticus nigrogularis).*—Observed only once, at the Native Settlement, where an adult and an immature bird were seen.

Western Magpie *(Gymnorhina dorsalis).*—Not conspicuous in the area. There was a small group at Shanaway farm, where a nest was being built in a marri, another 2 miles eastward, and birds were observed at Mogumber. The Shanaway birds were heard singing during the moonlight at night. The species appeared to be more plentiful eastward to New Norcia. Whitlock had the same experience with it—"pretty common from Mogumber to New Norcia; but to the westward rather rare."

GENERAL REMARKS ON DISTRIBUTION AND ABUNDANCE

It is tempting to compare the list just given with that published by Whitlock of his 1903 visit and also with the survey made by A. W. Milligan, with the assistance of Whitlock, Conigrave and others in the same year between Mogumber and the Wongan Hills via New Norcia *(The Emu,* vol. 4, 1904, p. 4). There are many pitfalls to be avoided in making such a comparison, as not only were the observations not made at strictly corresponding times of the year, but with such short visits it is impossible to take due account of the effects of fortuitous seasonal variations which may affect the status of nomadic species.

We dismiss from consideration, therefore, species of irregular occurrence like the Crimson Chat and Ground Cuckoo-Shrike (recorded by Whitlock and not by us), local migrants like the Grey Fantail (not reported by Whitlock) and forms whose status seems fairly conclusively to have been affected by settlement—the declining Rufous Treecreeper (observed by Whitlock but absent during our survey) and the increasing Banded Plover (found more plentiful by us than it was in Whitlock's day). The Magpie Lark may also be omitted as it is a species which has increased generally in the South-west during the past 30 years or so (see *The Emu,* vol. 47, 1948, p. 278).

There remain a number of species which stand out as either definitely more numerous now than they were in 1903 and some others which are definitely scarcer. For an analysis of the situation they present these birds may be divided into two groups: (a), the birds typical of the South-west corner, of the humid forest area; and (b), the birds of the drier areas which tend to avoid the South-west corner, particularly the heavy forest belt. Of the first-mentioned group only one, or perhaps two, come into the

picture. The Silvereye appears to have decreased in abundance and the other, the New Holland Honeyeater, may have increased in range (though we noticed it only at Lake Wannamal). In the second group, the dry-country South-west birds, there is an impressive list of species which have pushed farther into the South-west since 1903 or have increased in abundance, on the basis of Whitlock's assessment. They are Galah, Smoker, Crested Bell-bird, Striated Field-wren, Singing Honeyeater, and Black-throated Butcher-bird.

There are three other species in this category, however, which seem to have shown some decline: Restless Flycatcher, Brown Flycatcher and Dusky Miner (last-named not seen by us). The sparse population of the Blue-and-white Wren appears to have remained unchanged in the area though this species has made a notable advance southward nearer the coast.

There is a balance, therefore, in favour of an extension of the dry-country fauna, but no noticeable withdrawal of the South-west humid country fauna is evident, and in some cases, as in the Western Thornbill, Scarlet Robin and Spinebill, there has been a remarkable constancy in species boundaries over the period. Within the limits of the surveys there has been no outstanding instance of any member of the South-west humid country fauna extending its range.

FROM FIELD AND STUDY

Plumage Variation in the Willy Wagtail.—On December 28, 1951, at Naval Base, south of Fremantle, I saw a Willy Wagtail *(Rhipidura leucophrys)* in irregular plumage. The bird was similar to the adults usually encountered, but had restricted white on the underparts. The underparts were black, except for the white upper breast, under tail coverts and a small portion of the adjacent abdomen.

—D. N. CALDERWOOD, Claremont.

Larder Habit in the Magpie.—Each morning six Magpies *(Gymnorhina dorsalis)* assemble at my back door for small pieces of raw meat. On February 25, 1952 they were there at 9 a.m. One young bird which feeds from my hand took a number of pieces and then made several attempts to hide the last one. First it tried to fit it into a crack in the brickwork, then into a small tin and finally it ran among some pot plants and left it there.

Later, in the afternoon about 5 p.m., they were there again and this magpie ran and recovered the piece of meat hidden in the morning. It came up to the door with it and swallowed it.

—(Miss) S. ELLIOTT, Nedlands.

Senegal Turtle Dove at Goomalling.—While travelling through Goomalling on December 21, 1951, I observed a party of eight Senegal Turtle Doves *(Streptopelia senegalensis)* feeding in the railway yard. Further investigation showed that the birds had

established a strong colony in the township. On December 26 I observed one individual at Jennacubbine.

Unfortunately I could gain no idea how long these centres had been invaded by the species. The nearest previous records were from Wongan Hills, 28 miles north of Goomalling, and Northam, 25 miles south. Jennacubbine lies 11 miles south-west of Goomalling. —L. SEDGWICK, St. George's College, Crawley.

Koonac in Hyde Park Lake.—On February 13, 1952, I visited Hyde Park, Perth, to collect *Daphnia* from the park lake. For the first time in many visits during the last three years, no *Daphnia* were obtained. The weather was extremely hot (Observatory temperature, 101° F.) and the water very green with phytoplankton. Myriads of water-boatmen (Corixidae) were seen at the western end of the lake but there were practically none at the eastern end.

During netting operations the carapace of a freshwater crayfish was scooped up and identified as a Koonac *(Cheraps preissii)*. This location is outside the normal range of the species and is the most north-westerly record of its presence. It is possible the creature had been introduced by human agency.

—(Mrs.) IRENE SHIPWAY, South Perth.

Dugite and Rabbits.—On November 17, 1950 while at Esperance I inspected a Dugite *(Demansia nuchalis)* killed by Alfred Sanders, a farmer of that district. Mr. Sanders was searching for a horse in typical undeveloped country about one mile from the sea, when he was attracted by the squeal of a rabbit. A number of birds were also calling from nearby low bushes. On investigating he found that the Dugite had caught and was about to swallow a young rabbit (kitten). He killed the reptile and later in the day showed it to me. The snake was exactly six feet in length and weighed 3½ lb. It was of the colour variety known as the Kabarda as listed by L. Glauert *(Snakes of Western Australia,* 1950).

An interesting point was that the snake retained its hold on the kitten. —V. N. SERVENTY, Subiaco.

Birds and Zamia Seeds.—I read with interest Mr. W. H. Loaring's observations on birds and zamia seeds *(W.A. Naturalist,* vol. 3, 1952, p. 94). It will be found, I think, that Ravens *(Corvus coronoides)* frequently make use of these seeds: cases are referred to in Sedgwick's "Birds of the Rockingham District" *(Emu,* vol. 40, 1940, p. 129).

Mr. Smith's observation of a seed being carried off was of special interest, because I have seen Ravens carrying these seeds on several occasions. Once a passing Raven dropped a zamia fruit on to the bonnet of a vehicle which I was driving along a Peel Estate road.

The frequency with which Ravens carry food at times when not feeding young has led me to speculate upon the reason for this behaviour.

—E. H. SEDGWICK, Wooroloo.

Large Flock of White-fronted Chats.—It is customary for the White-fronted Chat *(Epthianura albifrons)* to associate in small flocks during the greater part of the year, but when driving through the Cannington district on February 28, 1952, Mr. G. F. Parton and I saw an astonishing number of these birds congregated in a few acres of grazing fields adjacent to the roadside. Everywhere over the ground at this spot the birds swarmed, and parties of 20 to 30 were constantly flying up to settle again near at hand. We found it impossible to form any true estimate of their numbers, but certainly many hundreds were present in the one small area. We watched them turning broken pieces of dung with a forward thrust of the bill, and noticed that there were more females—and juveniles—than adult males amongst those that moved close to us.

—W. H. LOARING, Bickley.

Red-eared Firetail Finch at Wongong.—While camped at Chandler's Farm on the Wongong near Jarrahdale on April 20, 1952, I saw four Red-eared Firetail Finches *(Zonaeginthus oculatus)*. These birds, once to be found in the coastal regions around Perth, are now only common in the south-west corner of the State, though also found in the Darling Range gullies north to the Mundaring reservoir *(Birds of Western Australia* by Serventy and Whittell, 1951).

On this occasion the birds were first noticed owing to the red flash from the rump. They came within 20 yards of the campfire during the breakfast period at 8 a.m. Four individuals were seen and followed up the creek for some 40 or 50 yards, when they began to return to the campsite as though under some territorial influence. Most of the time the birds were on the ground, rising into the trees when disturbed.

—V. N. SERVENTY, Subiaco.

Southern Emu-Wren at Gosnells.—On May 25, 1952, when hiking around the Sixty-ft. Waterfall in the Darling Range at Gosnells, I was most interested in meeting with the Southern Emu-Wren *(Stipiturus malachurus)*. It was in low scrub country on the flat where a creek flows out of the hills on to the plain. The only water in the creek at the time was in a few rock pools and these seemed to attract the birds. Some Blue Wrens *(Malurus splendens)* were also in the vicinity.

I actually saw only one Emu-Wren, which was difficult to observe as it darted from one bush to another, keeping well under cover. I walked on about ten yards and watched the bush with glasses. After a while the bird came in full view, displaying its blue throat and distinctive tail. I was unable to locate a female.

This is the first time I have seen this species at Gosnells, but it is likely it has been overlooked owing to its secretive habits.

—P. KNEEBONE, Gosnells.

Destruction of Nestling Birds by Reptiles.—During the course of four seasons among the birds of the Morawa district I have been greatly surprised by the high incidence of nesting "casualties." Some nests have been disturbed before their completion, some have disappeared before the eggs were hatched out, but by far the greatest number were plundered when they contained nestlings. Nests built fairly low were most frequently disturbed and the Crested Bell-bird *(Oreoica gutturalis)* a common victim.

My first deductions on examining such despoiled nesting sites pointed to the domestic cat gone wild, but the following incident, supplemented by the greater frequency of casualties among birds nesting in the much warmer late season, indicate that in many cases the culprit may be a species of *Varanus*.

On October 10, 1950, a very warm day, I set up my camera at 1.45 p.m. beside the nest of a pair of Black Honeyeaters *(Myzomela nigra)*. The tripod had been in position for some time and the parents very soon returned to the nest. My intention was to allow the birds about half an hour to settle down, when the sunlight would be favourably dispersed through a section of overhanging foliage. I stretched out under the shade of a low bush about 50 yards away and had fallen into a doze with the binoculars in one hand and the release thread held loosely in the other. Sudden cries of alarm from both parent birds together caused me to sit

A *Varanus gouldii* in the act of withdrawing after swallowing nestling Black Honeyeaters.

upright and focus the glasses on the nest. I could see something moving about among the branches and leaves, and, suspecting a snake, ran directly towards the nest. The intruder disappeared so swiftly into the tangled hatching of grass and debris under the bush that I was unable to identify it, but my anxious examination of the nest revealed that three young birds had been taken. Subsequent adjustment of the camera indicated that at some time during the surprise the shutter had been released. When the negative was developed the identity of the attacker was revealed—the head of a *Varanus* stood in plain view in the accidentally-exposed photograph. The species was identified by Mr. L. Glauert as *Varanus gouldii* (Gray).

—S. R. WHITE, Government School, Morawa.

Extension of Range of Migrant Orchid.—*Monadenia micrantha*, a South African orchid, was first recorded in this State from Young's Siding in 1944. At that time it was thought to be a newly-discovered species native to Australia. When W. H. Nicholls toured the South-west in 1946 in search of Western Australian species for his monumental work on Australian orchids he found *Monadenia micrantha* growing in abundance in the Albany area. His study of the living plants convinced him of its true identity. The localities he listed in that year were "on the main road between Upper King and Albany, also at the foot of an ironstone ridge a few miles west of Upper King River district, and in the vicinity of Cuthbert Siding." Nicholls returned to Western Australia in 1948 (a dry year) for further study of Western Australian orchids, but on that occasion failed to discover a single specimen of *Monadenia*.

Under these circumstances I was very interested in January of this year (1952) to find very many dead plants of the previous year's growth along the Marine Drive at Albany. Rev. W. Atkins reports the first appearance of this orchid in 1951 at Mt. Barker along the railway line. So it is evident that it will survive the vagaries of our seasons and is also extending its range along the roads and railways from its point of introduction (presumed to be Albany).

What factor is responsible for this spread is difficult to prove. Perhaps the plant favours the scraped or disturbed earth surface such as is found along roads and railways. Perhaps the air currents made by passing cars or trains suck up the minute seeds with the dust and deposit them on the bodyworks from where they are jolted off either by bumpy roads or the rough shunting of trains. If this be so here is a modern method of seed dispersal unplanned by Nature. That man's present-day methods of transport are being exploited by plants is well known to farmers, who find Double Gees in the car tyres and Guildford Grass flourishing in the virgin bush in cakes of mud dropped off wheels.

—(Mrs.) RICA ERICKSON, Bolgart.

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CAVE PAINTINGS NEAR YORK AND HYDEN

By V. N. SERVENTY, Subiaco.

During the period June 6 to June 12, 1952, accompanied by Mrs. B. and Mr. A. Main, I visited a number of caves in the York and Hyden districts of Western Australia. The following notes indicate the extent of the native paintings in the caves visited, with some historical information on the same subject.

GWAMBYGINE CAVE

This is at Cave Hill, Gwambygine, 5 miles south of York, on the property of Mrs. F. Clifton and was discovered early in the history of the State. The first published reference seems to have been that by Ensign R. Dale of the 63rd Regiment (*Journals of several expeditions made in Western Australia during the years 1829, 1830, 1831 and 1832*. 1833). In a chapter referring to an expedition to the "Eastward of the Darling Mountains", in August, 1831, p. 57, Dale states:

"At this spot we heard the natives, whose traces we had been following this morning, hailing each other at a great distance: we were fortunate enough this night in finding shelter from the rain, which was pouring down in torrents, under a sheltering rock; it was of a considerable size, having the shape and appearance of a thatched roof of a cottage. In the neighbourhood of our bivouac, and for some distance around were large masses of granite; in one of them we discovered a cavern, the interior being arched and resembling somewhat in appearance an ancient ruin. On one side was rudely carved what was evidently intended to represent an image of the sun, it being a circular figure about eighteen inches in diameter, emitting rays from its left side, and having without the circle, lines meeting each other at right angles; close to this representation of the sun were an impression of an arm and several hands. This spot appeared to be used by the natives as a place of worship."

George Fletcher Moore also gives the following description (*Diary of Ten Years of an Early Settler in Western Australia*, 1884, p. 73): " . . . its extreme end is a round figure, supposed to represent the sun, with the impressions of open hands around it. It appeared to us as if the rock had been covered with reddish

pigment, and that the impressions had been formed by the friction of a stone on the rock. . . . This cave is supposed to have been a place of worship: yet I know not why as the natives do not appear to have an object of veneration, nor is there any indications of a path leading to it."

He further discusses the subject *(A Descriptive Vocabulary of the Language in Common Use among the Aborigines of Western Australia,* 1842, p. 35): "Dumbun. subst.—a cave. The only vestige of antiquity of art which has yet been discovered, consists of a circular figure rudely cut out or carved into the face of a rock, in a cavern near York, with several impressions of open hands found in the stone around it. The natives can give no rational account of this. They tell some fables of the moon having visited the cave and executed the work. They have little curiosity regarding it and pay it no respect in any way. In short, it appears as if it did not concern them or belong to their people."

Writing under the pen name of "Polygon", P. Hasluck *(The West Australian,* August 30, 1930) wrote:

"There are no signs today of the rays that Dale described outside the circle. The most perfect specimen among the drawings is a left forearm and hand low down on the wall below the circle. This was outlined on the rock in red. It may have been done, as Moore suggests, by preparing a background of red and then rubbing away the colour with a stone to form the picture. Apparently the artist placed his hand and arm on the wall as he worked and stencilled the shape. To the left of the circle are two perfect imprints of left hands. These are done differently. The picture is not made by scraping away the colour or leaving the original rock bare, but by applying the colour in the shape of the picture and leaving the rock as the background. The hand is red, as though, as the old fable said, hands dipped in blood had left their marks. Other fainter and damaged drawings of hands are here and there. At one time the circle may have been surrounded by them."

No additional particulars on the cave or the drawings are given by D. S. Davidson in his "Aboriginal Australian and Tasmanian Rock Carvings and Paintings" *(Mem. Amer. Philosophical Soc.,* 1936, vol. 5, p. 120).

Mrs. Clifton informed us that from the information she had been given it appeared that the natives were nervous of the area and regarded it as the home of a Jingee Jingee or devil.

The cave faces to the east and is a typical hollow weathered in the granite. In depth it is no more than four or five feet, about 10 feet high and 40 feet long. At the south end is a small recess and in this are the paintings. Possibly other native work on the west and north walls has been removed by weathering. Although a few similar depressions were examined none were found to contain paintings. On the roof of the cave were fairly fresh nests of the Fairy Martin *(Hylochelidon ariel).* Apparently this is a well known haunt of the bird as this cave is recorded as a nesting

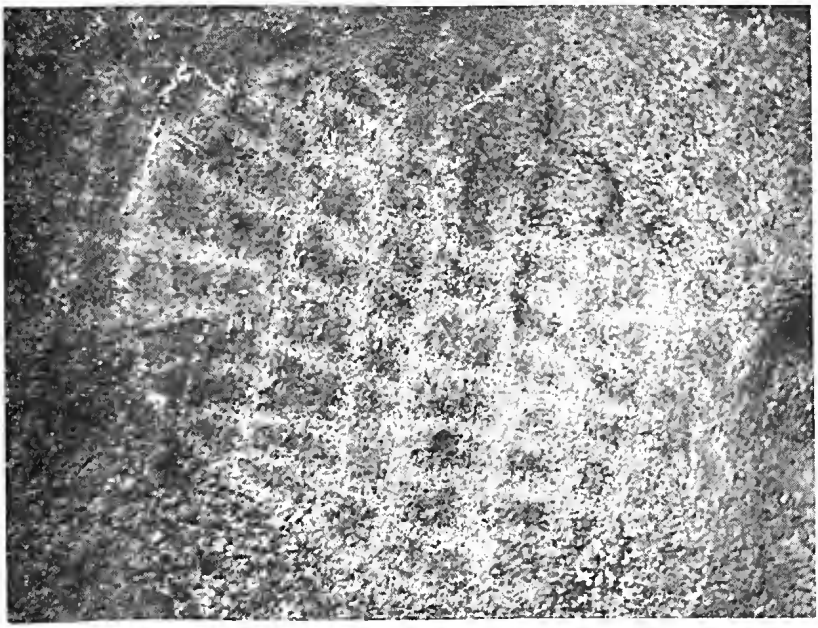


Fig. 1.– Gwambygine Cave. The "sun" of Ensign Dale's account. The thick white lines make the design, on a background of red.
—Photos V. N. Serventy.

Fig. 2.– Gwambygine Cave. The hand and forearm on the wall.

area by D. L. Serventy and H. M. Whittell *(A Handbook of the Birds of Western Australia,* 1951, p. 259).

Turning to the paintings themselves the central figure is as described by Hasluck. No trace of the rays mentioned by Dale can be seen. Also possibly Dale has written the word "without" as a mistake for "within" when referring to the lines meeting at right angles. This design is almost a perfect circle of 17 inches diameter, and is illustrated in Fig. 1. The circumference and cross lines are done with white paint and ochre is used in between. There is no carving. Surrounding the circle are stencilled hands. The most remarkable of these is a wrist as well as hand, the whole being over 11 inches long. It is about two feet above the floor of the cave and is of the stencil type. The natural rock gives the hand shape while around is the red ochre outlining it. The colour is still fairly bright and was either applied by blowing paint from the mouth while the hand was held in position, or else a brush made of bark or frayed out twig used as a tool to apply the paint. The neatness of the outline would seem to indicate the blowing method. Above this comes the circle some four feet from the floor and then above the circle are two hands, which may be stencils but are possibly done by dipping the hand in ochre and pressing on the wall, a printing method. In other words the palm and fingers, instead of being natural rock are red in colour. Both these hands are much fainter than the previous stencilled type. Further to the right are faint marks which may be other hands, while along the base is what appears to be a strip of faintly coloured rock and which may represent remnants of some drawings. The right or northern section is more exposed to the weather.

HYDEN ROCKS.

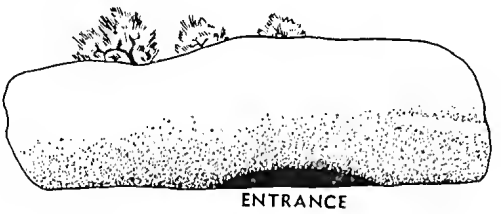
Hyden, about 160 miles E.S.E. from Perth, is at the terminal of the railway line from Wagin, via Lake Grace. The Hyden Rocks lie about two miles east of the town and are a popular picnic resort. The only traces of native work found were some very faint hands in two caves just below the dam and near the picnic area. Both were in boulders, separate from the main rock mass. The east end was hollowed out in both cases to make a small cave some five feet high. Two left hands were found in one cave and in the cave to the north of this, five left hands and three right hands. In both caves there were suggestions of markings indicating other hands but these were not definite enough to make identification certain. Apparently little is known locally about the paintings since there is no defacing. The casual observer would miss the significance of the very faint markings.

Near the east end of the Hyden Rocks is a very large cave. The opening is about 20 feet high and the cave is about 36 feet deep with a width of approximately 24 feet. It is also near a picnic ground and quite recently the walls have been whitewashed. There is a suggestion of ochre markings just above the whitewash but nothing definite could be recognised.

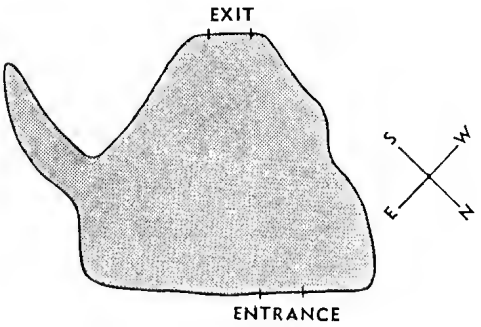
THE HUMPS.

This feature is situated about 8 miles N.E. of Hyden. Locally the rock formation is known as The Humps and is officially Government Reserve 4672. R. B. Day of Kulin describes one cave in the following words *(The West Australian,* January 27, 1951):

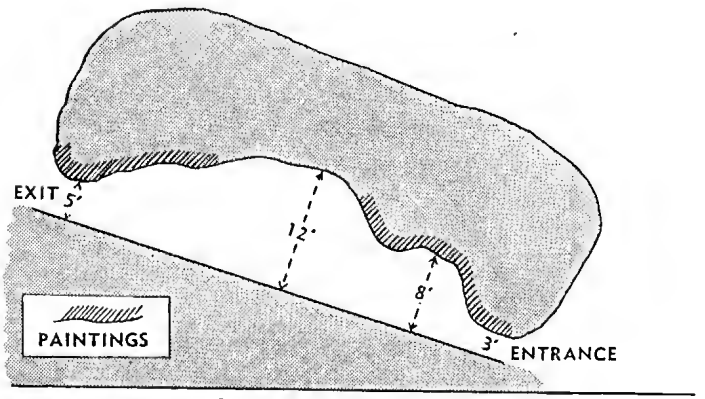
"The Humps is a great, bluff, granite outcrop, which towers over the surrounding countryside to a height of several hundred feet, and covers perhaps 90 acres. Its name is derived from the fact that at certain angles from the distance it resembles the



FRONT ELEVATION



PLAN OF CAVE



SECTION OF CAVE

Fig. 3.—The Cave at the Humps, near Hyden.

back of a camel. These great granite outcrops are typical of the inland of Western Australia, and as water is generally to be found on, or near them, explorers and adventurous prospectors of the early days used them as staging camps in their journeys of exploration. Here at The Humps is a native cave containing one of the few known relics of the tribes that once roamed the country. Inside can be seen the remnants of a large native drawing, partly defaced unfortunately, while on the roof and walls of the cave are hundreds of hand-marks done in red ochre. This type of cave was used in ceremonial rites and was often held in awe by the lesser members of the tribe. These marks are among the few records which the primitive hunter left to remind us that he once dwelt here. But for a very rare cave of this kind, no trace of the early inhabitants can be found."

This remarkable cave contained several hundred hand paintings. In addition near the entrance was a partly defaced marking, which is shown in Fig. 4. The entrance to the cave was about 3 feet high and 30 feet wide. Actually the whole cave is contained in a huge boulder 81 feet long. The diagrams illustrate the structure of the cave. It is interesting to note that a left hand side tunnel was quite dark and contained no paintings at all.

A rough sampling of hands gave six left hands and two right. Occasionally both right and left would occur together and this was particularly noticed with hands which I suggest are done by the "printing" method. Obviously in the stencil method a right-handed person would find it much easier to use his left hand as the template. The occasional right hands might indicate a certain amount of left-handedness or that some hands are drawn rather than stencilled.

A group of five hands was outlined in white paint while all the rest were worked in red ochre.

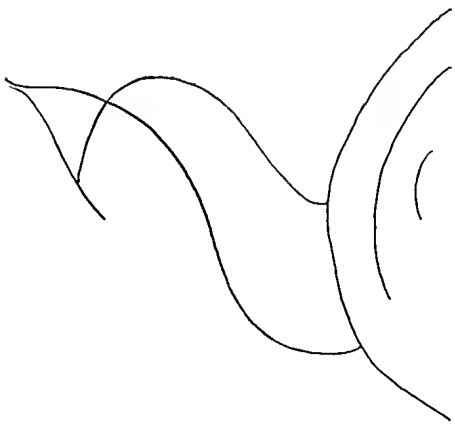


Fig. 4.—Copy of aboriginal marking in the cave at the Humps.

OTHER OCCURRENCES.

Further referenees to steneilled hands in the southern portion of the State have been recorded. W. D. Campbell in his deseriptions of various roek shelters in the Greenough River distriet *(Journal of the Natural History and Science Society of Western Australia,* vol. 5, 1914, p. 9) indicates that steneilled hands formed a large part of the paintings found. He also refers to steneils of weapons and other objeets. His deseription of the markings in a roek shelter at Sandspring, 23 miles east of Geraldton, seems worth quoting in full:

"The prineipal paintings are seen at mid-height on the right hand side extending diagonally upwards to the left-hand upper corner of the photograph. These in rotation are as follows: A pair of men's hands with the thumbs touehing, and the imperfect paintings of hands below these. About a foot above this line there is a very fresh outline of a tobaeeo pipe and a womera for throwing spears, whilc above and between thesc again are two hands. Near the bottom of the eave are seen the two egg-like figures already alluded to; also the eireular shaped marks beyond.

"These paintings are evidently of various ages, but are made in the same way and are similar to those of the aboriginals of the Eastern States. They have been made by plaeing the hand or artiele against the roek and dabbing the surrounding surfaee of the roek with a pigment made of a mixture of white ashes and fat, by means of a green stiek the end of whieh has been bruised into a brush-like tip. This mixture forms a hard eement. Thc durability of these paintings is increased by the oily nature of the pigment soaking into the sandstone."

A eave at Appertarra near Northampton yielded 12 left hands, 3 womeras and 2 stieks, all in white relief. These were again steneilled.

Willow Gully at the Bowes River gave "eleven right hands, at least three of which are evidently female hands, and twelve left hands, also three pairs of hands; total twenty-nine hands and one right foot. The weapons represented are seven boomerangs, horizontally placed with the curvature of the ends downwards. The paint material is either white elay or white ashes mixed with fat, whieh I understand is ealled by the aboriginals 'woolga'. Over these paintings are drawn some line drawings in ehareoal and red and yellowish oehre . . . " In a eave nearby were "steneilled paintings of three male left hands and a bifureated figure, which is probably a phallic symbol, and a branching figure. The two latter are painted not steneilled. On the roof there are two male left hands, one right and one left female hands, and on the west side there is one male hand."

Campbell does not say how he recognised female from male but doubtless it was by size. With steneilling, this is a very dubious conelusion to draw as thc size of thc final pieture would depend largely on the method of the artist rather than his or her hand size.

Evidence that some granite rock shelters may have had ceremonial significance is shown by W. D. Campbell. In the same journal (vol. 3, no. 2, 1911, p. 109), he says: "Mr. C. G. Gibson, Assistant Geologist, found a set of six boards in a granite rock shelter at a soak at the foot of a hill about 60 miles north-east of Laverton in October, 1905". The boards referred to are ceremonial ones of religious significance.

GENERAL REMARKS.

Stencilled hands are of fairly general distribution throughout the world and have been recorded in Europe, Asia, North America, Africa and Australia. The most famous, however, are the Aurignacian and Magdalenian of the European Later Palaeolithic, the Australian, and perhaps the African Bushmen. They are of general distribution in Australia and Lindsay Black *(Aboriginal Art Galleries of Western New South Wales,* 1943) gives a number of instances. There is a very well known occurrence in the Victorian Grampians known as the Cave of Hands.

Leonhard Adam *(Primitive Art,* Pelican Edition, 1949, p. 87), refers to them as follows: "In the first or Lower Aurignacian phase there are engravings drawn with the finger on soft clay walls. They are either simple spirals and frets, or crude representations of animals. There are paintings of animals, the crude contours done in black, yellow or red. And there are stencilled silhouettes of human hands, produced by laying the hand on the wall and blowing the colour over it or tracing the outline. Examples of similar stencilled hands are found in the rock art and bark paintings of Australia."

With regard to their purpose R. H. Croll *(Art of the Australian Aboriginal,* 1943), says: " . . . the hands appear to be no more than the rather playful work of a native, or natives, who had

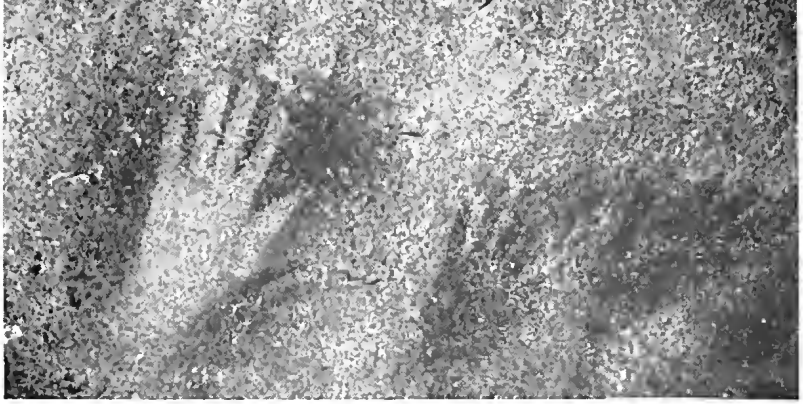


Fig. 5.—The Humps. A flashlight photograph showing one very clear "stencilled" hand and several of the "printed" type. These are all worked in red.

the urge to record something and here found opportunity." A similar attitude is taken by Colin Simpson *(Adam in Ochre,* 1951, p. 207), who says: "The stencilled hands we saw in Arnhem Land caves—and which I have also seen in a New South Wales cave and, which Leonhard Adam points out, were common to the caves of paleolithic Europe—are still a puzzle. Perhaps they mean no more than the 'I-was-here' initials."

However it is possible that the hands had more significance than this. There is the well known reluctance of the native to enter caves or to leave any personal relic lying about for enemies to use in ritual magic. A stencilled hand could be considered such a personal relic. There is also their association with other art forms and the fact that some observers have found such caves frightening to natives. The non-committal attitude recorded by Moore may have been a normal defence reaction when a thing of religious value was endangered by the presence of strangers, too powerful to be driven off.

Among writers who see a more serious purpose in the hands than Croll and Simpson is H. Basedow *(The Australian Aboriginal,* 1925, pp. 321-322). He states: "The Arunndta refer to the hand marks as 'ilja imbadja'. A native attaches considerable importance to his identity thus recorded and preserved in some of the caves, believing the brand to stand for his individuality with as much certitude as, say, the European who leaves his card or carves his name in stone or wood. It is compulsory for members of

Fig. 6.—The Humps. Another flashlight showing a group of hands outlined in white.

a certain rank in the Worora tribe to have their 'hand shadows' perpetuated upon the walls of caves in which the bones of their ancestors are reposed, because the spirits of the dead are thus supposed to be apprised of any visits which have been made to their last earthly resting places. It is beyond dispute that the natives possess the faculty of being able to recognise the hand-marks of their relatives and tribesmen, even though they may not have been present when they were made."

However, whatever their significance, it seems worthwhile that all such occurrences should be put on record before vandalism of the type already recorded at Gwambygine and Hyden destroys them for all time.

NOTES ON THE GENUS *IDIOSOMA*, A SUPPOSEDLY RARE WESTERN AUSTRALIAN TRAP-DOOR SPIDER

By BARBARA YORK MAIN, Zoology Department, University of Western Australia.

In 1870 Cambridge described a male specimen of *Idiosoma sigillatum* collected in 1864 from the Swan River, under the name *Idiops sigillatus*. The following year Ausserer proposed for this spider a new genus, *Idiosoma*. No further specimens were collected until 1897 when Pocock described a female of the same species. Later literature on local trap-door spiders intimate the rarity of this spider and report that after 1897 no further specimens were collected. Both described specimens are in the British Museum of Natural History. Prior to this report the genus was thought to be monotypic. The erection of two new species is considered warranted after an examination of Mygalomorph material in the W.A. Museum and additional specimens collected in the field by the author.

In this paper the generic characters are briefly restated, the two new species are described, and the main diagnostic features of *I. sigillatum* given. The variability of *I. hirsutum* sp. nov., *I. nigrum* sp. nov., and *I. sigillatum*, as deduced from a close examination of all available specimens and comparison with Cambridge's and Pocock's original descriptions is fully discussed in a monograph of W.A. Mygalomorphs at present in preparation.

Genus *IDIOSOMA* Ausserer, 1871.

Idiops sigillatus, O.P. Cambridge, P.Z.S., 1870, p. 105, pl. viii, fig. 2.

Acanthodon sigillatum, Simon, Hist. Nat. des Araign. i., 1892, p. 91.

Idiops sigillatus, Rainbow, Rec. Austr. Mus., iv., 1, p. 7.

Acanthodon sigillatum, Rainbow, op. cit.

Generic Characters: *Carapace*, longer than wide, anteriorly and posteriorly truncate, sides subparallel but sinuous; caput only slightly elevated. *Fovea*, deep, procurved. *Clypeus*, membranous

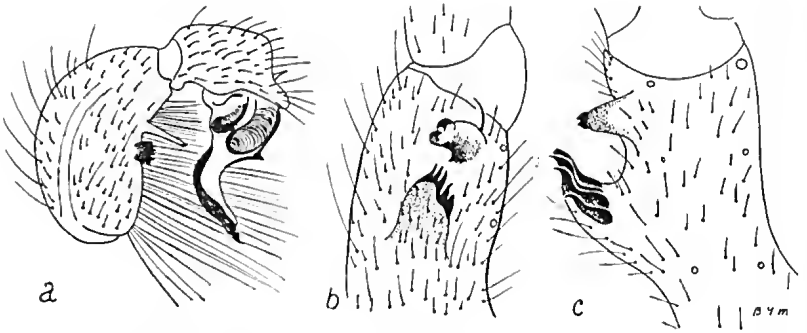
with bristles. *Eyes,* in three rows of 2, 2, 4; ALE close together on edge of carapace, AME. directly behind; PLE and PME in a transverse row. Group wider than long. *Chelicerae,* with teeth on both margins of furrow and an intermediate basal group. Rastellum prominent. *Maxillae,* with anterior scopula; bristles and spinules over ventral surface and euspules on inner margin (spinules and euspules may be absent in male). *Labium,* depressed; free but closely approximated to sternum; no euspules or spines. *Sternum,* longer than wide; three pairs of round sigilla; one pair oval sigilla behind labium. *Palps,* tarsus with scopula; female palp with claw. *Legs,* weakly spined; two anterior pairs of tarsi and metatarsi with scopula. Female upper claws with several unequal teeth, male with many teeth (six to twelve), in a single row. *Abdomen,* dorsally coriaceous, heavily sclerotised (not so heavily in male), distinctly corrugated in female, less so in male, the grooves and ridges running longitudinally and in some species transversely at the posterior, spinose. Ventrally corrugated only at the edges. Anteriorly abdomen elevated high above level of cephalothorax. Posteriorly abdomen is truncate but not as much as in *Cyclocosmia* and *Chorizops.* Two pairs of large conspicuous posterior sigilla, which, as Cambridge described them are "like seals" (Cambridge, 1870, p. 106). Two pairs of spinnerets.

Idiosoma sigillatum Cambridge.

Synonomy as for genus, additional references.
Idiosoma sigillatum, Ausserer, Verh. z-b. Vien, 1871, p. 150.
Idiosoma sigillatum, Koch, Die Araehn. Austral. 1871, I, p. 461 (German translation of Cambridge's description).
Idiosoma sigillatum, Pocock, Ann. Mag. Nat. Hist., xix (6), 1897, p. 109.
Idiosoma sigillatum, Simon, Hist. Nat. des Araign., Suppl. Gen. 1897, p. 901-2.
Idiosoma sigillatum, Hogg, P.Z.S., 1901, p. 230.
Idiosoma sigillatum, Rainbow, Rec. Austr. Mus., 1911, vol. ix, p. 110-1 (Census of Australian Spiders).

♀ Easily recognised by the dorsally coriaceous corrugated abdomen; ridges brown, grooves yellow; uniformly covered with small pointed spines; along tops of ridges large, stout, black, blunt-pointed spines and occasional bristles (text fig. 2a). Dorsally the corrugations are longitudinal, posteriorly transverse thus passing between and around sigilla. Venter yellow, not coriaceous, transversely wrinkled, with bristles and hairs. Cephalothorax and appendages reddish-brown. Other characters as for genus. (Variability of dimensions and ratios, cheliceral teeth, tarsal claws, spines and so on discussed elsewhere—as mentioned).

♂ Cephalothorax and abdomen smaller than female, legs longer and thinner; brown; abdomen with several longitudinal coriaceous corrugations, not nearly as pronounced as in female; long black pointed spines along tops of ridges; four conspicuous sigilla. Legs covered with spines, few hairs and bristles (measurements and ratios etc. given elsewhere).



Text figure 1.—*Idiosoma sigillatum* ♂. a, Tibia and tarsus of right palp, retrolateral; b, Tibia of first left leg, prolateral; c, Id., ventral.

Idiosoma hirsutum sp. nov.

♀ (measurements and ratios given are for the holotype). Carapace 14.00 mm. long, 9.75 mm. wide; chelicerae 5.00 mm.; abdomen 17.50 mm. long, 14.00 mm. wide. Cephalothorax and appendages reddish-brown. Anterior of carapace glabrous, posterior hairy. *Eyes,* ratio of ALE : AME : PLE : PME = 10 : 6 : 11 : 5. ALE more than half but less than their diameter apart; AME more than their diameter apart. Length: width of eye group = 2.10 : 3.25. *Chelicerae,* inner margin of furrow with 7 to 11 (usually 8) teeth, outer with 6 to 9 (usually 6), intermediate with 5 to 9 (usually 8), (numbers ascertained from examination of four specimens). *Maxillae* and *labium* as for genus. *Sternum,* as for genus; length: width = 29 : 20 (7.25 mm. : 5.00 mm.). *Palp* claw with 1 to 3 teeth, usually 3.

Legs	4	1	2	3			
	1.91	1.80	1.58	1.43			
		F.	P.	T.	MT	T	Total
I		8.50	5.00	4.75	4.00	3.00	25.25 mm.
II		7.00	5.00	4.00	3.50	2.75	22.25 mm.
III		6.00	4.50	3.50	3.25	2.75	20.00 mm.
IV		8.00	5.50	5.00	4.75	3.50	26.75 mm.
Palp		7.00	4.00	4.75		4.50	20.25 mm.

Width of patella I at "knee", 1.85 mm. Tibial index, 19.47. Width of patella IV at "knee", 2.15 mm. Tibial index, 20.48. Spination variable but essentially like *I. sigillatum* (see Pocock 1897, p. 111), does not seem to be specifically significant. Tarsal claws with 1 to 3 teeth, usually 3 (deduced from examination of four specimens). Abdomen dorsally with prominent longitudinal ridges and grooves, posteriorly they are transverse and extend between sigilla, thus whole of dorsum is corrugated. Tops of ridges brown, grooves yellow, colour demarcations form a pronounced line, whole

of dorsum uniformly covered with small pointed spines; long, fine hairs along tops of ridges. Venter yellow, not selerotised exeept at edges; transverse wrinkles; hairy. Four spinnerets.

Type loc.: Victoria Park. W.A. Museum 29-1060.

Loc. of paratype: South Perth. W.A. Museum 1914-1069.

Idiosoma nigrum sp. nov.

♀ (Measurements and ratios given are those of the holotype). Carapace 10.00 mm. long, 7.00 mm. wide; chelicerae 4.00 mm.; abdomen 13.25 mm. long, 10.50 mm. wide. Cephalothorax and appendages dark greyish-brown (some specimens reddish). Carapace glabrous. *Eyes,* ratio ALE : AME : PLE : PME = 7 : 5 : 11 : 4. ALE about half their diameter apart; AME more than their diameter apart. Length: width of eye group = 1.65 : 2.60. *Chelicerae,* 6 to 8 teeth in inner row, 5 to 6 in outer row, 6 to 9 in intermediate group. *Maxillae* and *labium* as for genus. *Sternum* as for genus; length: width = 24 : 19 (6.00 mm. : 4.75 mm.). *Palp,* claw with 3 teeth.

Legs 4 1 2 3

1.93 1.85 1.65 1.48

	F.	P.	T.	MT	T	Total
I	6.00	4.00	4.00	2.50	2.00	18.50 mm.
II	5.25	3.75	3.25	2.25	2.00	16.50 mm.
III	4.00	3.00	2.75	3.00	2.00	14.75 mm.
IV	6.00	4.00	3.75	4.00	2.00	19.75 mm.
Palp	5.00	3.00	3.00		3.50	14.00 mm.

Width of patella I at "knee", 1.25 mm. Tibial index, 15.63. Width of patella IV at "knee", 1.50 mm. Tibial index, 19.35. Spination variable, not essentially different from other two speeies. Tarsal claws with 2 to 5 teeth, usually 3. *Abdomen,* dorsally black, anterior yellowish-grey; heavily selerotised, more so than other two speeies — whereas former are leathery this speeies is hard and quite inflexible. Anteriorly less selerotised. Selerotisation comprised of angular plates, which anteriorly are wide apart and further back are adjaeent and welded together. Longitudinal corrugations; unlike *I. sigillatum* and *I. hirsutum* there are no transverse corrugations, thus the area between sigilla is quite flat. Ridges and grooves with short, stumpy, tubereular, black spines. The anterior and lateral spines rather like the small spines of the other two speeies, exeept for the colour; the larger spines however, are of a different shape (see text fig. 2c.), and relatively smaller than those of *I. sigillatum.* Very few bristles on dorsum; many bristles and hairs on dorsal anterior part and around edge of venter, also long, thin pointed spines behind spinnerets. Venter yellowish, not selerotised exeept at edges, transversely wrinkled, with hairs and bristles.

Type loc.: The Wongan Hills.

Loc. of paratype: The Wongan Hills.

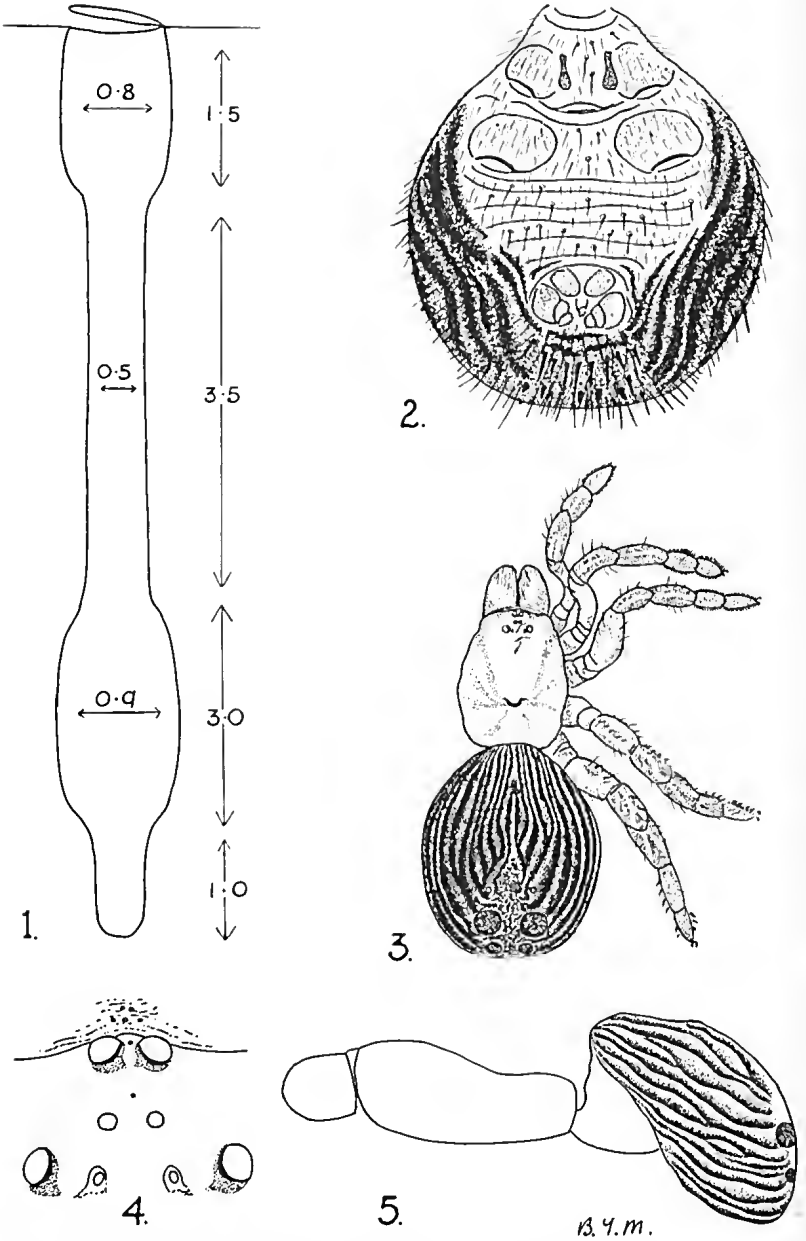


Plate 1.—*Idiosoma nigrum* sp. nov., ♀. 1. Longitudinal section of nest, measurements in inches. 2. Ventral view of abdomen. 3. Dorsal view of spider. 4. Eyes. 5. Profile of spider.

N.B.—Drawings not to same scale.

Locality of specimens examined: *Idiosoma sigillatum,* ♂ Claremont, ♂ West Midland, ♀ Nedlands, ♀ Cannington, ♀ Bayswater, ♀ Mt. Lawley, ♀ Bibra Lake, ♀ Swanbourne, ♀ Wembley, ♀ Forrestdale. *I. hirsutum,* ♀ South Perth, ♀ Midland Junction, 2 ♀ ♀ Victoria Park. *I. nigrum,* ♀ Northam, ♀ Mt. Dick, ♀ Goomalling, ♀ Bolgart, 6 ♀ ♀ Wongan Hills, 5 immatures Wongan Hills.

There are no natural history records of *I. sigillatum* or *I. hirsutum.* Of the sixteen specimens of *I. nigrum* fifteen were dug from their nests in the ground. The specimen from Northam was presented to the author by Mr. C. G. Jessup to whom it had been given by someone who did not mention how the specimen had been obtained. The Mount Dick specimens were obtained by scraping eucalypt leaf litter off the ground with a spade, thus removing the lids and exposing the tubes. The tube of the immature specimen was just less than 4 inches deep and contained no silk lining. The mature specimen's nest was lined throughout with white silk and showed the characteristic structure illustrated in Plate I, figure 1. These specimens were found within a few yards of one another in rich red soil on the eastern side of Mt. Dick where the hill flattens out.

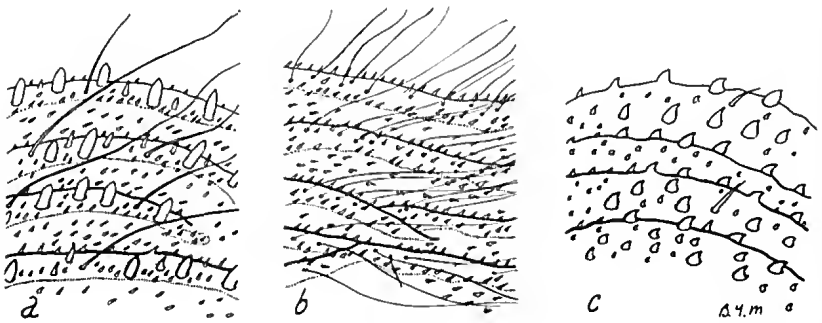
The nest of the specimen from Goomalling was exposed by the same technique under eucalyptus leaf litter. It was in sandy soil overlying and adjacent to red loam in the bush reserve to the north of the town.

In rich red loam beneath a eucalypt tree by the roadside about a mile south of Bolgart another specimen was dug from its hole. The measurements for the nest illustrated (Plate I, fig. 1) are of this spider's tube.

Two of the Wongan Hills specimens (adults), were discovered in red soil within a few inches of the base of a mallee growing alongside the Piawaning road as it passes through the Wongan Hills to the north-west of the town. The closed lids of these two tubes were observed without disturbing the debris. Attached to the lids were pieces of bark, leaves and twigs but they were not covered with loose litter. The remaining nine specimens from Wongan Hills were found on a flat shelf along one of the valleys in the Wongan Hills. All specimens were in an area about one yard square and several nests were no more than a few inches apart. Again the soil was deep red (weathered dolerite) and sparsely covered with *Casuarina* and *Eucalyptus* leaves. To the lids and lips of all the tubes were attached twigs, leaves, pieces of bark and *Eucalyptus* seed capsules, in some cases the twigs attached to the rims of the tubes were 4 inches long and spread out in a semi-circle.

The structure of all fifteen nests agreed essentially with that figured and all were lined with white silk. Of the twelve lids observed (some were lost in the slicing operations), all were of the wafer type, thin and easily bent, the edges sitting on top of the rim and overlapping it a little; all had debris attached to the upper surface. None of the specimens clung to the lid when opened, all were in the lower swollen part of the tube. Some specimens were upside down in their burrows, that is with the posterior truncation of the abdomen upwards, whereas other specimens had the anterior end facing up the tube, with their fangs opened ready to strike.

All nests had a plug of ant remains in the bottom of their tubes. Among the tubes excavated in the Wongan Hills was one which contained no spider but the pupal case of an Hymenopterous parasite. This has not yet emerged.



Text figure 2.—Abdominal ridges showing spination. a, *Idiosoma sigillatum;* b, *I. hirsutum* sp. nov.; c, *I. nigrum* sp. nov.

DISCUSSION

Females of the three known species of *Idiosoma* can be simply identified from the following table:—

Eyes arranged in three rows of 2, 2, 4; abdomen spinose, sclerotised and corrugated ..... *Idiosoma*

1a Abdomen dorsally black (for the type of spination see text fig. 2c) ..... *I. nigrum* sp. nov.

1b Abdomen dorsally with brown ridges and yellow grooves 2

2a Dorsum of abdomen uniformly covered with small pointed spines; large spines and occasional bristles along tops of ridges ..... *I. sigillatum*

2b Dorsum of abdomen uniformly covered with small pointed spines; no large spines and bristles but numerous long hairs along tops of ridges ..... *I. hirsutum* sp. nov.

Of the thirteen specimens of *I. sigillatum* and *I. hirsutum* examined there were no intergrading forms in regard to specics characteristics. Although they both occur scattered over the same broad locality, the Perth Coastal Plain, it is possible that they have some habitat preference, permitting their co-existence in the same broad region. Both the coastal plain forms are very distinct, even in gross appearance, from the eastern species and it is suggested that the Darling Range has provided the geographical barrier necessary for speciation. It is now the species boundary as no specimens have been collected in the hills from which area the author has many times collected Mygalomorphs.

Holotypes have been placed in the W.A. Museum, paratypes forwarded to the Australian Museum, Sydney.

The author is indebted to the Curator of the W.A. Museum, Mr. L. Glauert, for the opportunity of examining the specimens in the Museum collection.

LITERATURE CITED IN TEXT.

Cambridge, O. P., 1870, Monogr. of genus *Idiops*. *P.Z.S.* 1870.

Pocock, R. I., 1897, On some Trapdoor Spiders of the Family Ctenizidae from South and West Australia, Contained in the Collection of the British Museum. *Ann. and Mag. Nat. Hist.* xix (6).

NOTES ON TWO WELL-KNOWN AUSTRALIAN ANT SPECIES

By WILLIAM L. BROWN, Jr., Museum of Comparative Zoology, Harvard University.

The two ant species discussed below belong to the subfamily Ponerinae. Both are common in the vicinity of Perth, and *Euponera rufonigra* is here demonstrated to range far east into Victoria.

Rhytidoponera douglasi nomen novum

pro Rhytidoponera punctata var. *levior* Crawley, 1925, Ann. Mag. Nat. Hist., (9) 16: 581, worker.

nec Rhytidoponera mayri r. *glabrius* var. *laevior* Stitz, 1911, Sitzb. Ges. Naturf. Freunde, Berlin, pp. 353-353, figs. 1, 2, worker.

In his *Rhytidoponera* revision of 1936 (Mem. Nat. Mus., Melbourne, no. 9, pp. 14-89, pls. 3-6), Clark treats Crawley's variety *levior* as a good species and neglects the earlier name set forth by Stitz. *R. douglasi* is a characteristic form, and Mr. Athol Douglas, entomologist at the Western Australian Museum, for whom the new name is given, informs me that it occurs not only on Rottnest

Island, the type locality, but also on the adjacent mainland. Stitz' name *laevior* applied to three specimens, of which the one from Hunter River, New South Wales may be designated lectotype. This specimen may well belong to the original series from which Fred. Smith described *R. aciculata,* an assumption supported rather well by the agreement of certain details of Stitz' description and Clark's subsequent redescription of *R. aciculata.* Types should be examined before formal synonymy is suggested, however, since none of the descriptions mentioned are satisfactory.

Euponcra (Brachyponcra) rufonigra Clark

Euponcra (Brachyponcra) rufonigra Clark, 1934, Mem. Nat. Mus., Melbourne, no. 8, pp. 30-31, pl. II, figs. 12, 13, worker, female.

Euponcra (Trachymesopus) clarki Wheeler, 1934, Jour. R. Soc. W. Australia, 20: 140-141, worker, female. NEW SYNONYMY.

These two names were applied in part to what seems to be the same nest series, collected by Clark at Armadale, Western Australia. Examination of the types shows clearly that they are synonymous, though this synonymy might not be guessed from the original descriptions, both of which are in error in numerous minor ways. Wheeler's description was stated to have been published on the "5th October, 1934," while the National Museum Memoir No. 8 bears the cover inscription "Issued September, 1934." I have not been able to confirm the latter date, so the seniority of synonymy must remain in some doubt. It is to be regretted that mailing dates of this publication are not more precisely recorded.

This species is easily recognized and common in South-western Australia, despite the two original descriptions. Outside Western Australia, Clark has reported it from the Sir Joseph Banks Islands, South Australia. I have taken it at the following localities, among others: Merivale Downs, east of Esperance, Western Australia, sandplain heath and borders of yate *(Eucalyptus cornuta),* swamps, under logs and *Xanthorrhoea* stumps. Ravine des Casoars, Kangaroo Island, *Xanthorrhoea* stumps in sand, mallee heath; Kuitpo Forest, Lofty Ranges, under logs in *Eucalyptus leucoxylon*-dominated woodland; Wilpena Pound, entrance gorge, heavy red gum *(Eucalyptus camaldulensis)* woodland, under stones, the three foregoing localities in South Australia. In Victoria, I have collected this ant at Mirranatwa Gap, Grampians Ranges, under rock slabs in dense scrub of Grampians snow gum *(Eucalyptus alpina)* and at Djerriwarrh Creek, near Melton, in bull mallee scrub *(Eucalyptus behriana)* under stones. The ecological notes will serve to underline the breadth of the range and habitat tolerance shown by this species.

The generic and subgeneric placement is strictly provisional, as revision of the genus *Euponcra* will see considerable changes in the assignment of species and groups from all over the world.

THE FOOD OF TROUT IN WESTERN AUSTRALIA

By C. F. H. JENKINS, M.A., Government Entomologist.

The successful acclimatisation of trout in the various river systems of South-western Australia depends largely upon the presence of a suitable food supply. No detailed study has been made of the food of trout in our streams but the stomach contents of a number of specimens have been analysed and the information revealed is considered to be of sufficient interest to form the subject of a brief discussion.

Owing to the small number of trout examined and the variety of localities from which they have been obtained, it is considered desirable to itemise the stomach contents of each specimen.

1. Pemberton (Treen Brook), 1941. Rainbow Trout, female, weight 5¼ lb.

Very small fish bones, 2; crustacean appendages *(Cheraps* sp.); trout egg?, 1; several leaves and algal strands; unidentifiable macerated material.

2. Pemberton (Treen Brook), 1941. Rainbow Trout, weight 5 lb.

Crustacean appendages *(Cheraps* sp.); macerated crustacean flesh.

3. Pemberton (Big Brook), 1941. Brown Trout, weight 3 lb. 12 oz.

Crustacean appendages *(Cheraps* sp.) and macerated material.

4. Pemberton (Big Brook), 1948. sp.?

Syrphidae, 1; Diptera, 1; Dytiscidae, 1; Curculionidae, 1; Scarabeidae, 1; small Crustacea *(Cheraps* sp.), 2.

5. Lower Donnelly River, June 11, 1943. Rainbow Trout, weight 9 oz. (netted).

Formicidae (winged), 225; small spider, 1; Chironomid pupal skins, 2; Corixidae, 3; Psammocharidae, 1.

6. Yanchep, July 11, 1946. Rainbow Trout, male, length 35.5 cm.

Crustacea *(Cheraps* sp.) (macerated remains), 2; Carabidae, 1 (1 in. long); Dytiscidae, 1 (1 in. long); small twig, 1 acacia leaf and pieces of charcoal ½ in. long.

7. Serpentine River, November 1949. Rainbow Trout?

Crustacean remains *(Cheraps* sp.); Formicidae (winged), 36; Diptera, 48*; Coleoptera, 6; unidentifiable insect remains.

8. Serpentine River, November 1949. Rainbow Trout?

Crustacean remains *(Cheraps* sp.), 1; Formicidae (winged), 7; Diptera, 7*; Coleoptera, 2.

9. Bridgetown (Blackwood River), November 1950. Rainbow Trout.

Orthoptera (nymph), 1; Dermaptera, 1; Dytiscidae, 40; Gyrinidae, 3; Tenebrionidae, 4; Scarabaeidae, 2; Cerambycidae, 1;

* Terrestrial?

Chrysomelidae, 2; Curculionidae, 2; Hymenoptera sp., 3; Formicidae (winged), 550; Muscidae, 2; Arachnida, 1.

10. Bridgetown (Blackwood River), November 1950. Rainbow Trout?

Pentatomidae, 3; Reduviidae, 1; Jassidae, 1; Elateridae, 14; Dytiscidae, 3; Gyrinidae, 1; Cerambycidae, 1; Chrysomelidae, 3; Tenebrionidae, 2; Carabidae, 3; Scarabaeidae, 5; Buprestidae, 5; Curculionidae, 1; Coleoptera sp., 1; Formicidae (winged), 114; Ichneumonidae, 4; Scoliidae, 1; Psammocharidae, 2; Thynnidae, 1; Apoidea, 3; Hymenoptera sp., 12; Lepidopterous larva, 1; charcoal and macerated insect remains.

The most casual study of the information just listed will show that Crustacea (occurring in 7 out of 10 stomachs examined) are quite an important item of food for local trout and that aquatic insects are very poorly represented in the diet.

A detailed analysis of how the various food items are represented is hardly warranted in such an inadequate sample but the following summary will give some indication of the importance of the various food groups and the relative abundance of aquatic and terrestrial forms.

INSECT REPRESENTATIVES IN THE DIET OF TROUT.

Localities: Blackwood River, Serpentine River, Yanchep, Big Brook (Pemberton), Lower Donnelly River, Treen Brook (Pemberton).

Insect Orders	Numbers of individuals.	Percentage of total.	Aquatic representatives.	Terrestrial representatives.
Order Coleoptera	104	9.4	51	53
„ Dermaptera	1	0.1	1	—
„ Diptera	53	4.8	2	51
„ Hemiptera	8	0.7	3	5
„ Hymenoptera ...	939	84.8	—	939
„ Lepidoptera	1	0.1	—	1
„ Orthoptera	1	0.1	—	1
Totals	1107	100.0	57	1050

$$\frac{\text{Aquatic}}{\text{Terrestrial}} = \frac{57}{1050} = 1{:}18 \text{ approximately.}$$

In addition to the insects, remains were also identified of the following organisms:—

Crustacea (*Cherax* sp.?)—mostly appendages and macerated tissue making up a considerable proportion of the stomach contents of those trout from the Pemberton district.

Arachnids—2 small spiders.

Chordata—bones of fish; trout egg?

Plant material—leaves; algae; charcoal.

The complete absence of Caddis flies (Trichoptera) or May flies (Ephemeroptera) from the stomachs examined and the scarcity of other aquatic insects, emphasises the difference between the food supply available in local rivers and in the typical trout streams of the Eastern States and overseas.

Butcher (1945) shows that trout in Victoria feed on a preponderance of aquatic food, and Percival (1932) has shown the same thing for the New Zealand fish.

A brief survey of Pemberton streams made with Professor E. Percival in March, 1952 revealed a great lack of aquatic insect fauna and, although no systematic sampling was attempted, Professor Percival expressed the opinion that compared with New Zealand streams the Pemberton waters were particularly barren as regards aquatic insect life. This raises the question as to what is the future of trout acclimatisation in our South-west rivers. It would appear that the fish must rely upon crustaceans and drowned terrestrial insects for the bulk of their food. The hazardous existence which would be associated with any dependence upon the latter food source needs little emphasis. Termites, flying ants and grasshoppers often swarm in large numbers and at times may provide ample food, but for long periods they may be absent completely. Aquatic insects on the other hand would be almost constantly available either as adults or immature forms and a much more stable source of food would be provided. There is the distinct possibility that under present conditions the food supply in most of our streams is insufficient to maintain a trout population adequate for the needs of the angler. Should such prove to be the case, then the possibility of supplying sporting requirements by bulk releases of fish into various streams may need investigation.

Whether the introduction of different insect types would relieve the problem is very doubtful, but the wisdom of trying such introduction may be even more doubtful. Already the natural ecology of our streams has been upset by many introductions including that of the trout themselves and only after exhaustive investigations could attempts to establish different forms of insect life even be contemplated. The foregoing comments are based upon very superficial evidence and further investigations may reveal the erroneous nature of some of the deductions. The need for more extensive research, however, is clearly indicated and particularly would a biological survey of the south-west streams and a comprehensive examination of fish stomachs at all seasons of the year help to elucidate the problem of trout acclimatisation in South-western Australia.

Even before such a survey is taken the desirability of restricting trout or other fish releases to definite stream systems should be seriously considered. Once indiscriminate liberations have been made the clock cannot be turned back and the chance will be lost for ever of getting a true picture of virgin waters and the natural fauna which they normally support.

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FROM FIELD AND STUDY

Death Adder at Jarrahdale.—The highlight of the W.A. Naturalists' Club excursion to Jarrahdale on June 8, 1952 was an encounter with an 18 in. death adder *(Acanthophis antarcticus)* which had been tempted from cover by the winter sunshine.

At first glance it looked remarkably like the familiar bobtail *(Trachysaurus rugosus)*, with its broad horizontal stripes of brown and rust red, and the wide bloated body. Of course the lightning movements of the head on the slender neck soon revised the impression, as did the terrifying mouthful of fangs.

After death the appearance of the snake altered considerably. The body became flaccid and somewhat smaller, and the retraction of the teeth left the mouth looking almost innocuous. In fact the junior members who inspected the enemy after death were not nearly so impressed as those who took part in his despatch.

—(Mrs.) J. LYON, Mosman Park.

Black Honeyeaters *(Myzomela nigra)* **at Wooroloo.**—While proceeding along White Gum Gully, near Wooroloo, on February 10, 1952, we encountered honeyeaters unfamiliar to either of us. We watched these birds for 20 minutes with Zeiss 6 x 25 binoculars from distances down to 15 yards, obtaining a rather complete and detailed description of the birds. This evidence leaves no reasonable doubt but that the birds were Black Honeyeaters.

Two cocks and at least one hen were present. These were making short flights from a blossoming Blackbutt *(Eucalyptus patens)* and were possibly capturing insects. They did not probe the flowers while we were watching. The birds remained in a very circumscribed area, i.e. a portion of the crown of the one tree.

The area in which the birds were located is part-cleared Jarrah, Marri and Wandoo country.

This record extends the known range of the species as indicated by *The Birds of W.A.*, Serventy and Whittell, westward and into the jarrah belt.

—ERIC H. and L. E. SEDGWICK, Wooroloo.

Expediency of a Thirsty Cat.—The means by which a thirsty cat succeeded in obtaining a drink, as witnessed by my wife in early March this year (1952), is, I think, worth relating.

The lean black animal, one of the many poor beasts of its kind that roam the bush and eke out a precarious existence in a wild state, came down out of the scrub in the heat of midday, and warily made its way to a garden tap beneath which was the main container of a fruit-preserving outfit. This vessel was straight-sided and about 12 inches deep. At the bottom it held a few inches of water but, try as it would, the cat could not reach far enough down to enable it to lap at this.

Its next course of action was worthy of admiration as well as having its pathetic side. Standing on its hind legs with one paw on the rim of the container, it reached down and dipped the other in the water and on withdrawing it licked off the film of moisture thus collected. It obviously found some success in the application of the idea for it continued to dip and lick, dip and lick over and over and over again, till some of its thirst was relieved.

—W. H. LOARING, Bickley.

An Aboriginal Relic Near Pithara.—Few structural relics of the aborigines have as yet been reported from the Wheatbelt area though there must be many that have remained unrecognised. One of these, known locally as "the Octopus", is to be found on the property of Mr. George Mills (Blocks Ninghan 527, 528 Melbourne Loc. 1920) near Pithara.

On a stony clay pan, the only suitable one I saw in the district, the natives at some time or other created a structure composed of stones (laterite lumps) which are plentiful on the bed of the lake and on its shore.

At the centre is a mound of such stones still measuring about 12 inches in height and 25 feet in circumference. From its northern side there issues a curved row of stones 147½ feet in length measured along the arc. At the base this arm emerges at an angle of 30°E., reaching 60° at the summit and 120° at the end.

Three feet to the west of this arm, the imperfect remains of a second can be seen. It emerges at 330° and proceeds for 5 feet, where it is completely destroyed to reappear 100 feet away to the north-west where a few feet of the tip can be recognised.

From the western side of the mound at 255° a short arm 20 yards long is distinctly visible. There is no indication that this was

General view of the arrangement of stones near Pithara.
—Photo. Mrs. G. H. Mills.

at any time more extensive. Clusters of stones in the south-eastern quadrant may be the remains of a fourth arm.

The owner of the property, having been informed of the value of this remnant, is anxious to preserve it as a natural monument.

—L. GLAUERT, W.A. Museum, Perth.

Further Bunketch Bird Notes.—After another stay in the Bunketch district, from November 28, 1951 to January 16, 1952, I have some additional observations on the local bird-life to add to the information given in the *W.A. Naturalist*, vol. 3, no. 3, pp. 68-71.

Crested Pigeon *(Ocyphaps lophotes)*.—Although not recorded the previous year it now proved to be fairly abundant towards Pithara and at Kalannie. It appears to be a retiring species here and was only seen when feeding on the spilled wheat on the roads.

Southern Stone-Curlew *(Burhinus magnirostris)*.—Was heard calling twice at night.

Australian Little Eagle *(Hieraactus morphnoides)*.—Several birds were seen soaring over cleared country. The species is not, however, on present knowledge to be considered very common.

Black-shouldered Kite *(Elanus notatus)*.—One bird was seen, between Kalannie and Pithara. A watch was kept for the Letter-winged Kite *(E. scriptus)*, but none were seen.

Brown Hawk *(Falco berigora)*.—The only bird seen was a female, hit by a truck on the Dalwallinu road. The bird was large, with a wing-span of 38 in., and a weight of 1 lb. 7 oz.

Boobook Owl *(Ninox novæ-seelandiæ)*.—The bird was heard often at night, though not seen and it is puzzling why it was not heard last year.

Tawny Frogmouth *(Podargus strigoides)*.—A bird, which had been hit by a car, was brought in by a farmer, and identified as this species.

Spotted Nightjar *(Eurostopodus guttatus)*.—This bird was added to the list through the medium of a specimen hit by a car, and brought in for identification.

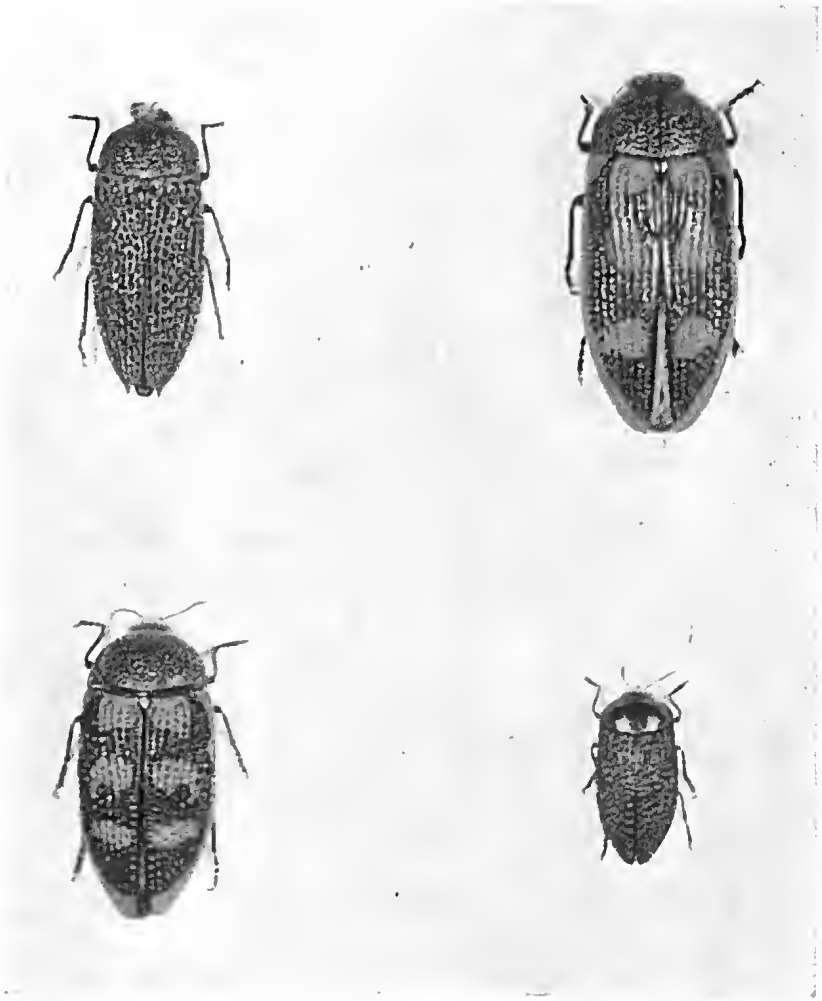
White-browed Babbler *(Pomatostomus superciliosus)*.—A small party of these birds was seen on many occasions at the Kalannie recreation ground.

White-fronted Chat *(Epthianura albifrons)*.—This year opportunity was taken to examine the nearby salt lakes, but the only new bird seen was this species. Several small flocks were observed.

Brown Song-Lark *(Cinclorhamphus cruralis)*.—This species was observed twice in cleared country between Bunketch and Kalannie.

All told, a further 11 species were added to the list for Bunketch, making a total of 54 species for the two visits. Mention might be made of the omission of the Black-throated Butcher-bird *(Cracticus nigrogularis)* in the original paper although it had been reckoned in the final total. The bird is quite common throughout the whole district.

—DON REID, Wembley.



Western Australian *Stigmodera*.

S. sanguinosa Hope.

S. roei Saund.

S. cancellata Don.

S. gratiosa Chevrol.

— x 1¼

THE WESTERN AUSTRALIAN
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WESTERN AUSTRALIAN STIGMODERA

By R. P. McMILLAN, Cannington.

Of all the Coleoptera in Australia the most colourful are the Buprestidae and in that family a beautiful genus is *Stigmodera*. The genus *Stigmodera*, in its wider sense, contains a larger number of species than any other genus of beetles in Australia, also some of our most beautiful species. In its restricted sense there are only eight species; four on either side of the continent. But one of the western species *(sanguinosa)* extends along the southern part of Australia into the west part of Victoria, as far east as Bendigo, where it meets *macularia* Don. Notes on the Western Australian species are given below.

The following diagnosis of the genus *Stigmodera* is extracted from the key, by M. Andre Theary, included in H. J. Carter's "Check List of the Australian Buprestidae" *(The Australian Zoologist*, vol. 5, 1929, pp. 265-304:—

> Body depressed. Labrum rather long, or longer than wide, rounded or subacuminate in front, overlapping the mandibles; mouth produced into a muzzle; mentum wide, rounded. Prosternum flat, or feebly convex, its anterior margin not forming a conical process; process of the posterior margin fitting into the sternal cavity, which it fills. Lateral prolongation of the abdomen hidden; not concealing, or very slightly concealing the metathoracic epimera. Apex of elytra often dentate, but never denticulate. First segment of the posterior tarsi longer than the second; the fifth elongate and longer than the fourth. Female provided with a sessile and unarmed ovipositor.

The genus and its subgenera are separated thus:—

1–2 Elytra hollowed out with large foveoles, sometimes *(S. cancellata* Don) striate-cancellate. *Stigmodera.*

2–1 Elytra striate or striate-punctate, sometimes with costae.

3–4 Tarsal hooks lobed or toothed at base, size generally large. Subgenus *Themognatha.*

4–3 Tarsal hooks simple, size generally small. Subgenus *Castiarina.*

The following descriptions are based on the author's examination of local specimens in his own collection and that of the W.A.

Museum, supplemented by the accounts in Edward Saunders' *Species of the Genus Buprestis* . . . (London, 1870).

Stigmodera sanguinosa Hope, 1846.

Head and thorax green, the lateral margins of thorax golden. Elytra reddish brown, the bottoms of the pits in the elytra covered brilliantly golden. Under, legs and antennae golden copper. Length, 20-27 mm.

I have seen specimens collected from Bullsbrook, Cunderdin, Highbury, Beverley and Busselton. The species has also been collected in South Australia and Western Victoria.

The beetle may be found on the flowers of *Leptospermum*, paper-bark and Christmas Tree. It has been collected during October and November.

Stigmodera roei, Saund., 1868
(= *cancellata* Boisd., 1835; *vescoi* Gehin, 1855).

Above green, sometimes may be a greenish blue. Elytra with margins, apex and three spots on each reddish (sometimes these may be yellow). Of these spots one almost touches the base, the second is a little more than one-third of the entire length of the elytra from the base and the third about one-third of their length from the apex. Underside, legs and antennae coppery green. Head deeply punctured, hairy, with a smooth dorsal line on the vertex. Length, 18-30 mm. The colour varies from a reddish tinge in the north and changes to green and blue further south. Inland the blue variety seems to predominate.

This beautiful beetle has been collected from the Murchison River, Mullewa, Beneubbin, Cunderdin, Bejoording, Balkuling, Spencers Brook, Wembley, Swanbourne and Broomehill.

It is found on a variety of food plants, such as Geraldton Wax, *Melaleuca* and *Leptospermum*. It can be collected in October and November. In the coastal areas it breeds in the Peppermint *(Agonis flexuosa)*.

Stigmodera gratiosa Chevrol., 1843
(= *smaragdina* Hope, 1847)

Brilliant golden green all over, in some localities a bluish tinge is evident. Length, 13 to 18 mm.

The most beautiful of the genus. This beetle on a spray of white *Leptospermum* flowers is a wonderful sight.

It is a fairly common insect and has been taken at the following places: Geraldton, Moora, Swan View, Kalamunda, Gosnells, Rockingham, Toodyay, Northam, Beverley, Cunderdin and Lake Grace.

Stigmodera gratiosa can be found in flowers of *Leptospermum* and in some species of *Hakea*. In inland areas it can sometimes be taken whilst feeding on the giant yellow everlasting. There is a sticky substance on the stalk of the plant that the beetles seem to relish. Breeding plants are *Melaleuca* and *Leptospermum*. The adult beetles emerge during September, October and November.

Stigmodera cancellata Don, 1805
(= *dejeani* Hope, 1836; *dejeaneana* Boisd., 1835).

Colour and pattern much the same as in *Stigmodera roei* with the same variations as to blue and yellow varieties. The beetle is, however, much flatter and more elongate than *roei*. The underside is coppery green, thorax coppery green, sometimes purplish, elytra green with six reddish spots. The spots in both *cancellata* and *roei* range in their colour patterns from reddish-orange to blood-red, and the rest of the body from green to blue. Length, 20-34 mm.

This beetle has been taken in the following districts: Northam, Wembley, Bunbury, Busselton, Augusta, Denmark and Albany.

Food plants are Geraldton Wax, *Leptospermum* and Peppermint. In the coastal areas it breeds in Peppermints, the adult beetle emerging during October and November. Some specimens have been collected in December.

EVIDENCE OF A MID-RECENT CHANGE OF SEA-LEVEL AT COTTESLOE

By M. A. CARRIGY AND SHIRLEY CARRIGY, Mosman Park

I.—INTRODUCTION.

The mean sea-level during the Mid-Recent epoch of geological time (3,000 to 5,000 years ago) was 10 to 11 feet higher than it is at present. Fairbridge (1950a) believes that this sea-level in Western Australia was at its highest during the warm "Atlantic" stage of the climate which is well documented in Western Europe. The stable coastline of Western Australia, and the presence of a narrow belt of soft dune limestones, into which each stand of the sea cuts a characteristic notch or undercut (see Figs. 1 and 2) makes it ideal for the study of these eustatic changes in sea-level.

The physiographic features associated with the 10 ft. rise are particularly well preserved along most of our coastline, and were cited as evidence of uplift of the land by Somerville (1921). That they could be correlated with a world wide fluctuation in sea-level was first recognised by Teichert (1950) who made a study of the evidence to be found on Rottnest Island. Supporting evidence from the mainland was brought forward by Fairbridge (1950b) from the Point Peron area.

Three theories as to the origin of the variations in mean sea-level are currently held. The first attributes them to climatic fluctuations, causing varying amounts of water to be withdrawn from the sea and held in polar ice caps. The second to structural changes in the earth's crust, such as raising and lowering of the ocean floors and continents. The third to the displacement of water by sediment brought down by the rivers and deposited in the sea; this, of course, can only account for minor rises in mean sea-level. However, it seems more desirable at the present time to retain a multiple hypothesis than to attempt to ascribe the changing sea-level to any particular cause.

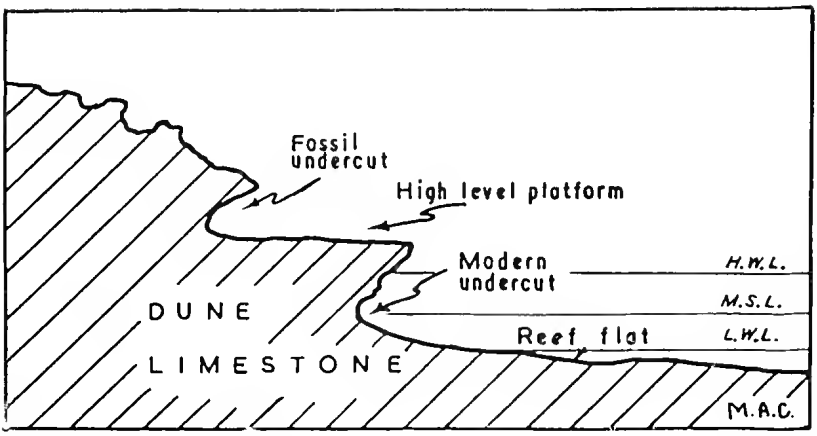

Fig. 1.—Diagrammatic cross-section of the headland at the bottom of Beach Street.

II.—EVIDENCE AT COTTESLOE

On the rocky headland south of Cottesloe beach, at the bottom of Beach Street, due west of Mosman Park Railway Station, are the physiographic features under discussion. They are the result of a higher sea-level than that existing today. It has cut into the limestone forming an undercut and depositing beds of shells which are now well above the reach of the present day seas.

The presence, on this headland, of the high level platform and undercut, and fossil shell beds, was first noted by Somerville (1921) who estimated that the shell beds extended up to 23 feet

Fig. 2.—Fossil undercut with remnants of the high level platform in the foreground.

above datum, mean low water springs (this level roughly coincides with that of the wide shallow contemporary reef flats developed on almost all the rocky limestone outcrops along the Western Australian coastline, thus shore line erosion features can be referred to the level of this reef flat as a first approximation to datum).

(a) *The High Level Platform.* A high level platform and its fossil undercut are well preserved in this area (see Fig. 2). These features are about 6 ft. higher than their present day counterparts. Remnants of a platform of this height have been recognised by Fairbridge at Point Peron and are regarded by him as being slightly younger and less well preserved than the highest or 10 ft. platform in this area.

The fossil undercut is nearly 3 ft. high (see Figs. 1 and 2), and as it was formed in the intertidal belt this gives a good idea of the mean spring range of the prevailing tides. The modern undercut here is about 5 ft. high because it has had a composite origin, being notched by the present sea-level together with a stand two feet higher. When it is found alone the undercut result-

Fig. 3.—Fossil shell beds. The man is standing at the same height as the high level platform and pointing to the highest fossil horizon. In the foreground is beach sand piled up by storm waves. —Photos by S.D.C.

ing from the present sea-level is about 3 ft. high and thus corresponds to the 3 ft. mean spring tidal range. It is very well developed in this area and has an overhang of at least twenty feet.

(b) *The Shell Beds.* The shell beds are 9 to 10 ft. thick (see Fig. 3). The base of the beds is at the same height as the top of the high level platform, the highest fossil horizon is thus nearly 20 feet above datum. The shell beds are in places cut through by solution pipes.

Between these rocks and the Cable Station, a quarter of a mile south along the beach, Somerville has measured the same beds up to 23 feet above datum. As mentioned previously he cited this as evidence of an uplift of the land to that extent. In the writers' opinions these beds are beach deposits of the 10 ft. sea-level, shells being deposited up to the 20 ft. level (above datum) in the swash zone of a shelving beach. Analogous deposits in the same zone of the present sea-level are to be seen 10 ft. above the modern reef flat.

The fauna of the shell beds is very similar to that of the present day. Reath (1925) has cited specimens collected at Fremantle from the continuation of the Cottesloe beds as evidence of warmer seas at the time of deposition. After comparing Reath's list with that of B. C. Cotton in Fairbridge (1950b) the writers found that of four species recorded by Reath as indicative of warmer seas, two were recorded by Cotton at Point Peron as living on the reefs, viz. *Turbo pulcher* (Menke) and *Tonna variegata* (Lamarck). Of the other two it was found that *Arca fusca* (Reeve) of Reath's list can only be differentiated from *Barbatia pistachia* (Lamarck) of Cotton's list with certainty on the basis of colour, hairs on the periostracum, and a variation in shape, being slightly more inflated (Allan, 1950, p. 254). The former two characters are absent in the fossil state and the third alone is hardly sufficient justification to separate the species. Further, the fourth species *Hipponix antiquata* (Linne) of Reath's list is recorded in a checklist by Hedley (1916) who took it from a list of identifications of shells from Geraldton by Vereo (1912) where it is called *Capulus antiquatus* (Linne) and is recorded as also occurring at the present time in South Australian waters and is thus not indicative of warmer seas.

We have classified our specimens by comparison with the modern fauna and have followed the nomenclature of Cotton. A complete faunal list of the Cottesloe shell beds has not been prepared, but common species present are:—

Class Gasteropoda: *Melanerita melanotragus* (Smith), *Austroehoehlea rudis* (Gray), *Bullaria tenuissima* (Sowerby), *Floraconus anemone* (Lamarck), *Notoacmea scptiformis* (Angas), *Patelloida alticostata* (Angas), *Sabia conica* (Schumacher), *Nerita lineata* (Gmelin), *Sophismalepas nigrita* (Sowerby), *Ninella torquatus* (Gmelin), *Siphonaria baconi* (Reeve), *Euplica bidentata* (Menke), *Marinauris spp., Niotha pyrrhus* (Menke), *Tonna varicgata* (Lamarck), *Propcsinum*

pictum (Reeluz), *Dicathais aegrota* (Reeve), *Phasianella spp.*, *Herpetopoma aspersa* (Phillipi).

Class Lamellibranchiata: *Barbatia pistachia* (Lamarck), *Glycymeris striatularis* (Lamarck), *Brachyodontes erosus* (Lamarck), *Gomphina undulosa* (Lamarck).

Class Cirripedia: *Balanus spp.*

These are all contemporary reef dwelling forms indicating, as suggested by the high level platform and undercut, the proximity of a reef flat habitat during life.

III.—CONCLUSIONS

There is evidence in the form of an emerged platform and undercut of a change in sea-level of approximately 10 ft., which has been correlated with the warm climatic period of 4,000 to 5,000 years ago. Fossil shell beds up to 20 ft. above datum have been deposited by this sea-level. The fauna of these beds are all species at present living in the reef flat environment the dead shells of which are deposited on the contemporary beaches in the Fremantle-Cottesloe area. The high level shell beds do not indicate, as thought by Somerville (1921), a rise of sea-level of 23 ft.

Re-examination of Reath's 1925 faunal list from the sub-recent shell beds of the Perth area has shown that of the four species previously cited by him as indicative of warmer seas than those now prevailing, two are, in fact, living on the reefs off Fremantle today; another is recorded from South Australian waters. The fourth is a doubtful identification and the original specimen should be consulted and the species determination reviewed. The fauna gives no evidence of a change in the temperature of the sea during the time of the 10 ft. sea-level.

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A GABBIN BIRD LIST

BY L. SEDGWICK, St. George's College, Crawley.

Following on D. Reid's paper on the birds of Bunketch *(W.A. Naturalist,* vol. 3, 1951, p. 68), these notes from an adjacent district may be of interest for comparative purposes.

Gabbin lies 40 miles south-east of Bunketch and 57 miles east of Wongan Hills in a marginal wheat-producing area. My observations were made during the period from November 23 to December 31, 1951, when I was employed on the local wheat bin. This work gave me ample opportunity to observe and to investigate most of the bush lying within three miles of the siding.

The country around the township was very largely cleared, but to the north of the railway line were some fairly large expanses of bush. Some of these areas were eucalypt forest, containing Salmon Gum and Gimlet and with a fairly open forest floor. The rest of the bush consisted mainly of *Casuarina* and *Leptospermum* together with masses of lesser shrubs which formed a dense undergrowth. Other less extensive habitats were the mallee stands, and the open sandplain areas covered with small shrubs—*Grevillea, Hakea, Acacia,* etc.

Adjacent to the railway siding lay a dam, which held water all through the period of observation. Being the only open water for some miles around, it attracted parrots and Bronzewing Pigeons in large numbers at dawn and dusk. On its banks stood a group of red-flowering mallees, whose profuse blossom attracted many honeyeaters. These trees were apparently the only ones of their type for some distance.

The weather was usually hot and dry, but one thunderstorm occurred in the first week of December. This produced an enlivening effect on many of the birds, especially the thornbills and honeyeaters. Their activity soon abated when more seasonal weather returned.

During my stay I recorded 50 species, but the list is by no means complete. Observations made over an entire year, and an investigation of the salt lakes lying 15 miles to the south, east and west would have made the survey far more adequate.

LIST OF BIRDS

Emu *(Dromaius novæ-hollandiæ).*—Reported to be common in areas away from the township. One young individual was brought in to me for examination.

Stubble Quail *(Coturnix pectoralis).*—One pair flushed from low grassy tussocks. No definite identification could be made from the brief glimpse I obtained.

Bronzewing Pigeon *(Phaps chalcoptera).*—The dam opposite the siding attracted many at evening; 43 were seen drinking between 10 and 30 minutes after sunset on one occasion.

Crested Pigeon *(Oeyphaps lophotes).*—A pair seen on several occasions. This species is reported to have arrived in the district only in the latter half of 1951.

Banded Plover *(Zonifer tricolor).*—Frequent on cultivated land. Birds observed in parties of up to five in number, and were often heard calling at night.

Avocet *(Recurvirostra novæ-hollandiæ).*—Not recorded, but reported to appear occasionally on water holes in the district.

? Little Eagle *(Hieraaetus morphnoides).*—A raptore which may have been this species rather than the Whistling Eagle *(Haliastur sphenurus)* was seen occasionally. One was observed to kill a rabbit, dropping on it from about 50 feet with half closed wings, and killing it instantly.

Kestrel *(Falco cenchroides).*—The common hawk of the district.

Red-tailed Black Cockatoo *(Calyptorhynchus banksii).*—Two parties seen, one of two birds and one of six. Both flocks were in transit.

Galah *(Kakatoe roseicapilla).*—Very common throughout the cultivated areas.

Regent Parrot *(Polytelis anthopeplus).*—Flocks of about 30 birds seen on several occasions, though always in transit.

Mulga Parrot *(Psephotus varius).*—Occurs frequently in the *Casuarina* thickets, where the cones seem to be an especial attraction.

Tawny Frogmouth *(Podargus strigoides).*—Not recorded, but some marbled feathers that I found in the lining of a Yellow-tailed Thornbill's nest indicated the presence of the species.

Owlet Nightjar *(Aegotheles cristatus).*—One seen resting on a dead limb an hour after sunset on a full moonlight night. It later flew off to forage in a Salmon Gum forest.

Rainbow-bird *(Merops ornatus).*—Not recorded. It was reported to be generally an abundant bird during summer, but this year it was unusually sparse.

Pallid Cuckoo *(Cuculus pallidus).*—Present during November. The last record was of a call heard on December 3.

Narrow-billed Bronze Cuckoo *(Chalcites basalis).*—Present at the townsite during November. My last record was of one calling on December 1.

Welcome Swallow *(Hirundo neoxena).*—Common at the townsite.

White-backed Swallow *(Cheramœca leucosterna).*—Two pairs resided at the townsite and a flock of 8 was seen on one occasion.

Tree-Martin *(Hylochelidon nigricans).*—Common at the townsite.

Willy Wagtail *(Rhipidura leucophrys).*—Pairs holding territories at the townsite and in roadside vegetation.

Western Shrike-Thrush *(Colluricincla rufiventris).*—Present in the area, but retiring, and not often observed. Heard calling occasionally.

Crested Bell-bird *(Oreoica gutturalis).*—These were usually heard calling from *Casuarina* areas.

Magpie-Lark *(Grallina cyanoleuca)*.—Moderately frequent in forest areas.

Black-faced Cuckoo-Shrike *(Coracina novæ-hollandiæ)*.—A pair present at the townsite throughout my stay.

White-winged Triller *(Lalage sueurii)*.—My only record was one male seen on December 2, in the railway station yard.

Southern Scrub-Robin *(Drymodes brunneopygia)*.—Only one individual was observed in some low sand-plain scrub.

White-browed Babbler *(Pomatostomus superciliosus)*.—Flocks occurred frequently through the *Casuarina* thickets, and their disused nests are a feature of these areas.

White-fronted Chat *(Epthianura albifrons)*.—Small flocks occasionally seen, particularly along the railway reserve.

Crimson Chat *(Epthianura tricolor)*.—Flocks of about 8 individuals were seen on five occasions at various points through the district, though always in roadside bushes. Out of the 43 individuals observed, only one fully plumaged cock was seen.

Weebill *(Smicrornis brevirostris)*.—Very common in eucalypt areas.

Brown Thornbill *(Acanthiza pusilla)*.—This was the least common of the local thornbills, and was usually found associated with the Yellow-tailed Thornbill.

Yellow-tailed Thornbill *(Acanthiza chrysorrhoa)*.—The commonest bird in the *Casuarina* thickets. It was frequently associated with Brown and Chestnut-tailed Thornbills, as well as Redthroats and Weebills. Numerous unoccupied nests were found.

Chestnut-tailed Thornbill *(Acanthiza uropygialis)*.—Occurs in the *Casuarina* scrub areas, where it forages in larger, denser flocks than the other thornbills.

Redthroat *(Pyrrholæmus brunneus)*.—Occasionally noted in thickets. One pair was observed in display in November; the birds indulged in vigorous song and pursuit, interspersed with rapid see-saw movements similar to those of the Rufous Whistler. The whole display was located in one small bush.

Black-faced Wood-Swallow *(Artamus cinereus)*.—Common during my visit to the district, but they are reported to appear only periodically. Several farmers considered that these invasions have a reducing influence on the grasshoppers which are troublesome in the locality from time to time.

Brown Honeyeater *(Gliciphila indistincta)*.—Occasionally noted, especially feeding in the red flowering mallees at the dam.

Singing Honeyeater *(Meliphaga virescens)*.—Frequent in eucalypt areas. One pair of chicks which had only just left the nest noted on November 25.

White-eared Honeyeater *(Meliphaga leucotis)*.—Seen always in the red-flowering mallees at the dam.

Yellow-throated Miner *(Myzantha flavigula)*.—A flock of about 20 birds resident at the townsite.

Red Wattle-bird *(Anthochæra carunculata)*.—A few in the Salmon Gum forest.

Spiny-cheeked Honeyeater *(Acanthagenys rufogularis).*—Only two pairs seen, both in the railway station yard.

Australian Pipit *(Anthus novæ-seelandiæ).*—Restricted to cultivated land, and the railway reserve.

Zebra Finch *(Poephila castanotis).*—A small flock seen in the station yard on one occasion. Old nests were noted several times.

Crow *(Corvus sp.).*—Flocks were noted throughout the area. Since I was not able to examine a specimen, the birds were not positively identified.

Squeaker *(Strepera versicolor).*—Only one pair was seen; these resided in the timber adjacent to the dam.

Grey Butcher-bird *(Cracticus torquatus).*—This was the common butcher-bird in the area. A family party was located in the station yard, and became very confiding, coming inside the hut for meat scraps or cheese.

Pied Butcher-bird *(Cracticus nigrogularis).*—Seen on only two occasions.

Western Magpie *(Gymnorhina dorsalis).*—Only one flock of 8 individuals in the township area—none was seen in the surrounding country.

PRESENT CLIMATIC FLUCTUATIONS IN WESTERN AUSTRALIA

By J. GENTILLI, Nedlands.

Biogeographers have repeatedly noticed slight changes in the geographical distribution or in the habitats of some species, or in the relative abundance of communities or individuals. There have been records of "invasions" of wet areas by "dry" species, and there have been records of the dying out of certain communities over small areas which have become unsuited to their continued existence.

It is too easy to blame or thank Man for these changes. It is quite possible that the abundance of very young individuals of the Western Flooded Gum *(Eucalyptus rudis)* may be due to lack of competition by other species which have been cut down too ruthlessly by Man, but is there any proof of this fact? Does not *Eucalyptus rudis* grow where the ground water comes so close to the surface that no other local species of *Eucalyptus* could survive? Around several swamps which have gradually become lakes, Paperbarks *(Melaleuca)* have died, literally drowned. Obviously the water table has come closer to the surface. But is this a change restricted to the Perth area, or is it only part of a general change which affects large regions or perhaps the whole continent? Over large regions of Western Australia a change is quite apparent, namely the rise of salt to the surface of the soil. It is a problem which has baffled expert opinion for years. Perhaps the clearing of the native vegetation has altered

the delieate hydrologie balanee of the ground, so that the water table has eome nearer to the surfaee thus enabling the water to ereep upwards by eapillarity, finally evaporating and leaving its salt load at the surfaee of the soil. Could the rise of the water table be due to an inereased rainfall, perhaps eombined with the elearing of the native vegetation?

An objeetive study of some of the elimatie material available provides some interesting evidenee of elimatic ehanges, whieh may not be part of any long-term trend, or any established eyele, but are there nonetheless, and are of suffieient import to warrant further study and careful planning in ease the trend thus diselosed happens to eontinue into the future.

THE METHODS USED

The study of any ehanges in time-series may be earried out by drawing suitable graphs and analyzing them, but this method is open to errors due to the seales adopted, the aeeuraey of the graph, and the individual worker. Mathematical methods are more reliable, and among these the method of moving averages has been used by many research workers, among whom might be quoted Ahlmann and his sehool. This method eonsists of taking the average (arithmetie mean) of a short series of data then dropping the first item of the series and adding the next item after the last and eomputing the new average, and so on. Five-year averages are usually adopted beeause they are readily eomputed, and are eentred on the eentral year of each series. Seven-year averages may also be eomputed, but sinee in this ease the eentral year of the initial series is the fourth year, the first three years (and the last three years) of the whole sequenee are lost.

The method of moving averages has the advantage of showing all the major variations within the sequenee, while at the same time smoothing out the minor fluetuations within eaeh short series. It is a flexible method whieh follows the original data rather elosely, and for this reason long-term trends must be determined by other methods, which although strietly based upon all the items in the sequence, do not follow single fluetuations too closely. The eomputation of semi-averages is perhaps the easiest of these methods, because it involves eomputing the separate averages of the first and seeond half of the whole sequenee, and plotting the straight line between the two points thus determined. The method however does not lend itself to any further mathematieal treatment, and in any ease can only yield a straight line. The method of least squares (so ealled beeause in any ease the line obtained is sueh that the squares of the differences between the points on this line and the eorresponding points in the original sequence are smaller than the squares obtained by using any other line) is mathematieally sound, based on every item in the sequenee, and eapable of further development. In some eases it has been thought better to use this method, although it involves a slightly greater amount of work.

THE RAINFALL OF PERTH

Records of rainfall are available from 1877 onwards, but there is a break in the series due to the opening of the new Observatory in 1897. Before that year the observations had been made in the Government Gardens, very near the Swan River. The Observatory, built on a hill, is not only higher above sea level, but also differently exposed to the weather. A statistical analysis showed that observations of the *quantity* of the rainfall in the two localities hardly showed any significant difference, whereas observations of the *number of wet days* disclosed a substantial difference, so that Government Garden records and Observatory records should be treated separately for that purpose. The treatment of data on the quantity of the rainfall as a continuous sequence, i.e., using the data from Government Gardens from 1877 to 1896 and the data from the Observatory from 1897 onwards, seems therefore justified (official statistics do this for all records, including those in which the two localities actually differ).

The mean annual rainfall for the period 1877-1945 was found to be 34.85 inches. The least-square straight line passes through 32.56 inches in 1877 and 37.14 inches in 1945, showing an increase of 4.59 inches or 14.1 % during the 69-year period.

The same statistical treatment gives the following values for the monthly rainfall:

TABLE 1.—COMPUTED LEAST-SQUARE VALUES OF MONTHLY RAINFALL, PERTH

Month	1877 points	Mean points	1947 points	Change 1877-1947 points	Change 1877-1947 %
January	40	33	26	−14	−35
February	49	39	29	−20	−41
March	63	82	101	+38	+60
April	158	173	188	+30	+19
May	483	507	531	+48	+ 9
June	586	709	832	+246	+42
July	597	671	745	+148	+25
August	564	572	580	+16	+ 3
September	319	339	359	+40	+11
October	205	218	231	+26	+12
November	76	76	76	0	0
December	58	55	52	− 6	−12

The table discloses that summer rainfall (December to February) has slightly decreased, whereas the rainfall of winter type (April-October) has increased considerably. The increase has reached the highest value in June, with 246 points for the 71 years—42% of the initial amount. The increase in the July rainfall, 148 points (25%) comes next. The increase in the May rainfall, 48 points (9%) is much smaller, and the increase in the August rainfall, 16 points (3%) is the smallest of all those experienced in the cooler months. The very high percentage increase in the March rainfall (60%) may be mostly due to chance, because this month falls between the summer and winter types of rain.

A change in the regime of the rainfall is also evident. In the values computed for 1877 July was the wettest month, and the decrease from July to August was not very great. Now June is the wettest month, and the rainfall in August has hardly changed.

TABLE 2.—MONTHLY RAINFALL REGIME, PER CENT. OF ANNUAL TOTAL.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year
1877	1.2	1.5	2.0	4.9	15.5	18.3	18.7	17.6	10.0	6.4	2.4	1.8	100.0
1947	.7	.8	2.7	5.0	14.2	22.2	19.9	15.5	9.6	6.2	2.0	1.4	100.0

Table 2 shows that August, which received 17.6% of the year's rainfall at the beginning of the period under observation, now receives 15.5. The decrease is only relative, because the total rainfall for the month has not decreased at all, but it may be quite significant for plant and animal life that August and September received 27.6% of the annual amount of rain in 1877 and receive 25.1 now. The months from August to February received 40.9% of the annual rainfall in 1877, but the same months now receive only 36.2% of the annual total.

Even though the amount of summer rain has decreased slightly, there is no evidence of any greater severity of summers. Some data have been collated and are shown below:

TABLE 3.—NUMBER OF DRY MONTHS PER DECADE, PERTH.

Decade	Months with less than 25 points	Months with 25 to 50 points	Months with 50 to 75 points	Months with 75 to 100 points	Months with less than 50 points	Months with 50 to 100 points	Total Dry months
1877-1886	19	2	14	9	21	23	44
1887-1896	25	7	7	8	32	15	47
1897-1906	25	14	7	3	39	10	49
1907-1916	23	14	4	7	37	11	48
1917-1926	20	7	6	8	27	14	41
1927-1936	24	14	3	8	38	11	49
1937-1946	26	7	5	3	33	8	41

The number of very dry months has hardly changed. The years with *five* consecutive months with less than 25 points of rain each were 1877, 1891, 1902, 1920, 1932. In addition, 1911 had *four* of these very dry months. Obviously there is no trend that can be detected in this series. The number of months with 25 to 50 points of rain shows some increase, and conversely that of months with 50 to 75 points shows a decrease. Whether the changes are significant, and whether they disclose a definite trend or are just due to chance, only future observations can tell.

It is clear that some changes have taken place in the rainfall of Perth, and some of these changes are of sufficient significance to alter the climatic environment to a noticeable extent.

THE RAINFALL OF ALBANY

A partial analysis of trends in the rainfall of Albany was carried out by Mr. Ross Ewen in the course of his studies at the Geographical Laboratory of the University of Western Australia. Rainfall records for the 73 years from 1877 to 1949 were partly obtained from published data and partly made available by the courtesy of the Weather Bureau, Perth, so that a sufficiently long series was available for the computation of the least square trend-line.

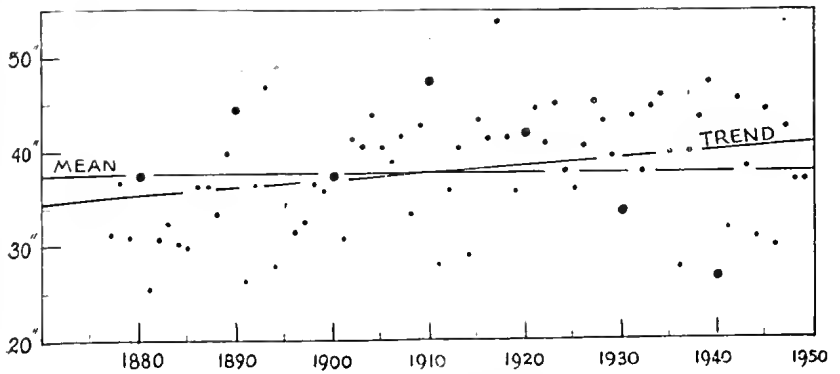

Fig. 1.—The rainfall of Albany. The graph shows the actual rainfall of Albany for the period up to 1949. The smaller dots show the actual rainfall for each year, and the first year of each decade is shown by a larger dot for easy reference. The horizontal line shows the mean (average) rainfall for the period, and the sloping line shows the trend computed as explained in the text. It is clear that the increase in the rainfall took place especially at the beginning of the century, and has continued unabated until the 'twenties. Later on, very wet years have been separated by very dry years. The rainfall of the next two decades will show whether the increase has come to an end or whether the droughts have been accidental.

The total annual rainfall reaches an average of 37.57 inches, and the least-square values found were 34.33 inches for 1877 and 40.81 inches for 1949, i.e., an increase of 6.48 inches (19%) over the 73 years. This is an increase which agrees with that found for Perth, and is even more remarkable.

It was not possible through lack of time to compute trend values for each month, and the winter months were chosen for detailed study. The values found are shown in the table below:

TABLE 4.—COMPUTED LEAST-SQUARE VALUES OF MONTHLY RAINFALL, ALBANY.

Month	1877 points	Mean points	1949 points	Change 1877-1949 points	%
June	467	546	625	158	34
July	470	574	678	208	44
August	510	521	532	22	4

Remarkable changes are revealed by this table. August was the wettest month of the beginning of the period studied, but the conspicuous increase in the rainfall of June and July (amounting to nearly 57% of the increase for the annual rainfall) has now made July the wettest month, and the peak of the annual rainfall has clearly shifted to an earlier time of the year.

The same trend is disclosed by the averages for ten-year periods, and these values are given as an example of the results that may be obtained by the simpler method:

TABLE 5.—TEN-YEAR AVERAGES, MONTHLY RAINFALL, ALBANY.

Deeade	June	July	August
1877-1886	4.69	4.39	5.31
1887-1896	5.47	4.98	4.99
1897-1906	5.56	5.58	5.22
1907-1916	5.42	6.74	5.59
1917-1926	5.73	5.81	4.94
1927-1936	5.65	6.38	5.57
1937-1946	5.31	6.01	5.22

Perth and Albany have similar rainfall eaused by the same faetors, and the analogy found between the two localities is only to be expeeted if these faetors vary in a similar way. Beeause of the length of the period analyzed and beeause of the distanee between the two loealities it seems warranted to assume that the ehanges postulated are on a large seale and at least regional, if not global, in magnitude.

THE RAINFALL OF ONSLOW

Onslow, situated in that belt of eountry just reaehed by the winter rains as well as by the summer rains, but never well endowed with rains from either system, provides an exeellent instanee for further study. Mr. Peter Good, in the eourse of his studies at the University of Western Australia, earried out the neeessary eomputations, the results of which are shown in the table below. The period eovered, 63 years, from 1886 to 1948, is suffieiently long to give reliable results.

TABLE 6.—COMPUTED LEAST-SQUARE VALUES OF MONTHLY RAINFALL, ONSLOW.

Month	1883 points	Mean points	1948 points	Change 1883-1948 points	Change 1883-1948 %
January	83	96	109	26	31
February	(—31)	106	(243)	274	.....
Mareh	60	169	278	218	363
April	98	101	105	7	7
May	172	162	152	—20	—12
June	183	157	131	—52	—28
July	79	76	73	— 6	— 8
August	48	44	40	— 8	—17
September	4	4	4	0	0
October	1	2	3	2	200
November	1	4	7	6	600
Deeember	7	15	23	16	229

The rainfall of Onslow is too erratie for any definite trend to be obtained with any degree of eertainty. A eomputation of the annual average rainfall based on ten-year periods, earried out by Miss Patsy Baek, gave the following results:—

TABLE 7—AVERAGE ANNUAL RAINFALL FOR TEN-YEAR PERIODS, ONSLOW.

Deeade	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1886-1895	62	67	95	37	220	174	87	54	3	1	3	2
1896-1905	46	84	63	111	164	158	140	16	8	0	1	40
1906-1915	129	51	66	166	67	206	89	44	6	0	1	1
1916-1925	156	272	284	64	142	177	26	45	6	6	2	0
1926-1935	52	88	373	91	163	119	72	61	1	4	1	29
1936-1945	107	206	123	89	174	100	32	34	1	1	13	29

It is quite clear that some change has taken place over the period under consideration, but it would not be justified to say that this change is part of a definite trend. On the other hand, the fact that during June there used to fall over 1.5 inches of rain (on the average) during the first 40 years on record, and less than 1.2 during the last 20 years, and that in July the average of more than 85 points for the first 30 years has fallen to less than 72 points for the last 30 years, so that for instance the three winter months had an average total rainfall of 166 points during the last 10 years ending 1945, against an average of 315 points during the first 10 years (ending 1895), is likely to affect plant and animal life. Ephemeral plants will find winter more forbidding, perennial plants may find their flowering season curtailed. The changes may not be part of a trend, but they are important enough to be significant.

WET DAYS ON THE GOLDFIELDS

As a test of the general magnitude of the changes and of their geographical significance, a study was made of the number of wet days at Southern Cross, Coolgardie and Kalgoorlie during the two decades 1931-40 and 1941-50. The results are tabulated below, and show that the drier areas have experienced a slight increase in the total annual number of wet days, whereas the wetter area has experienced a decrease. The increase varies from 5.4 days per year at Coolgardie to 7.9 days per year at Kalgoorlie, and would not be so important if it did not correspond to a definite change in the winter number of wet days, a factor of great significance where the rainfall is scanty.

TABLE 8—TOTAL NUMBER OF WET DAYS PER DECADE.

Month	SOUTHERN CROSS				COOLGARDIE				KALGOORLIE			
	1931-1940	1941-1950	Difference No.	Difference %	1931-1940	1941-1950	Difference No.	Difference %	1931-1940	1941-1950	Difference No.	Difference %
January	27	24	— 3	—11	30	25	— 5	—17	32	21	—11	—35
February	18	35	+17	+94	21	38	+17	+81	18	33	+15	+83
March	32	35	+ 3	+ 9	33	33	0	0	38	26	—12	—32
April	36	38	+ 2	+ 6	39	38	— 1	— 3	39	40	+ 1	+ 3
May	70	66	— 4	— 6	48	67	+19	+40	42	63	+21	+50
June	88	77	—11	—13	54	80	+26	+48	41	75	+34	+83
July	103	90	—13	—13	75	86	+11	+15	58	76	+18	+31
August	89	71	—18	—21	70	69	— 1	— 1	66	67	+ 1	+ 2
September	51	42	— 9	—18	38	42	+ 4	+11	33	48	+15	+45
October	55	30	—25	—45	39	31	— 8	—21	34	38	+ 4	+12
November	39	30	— 9	—23	36	27	— 9	—25	34	31	— 3	— 8
December	23	24	+ 1	+ 4	20	21	+ 1	+ 5	32	28	— 4	—13
Summer	68	83	+15	+22	71	84	+13	+17	82	82	0	0
Autumn	138	139	+ 1	+ 1	120	138	+18	+15	119	129	+10	+ 8
Winter	280	238	—42	—15	199	235	+36	+18	165	218	+53	+32
Spring	145	102	—43	—30	113	100	—13	—11	101	117	+16	+16
Year	631	562	—69	—11	503	557	+54	+11	467	546	+79	+17

The average 1931-40 winter had 28 wet days at Southern Cross, 19.9 at Coolgardie, and 16.5 at Kalgoorlie. The average 1941-50 winter had 23.8 wet days at Southern Cross, 23.5 at Coolgardie and 21.8 at Kalgoorlie. A striking aspect of this change is that whereas during 1931-40 there was a decrease of 11.5 in the frequency of winter wet days from Southern Cross to Kalgoorlie, during 1941-50 the decrease was reduced to 2. The change during these two decades had an equalizing effect.

THE TEMPERATURE OF PERTH

So much work has been done on changes of temperature in the Northern Hemisphere that it was thought desirable to analyze the temperature of Perth in order to find whether there had been any significant change. Because of the change of location from Government Gardens to the Observatory, records were compared for the two localities and for the same period, 1897-1926.

TABLE 9.—MEAN TEMPERATURE OF PERTH.

Month	Govt. Gardens	Observatory	Diff.
January	74.8	73.8	1.0
February	74.7	74.0	0.7
March	71.9	71.2	0.7
April	66.9	66.6	0.3
May	60.8	60.6	0.2
June	56.8	56.8	0.0
July	55.4	55.2	0.2
August	56.4	55.9	0.5
September	59.0	58.2	0.8
October	62.0	60.8	1.2
November	67.4	66.2	1.2
December	71.7	70.6	1.1

It is clear that the difference is significant because it follows a definite trend and its magnitude is far from negligible in spring and summer, but no explanation of its cause is attempted here.

A study in trends gives the following results.

TABLE 10—COMPUTED MEAN MONTHLY TEMPERATURES, PERTH

Month	Government Gardens 1876	1926	Diff.	Perth Observatory 1897	1915	Diff.
January	75.39	74.01	−1.38	73.81	73.79	−0.02
February	76.13	73.47	−2.66	73.66	74.34	+0.68
March	72.94	71.26	−1.68	70.92	71.48	+0.57
April	66.07	67.13	+1.06	66.50	66.70	+0.21
May	60.08	61.12	+1.04	60.21	60.99	+0.77
June	55.57	57.63	+2.06	56.20	57.40	+1.19
July	54.57	55.63	+1.06	55.07	55.33	+0.25
August	56.29	56.31	+0.02	55.51	56.29	+0.78
September	58.91	58.89	−0.02	57.96	58.44	+0.49
October	62.78	61.01	−1.77	60.62	61.42	+0.36
November	68.36	66.84	−1.52	65.05	67.35	+2.30
December	72.16	71.24	−0.92	70.18	71.02	+0.83

It is clear from the preceding table that winters are warmer than in the recent past, although the exact magnitude of the change cannot be known. An attempt to combine the records for the two localities on record after having allowed for the difference between their temperatures as disclosed by the comparison made above gives the following result:

TABLE 11.—ESTIMATED MEAN MONTHLY TEMPERATURES, PERTH.

Month	1876	1917	Diff.
January	74.4	73.7	−0.7
February	75.4	74.3	−1.1
March	72.2	71.4	−0.8
April	65.8	66.8	+1.0
May	59.9	61.1	+1.2
June	55.6	57.4	+1.8
July	54.4	55.3	+0.9
August	55.8	56.3	+0.5
September	58.1	58.6	+0.5
October	61.5	61.1	−0.4
November	67.2	67.4	+0.2
December	71.1	71.3	+0.2

The annual range of temperature, which is estimated at 21° F. for 1876, would only be 19° F. for 1947. All told, winters are very slightly warmer than they used to be, and summers perhaps a little less hot. The climate is perhaps a little less continental than it used to be.

THE CLASSIFICATION OF CLIMATE

No analysis of types of climate over a long period has been carried out in Western Australia, but two studies, the one tabular, and the other geographical, cover shorter periods and are worthy of notice.

A computation by Mr. N. P. Rudeforth of the index of precipitation effectiveness for Mount Barker during a period of 15 years shows an increase in humidity. During the first 7 years the climate was twice humid (B5), three times subhumid wet (C4), once subhumid dry (C3), and once semiarid (D2). During the last 7 years the climate was four times humid (B5), twice subhumid wet (C4), and once subhumid dry (C3).

TABLE 12.—PRECIPITATION EFFECTIVENESS, MOUNT BARKER

Year	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Annual Total	Climate
1936	1.2	.5	.2	1.8	7.0	8.2	7.2	6.0	3.0	3.5	1.2	1.8	41.6	C3
1937	1.2	.1	4.0	3.6	12.0	4.5	6.5	8.8	6.2	4.0	2.0	.8	53.7	C4
1938	.8	.2	2.6	3.0	9.5	8.2	10.5	4.5	3.0	3.5	2.5	.8	49.1	C4
1939	11.5	2.5	.6	3.0	5.2	9.4	7.6	9.0	1.5	11.0	5.2	.2	66.7	B5
1940	.9	.2	.3	1.8	2.8	3.5	7.0	4.0	4.0	1.8	1.5	2.8	30.6	D2
1941	.5	.3	9.5	3.2	4.6	6.5	7.5	5.8	9.5	5.2	2.5	.2	55.2	C4
1942	.8	.2	6.5	4.8	9.5	10.0	10.5	10.8	6.5	6.5	1.8	5.0	72.9	B5
1943	2.2	2.2	6.5	5.0	4.8	4.8	14.0	7.5	5.0	1.0	1.0	1.5	55.5	C4
1944	.2	1.2	.6	2.0	6.8	3.5	9.5	7.0	4.8	1.0	2.0	3.0	41.6	C3
1945	.2	0	4.5	1.5	7.0	15.8	11.2	14.8	9.5	3.0	2.2	1.8	71.5	B5
1946	.2	.2	1.0	2.0	8.0	9.4	10.0	6.0	3.6	2.5	5.0	2.5	50.4	C4
1947	.2	1.5	.6	19.0	.3	15.0	7.5	5.0	5.8	12.0	5.2	.2	72.3	B5
1948	.1	.2	.7	4.0	1.8	5.0	10.0	8.5	6.8	3.5	6.2	2.5	49.3	C4
1949	.8	.1	2.0	2.4	4.5	6.2	14.0	11.8	4.2	13.0	5.8	.2	65.9	B5
1950	1.0	.2	.1	.1	23.0	8.0	10.5	6.5	7.5	6.5	3.5	1.0	67.9	B5

The geographical study of climate carried out by Messrs. Graham, Russell and Vance consisted of an analysis of Western Australian climates according to Koeppen's method. The maps thus obtained (Figs. 2 and 3) show humid climates black, semiarid climates ruled, and arid climates white. In this case it is not possible to detect a trend, which only a statistical-historical method could disclose, but considerable annual variations are noticeable within the established pattern.

Has the climate changed? It undoubtedly has, but for how long remains to be seen. Another problem to be solved is that of the cause of these changes, and it is hoped that some results may be obtained by further research.

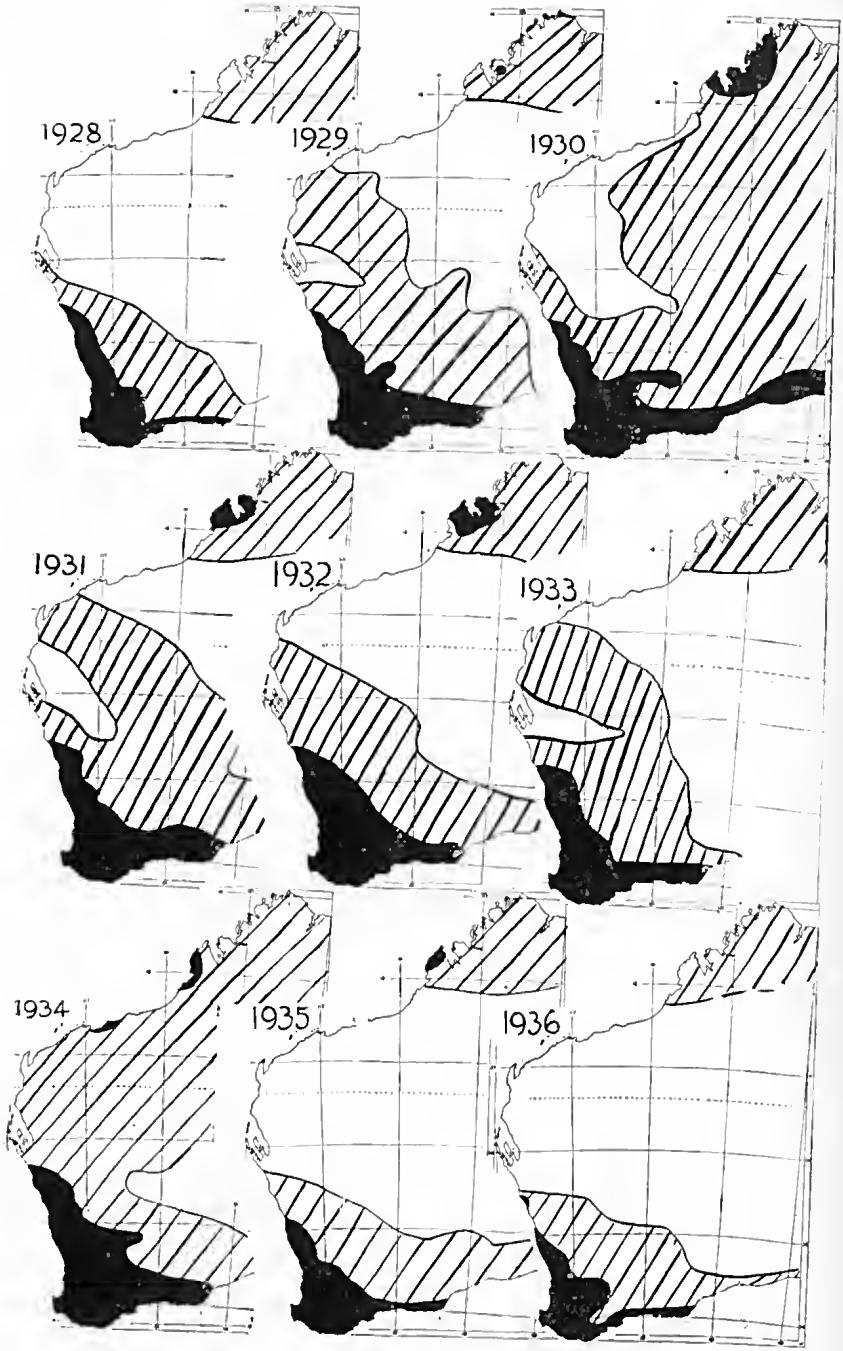

Fig. 2.—The elimates of Western Australia for eaeh year since 1928. The humid areas are shown blaek. The semiarid areas are shaded, and the arid areas are white; the elassification of elimates used is that of Koeppen.

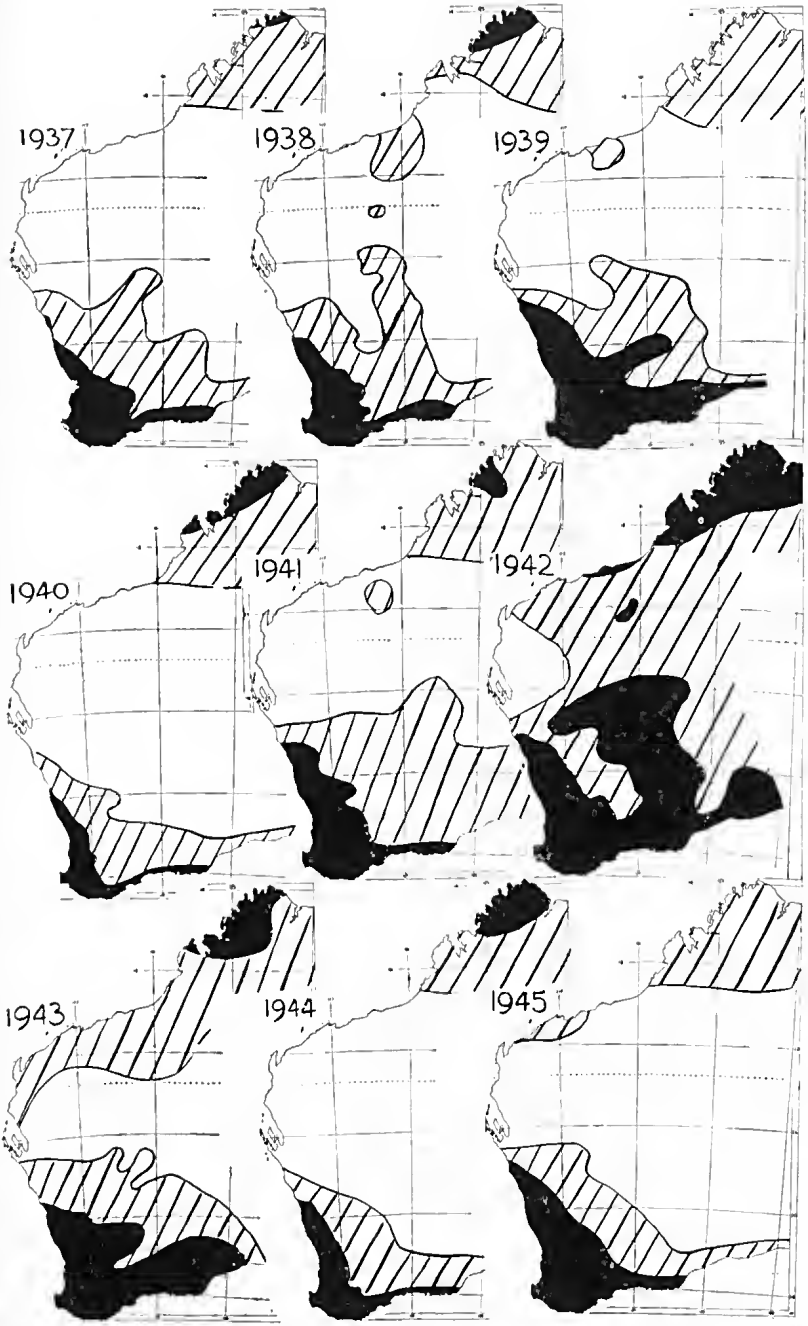

Fig. 3.—Western Australian climates, continued.

HERPETOLOGICAL MISCELLANEA

By L. GLAUERT, W.A. Museum, Perth

I.—NOTES OF SOME FORMS OF *DIPLODACTYLUS*

The recent contribution on the Victorian species of tuberculated *Diplodactylus* by Mr. C. W. Brazenor (1) suggested that it might be advisable to examine the extensive Western Australian series preserved in the W.A. Museum. The task has been undertaken at intervals when opportunity offered and has revealed some interesting facts.

Diplodactylus spinigerus spinigerus (Gray) (2)

An examination of 43 specimens shows that the lizard exhibits considerable variation. The general colour of this form is greyish with a brownish-grey zigzag vertebral stripe usually marked out by enlarged tubercles which pass into blackish (in life dark purple) soft spines on the tail. The other colour form is a more or less uniform greyish brown. This dark phase may be met with throughout the range of the lizard whereas the light phase is more coastal in distribution although specimens from Cunderdin, Kulin and Mount Magnet are in the collection.

In this form the larger tubercles on the back are generally in a more regular arrangement.

The upper labials vary from 10 in one case to 15 in 10 instances, the great majority numbering 12 (21 cases) and 13 (28 cases). The lower labials range from 10, in one case, to 15 in ten, the majority being 12 (in 24 instances) and 13 (in 22). It is stated that in *spinigerus* the spines over the eyes are absent and in many instances this is the case; when any enlargement takes place it is usually in solid tubercles although now and again small soft spines, blackish in colour have been noticed on some of the dark specimens collected near Perth. The number and shape of the lamellae under the fourth toe are not constant. All but three of the dark form are females.

Diplodactylus spinigerus ciliaris (Blngr.)

Eleven specimens in the collection represent this form. They have the spines over the eyes developed as shown in Boulenger's figure (3); the enlarged tubercles along the back are similarly arranged, but the upper labials vary from 13 to 15 and the lower ones from 10 (ten series) to 15 (six series). The Museum has material from the Murchison, the Mt. Margaret district and the Canning Stock Route (Yandil Station).

(1) Memoirs of the National Museum of Victoria, No. 17, p. 215.

(2) The specimen figured on plate XVI of the Reptiles of the "Erebus" and "Terror" Expedition (fig. 5) appears to be an individual with a replacement tail as there are no indications of the double row of spines which are so characteristic.

(3) Catalogue of the Lizards in the British Museum (Nat. Hist.), 2nd edn., vol. I, plate VIII, fig. 2.

Diplodactylus spinigerus aberrans subsp. nov.

Although the type locality of *D. s. ciliaris* is given as Port Darwin, showing that the sub-species has a very wide range in the north, it was surprising to find that in West Kimberley at La Grange and Wallal, a distinct form had been collected which may be described as follows:—

Snout, 9 mm., rounded, longer than the distance between the eye and the ear opening, nearly twice the diameter of the eye, 5 mm. Eye large, much larger than its distance from the mouth. Ear opening oval, horizontal diameter 2 mm. Body and limbs normal, eight lamellae under the fourth toe, the apical pair broadly heart shaped, next two transverse, slightly emarginate distally, the three or four basal ones divided. Upper surface covered with granules, larger than in *spinigerus* and *ciliaris,* smaller on the sides and below, the enlarged tubercles replaced by small soft spines in two rows from the eyes over the nape to the shoulders, a few tubercles scattered over the back in no definite order. Rostral pentagonal, grooved, not divided; nostril between the rostral first upper labial and three nasals. Thirteen upper and twelve lower labials. Mental slightly larger than the adjacent labials. Lower surface covered with small granules, largest on the abdomen. Tail shorter than the head and body, flattened above, almost quadrangular in section, covered with granules larger than those on the body, two rows of soft curved spines, between which are double series of enlarged granules, extending almost to the tip.

Colour: Indistinctly greyish brown, the spines on the head and neck darker, tail much paler, yellowish. Under surface pale with brownish yellow markings on the chin, indistinct dark markings on the belly and limbs.

Measurements, in millimetres: Total length, 134 (approx.); head to hind margin of ear, 21.5; head width behind the eyes, 16; head and body, 80 (approx.); tail, 84 (approx.); fore limb, 28; hind limb, 36.

This subspecies differs from its relatives essentially in the ornamentation of the tail, there being a number of longitudinal series of enlarged tubercles between the two rows of soft spines. In the other forms the space between these rows of spines is uniformly granular.

Type, R 2803, from Mt. Wynne, West Kimberley, in the W.A. Museum.

I am indebted to Dr. H. W. Parker of the British Museum (Nat. Hist.) who kindly compared a specimen with the type of *D. s. ciliaris* and to Mr. J. R. Kinghorn of the Australian Museum, Sydney who allowed me to examine specimens under his charge which were found to include one from King Sound belonging to this new subspecies.

It will be of interest to record that the donor of one of the specimens in the collection, Mr. H. W. B. Talbot, mentioned that the lizard "squirted out stuff like cobweb from the spines on its tail," a habit which I have observed on one occasion when handling a local *D. s. spinigerus* at Spearwood some years ago.

Diplodactylus strophurus (Dum. & Bibr.)

Four specimens of *Diplodactylus* in the Museum collection, R5325 from Carnarvon (the type locality), R2607 from Milly Milly Station and R5923 from Mount Narryer Station in the Murchison district, and R6535 from the Yalgoo district agree very closely with Dumeril & Bibron's description and figure of this species (4). The blunt enlarged tubercles are scattered more or less irregularly over the back and sides, not in longitudinal rows and the tail bears transverse rows of tubercles and several rows of small granules on each segment. There are a few enlarged tubercles over the eye but nowhere are there traces of the soft spines so characteristic of *D. spinigerus* and its forms.

The coloration is uniform above with no indications of the darker lines or blotches on the head and body. Specimens of *D. strophurus* Boulenger (5), not of Dumeril and Bibron, from South-eastern Australia, can be readily distinguished from this Western Australian lizard. The *D. intermedius* of Ogilby (6), New South Wales, which may be a *spinigerus* with replacement tail, also cannot be confused with *strophurus*.

A number of *spinigerus* and *ciliaris* with replacement tails are present in the collection. When the new growth does not match the remnant the scalation is similar to that found on the back, there being no trace of segmentation or of the rings of enlarged tubercles on each segment so characteristic of *strophurus*. In one example, R1304 from Laverton, the soft spines on the tail are replaced by enlarged tubercles resembling those arranged in two series along the back. The lizard resembles the specimen from Day Dawn figured by F. Werner (7) as *D. intermedius* Ogilby.

II. SOME NEW WESTERN AUSTRALIAN LIZARDS

Amphibolurus barbatus mierolepidotus subsp. nov.

Two Dragon Lizards received from the Drysdale River Mission in 1922 differ from the typical *A. b. barbatus* of the Eastern States and from *A. b. minor* of more southerly Western Australia to such an extent that they must be regarded as representing a distinct form.

Plates on the head are smaller especially on the snout; the spines of the transverse series on the head between the ears are bluntly pointed, not acute; there are four clusters of spines on the nape behind the transverse series; and the spines of the "beard" are smaller and less acutely pointed. Scales on the back are smaller, and the enlarged keeled ones are arranged in oblique rows from the vertebral area to the lateral series of spines, not scattered irregularly over the surface; prominently keeled, only a few are spinose. Scales on the chin are strongly keeled, mucronate, on the throat faintly so; on the chest with one strong median keel and two weak lateral keels, median keel strongly

(4) Erpetologie generale, vol. III, p. 397; plate XXXII, fig. 1.
(5) Catalogue of the Lizards in the British Museum (Nat. Hist.), 2nd edn., vol I, p. 100.
(6) Records Australian Museum, vol II, p. 10.
(7) Fauna Sudwest Australiens, II, p. 457.

spinose, lateral keels mucronate. Limbs are feebly keeled, less spinose than in the nominate form.

Colour: Very faded but a dark band from the eye through the ear on the nape, tail with distinct dark rings, the entire under surface pale with indications of dark markings on the chin.

Comparative measurements in millimetres, are as follows:

	A. b. microlepidotus	*A. b. barbatus*		*A. b. minor*
	R 591	R 592	R 10514	R 42
Total length	435	431	450	—
Length of head ...	37	34	50	33
Width of head	27.5	26.5	33.5	23.5
Head and body	153	143	190	115
Head in head and body	4.1	4.2	3.8	3.5

The subspecies can be easily distinguished from *A. b. barbatus* and *A. b. minor* by the much smaller scales on the upper surface of the head and body.

Type locality: Drysdale River Mission, North Kimberley; presented by Rev. Father Salinas, July 1922. Types, R 591 and R 592 in the W.A. Museum, Perth.

I wish to express my thanks to Mr. J. R. Kinghorn for assistance and advice in dealing with this interesting form. In a letter Mr. Kinghorn writes: "I think you have something worth noting. I should not hesitate if I were you in giving it a name."

Lygosoma pallidum Blngr.

Specimen R5336, from Carnarvon, closely resembles the description by Boulenger but differs in that the distance from the tip of the snout to the forelimb is 1.4 times the distance from the axilla to the groin; in that the frontal is in contact with two supraoculars only and in the presence of two pairs of nuchals.

The colour in spirits is whitish cream with a number of narrow brown cross bands interrupted in the vertebral region of the body but continuous on the tail. Lower surface whitish. Limbs with faint dark cross bands.

Lygosoma lesueurii concolor subsp. nov.

Distance from the tip of the snout to the forelimb nearly twice in the distance between the axilla and the groin; snout narrowly rounded; rostral narrowly in contact with the frontonasal; frontonasal broader than long; prefrontals narrowly in contact; frontal large, twice as long as its distance from the tip of the snout, not wider than the supraoculars, its sides straight, longer than the frontoparietals and the interparietal combined; four suproaculars, second the largest, three in contact with the frontal; nine supraciliaries; lower eyelid scaly, parietals in contact behind the interparietal, three pairs of the enlarged nuchals; eight upper labials 6th and 7th under the eye. Ear opening oval, as long as the eye, with four or five lobules.

Body scales smooth, dorsal largest, ventrals somewhat larger than the laterals, 28 round the middle of the body, two enlarged

preanals; tail nearly twice as long as the head and body; dorsal scales not much larger than the laterals, middle row below considerably enlarged. Limbs short, the adpressed limbs fail to meet by the length of the hand, in younger individuals they overlap slightly; 23 lamellae under the fourth toe, the two basal ones considerably enlarged laterally.

Colour, in spirits, above uniform orange citrine (8), the edges of the scales slightly darker; below whitish.

Measurements (approximate) in millimetres:

	R5049	R5340	R5013
Head and body	85	60	61
Tail	160	120	imperfect
Fore-limb	19	16	15.5
Hind-limb	34	27	28
Snout to fore-limb	27.5	19	20

The form differs from the nominate race in having shorter limbs and a uniform coloration above.

The type R5049 was collected on Marrila Station, inland from Maud's Landing, by Mr. R. A. Anderson, November 1934. A second, R5340, was found near Carnarvon and a third, R5013, at Boolardy Station, north of Yalgoo.

Lygosoma leonhardii Sternfeld (9)

A slender skink, distance from the tip of the snout to the fore-limb about 1.5 times in the distance from the axilla to the groin; nasals separated; frontonasal broader than long, in contact with the rostral and the frontal, which is 1.5 times as long as the frontoparietals and interparietal combined, twice as long as its distance from the tip of the snout, in contact with three anterior supraoculars; four supraoculars; eight supraciliaries, the last the largest; frontoparietals slightly shorter than the interparietal; four pairs of nuchals; eight upper labials, 6th and 7th under the eye. Ear opening about as large as the eye, with three lobules; body scales, 32 smooth scales round the middle laterals smallest, the two vertebral series much the largest. The adpressed hind limb nearly reaches the elbow; toes slender, compressed, keeled, 24 lamellae under the fourth toe.

The coloration, except on the uniform reproduced part of the tail, is close to *L. strauchi* as figured and described by Boulenger (10).

This lizard, which is close to both *L. strauchi* from Queensland, and *L. leonhardii* from Hermannsburg, is considered to belong to the latter Loveridge (11) having shown that it is variable in some of its characters. Measurements: head and body, 67; fore-limb, 13; hind-limb, 35 mm.

The specimen R7069 was collected at Grant's Patch, 30 miles east of Kalgoorlie, by Miss Joy Daniels in 1938.

(8) Ridgway's Color Standards, plate IV.
(9) Sternfeld, Senekenbergiana, 1919, VI, no. 3, p. 79.
(10) Boulenger, Cat. Liz. B.M. (N.H.), vol. III, 1887, p. 229, plate XII, fig. 3.
(11) Loveridge, Bull, M.C.Z., 1934, vol. 77, no. 6, p. 346.

FROM FIELD AND STUDY

Birds at the New Causeway Construction.—Early in November (1952), the suction dredge was working the river at the eastern end of the new Swan River Causeway, and discharging its silt on the north side close to the Great Eastern Highway side of the circus. A flock of about 300 Silver Gulls *(Larus novae-hollandiae)* was patiently waiting for the food items that came to light when the discharged silt settled. Behind them and in a distinct flock were about 100 White-headed Stilts *(Himantopus himantopus)*.

—W. BAGGS, Victoria Park.

Use of the Upper Nest of the Yellow-tailed Thornbill.—In the only references I have, Cayley and Serventy and Whittell, it is stated that there is no direct evidence of the use of the upper construction of the nest of the Yellow-tailed Thornbill (chigaree, coastal chickaree, local chipparee, *Acanthiza chrysorrhoa)*.

Don Dowsett, aged 13, a reliable observer, noticed a pair with their second clutch of three eggs. The male was settled right down in the top compartment. On being disturbed he flew out uttering a continuous warning of "cheps." The female emerged at once and flew off, but in silence. Later when the eggs were hatched, Don Dowsett, late at night with a torch made sure the bird was occupying the top compartment. This time he made no attempt to escape or to warn and the light was switched off at once.

The top nest is deep, some 3 in., with a trough leading off in the opposite direction to the lower opening. If finished like the lower nest it would form a tunnel exit.

—HERBERT BERRY, Government School, Wandering.

Field Diaries of F. Lawson Whitlock.—Members of the Naturalists' Club will be interested to learn that the notebooks maintained by our veteran ornithologist and honorary member, Mr. F. Lawson Whitlock, were handed over by him to me, and I have now deposited them in the Archives Department of the Public Library, Perth. Here they will be available for reference by interested students. The notebooks represented are as follows: Expedition to Lake Way (July 1 to August 31, September 1 to December 6, 1909). Notes in connection with the Lake Way trip (July to December, 1909). Shark Bay (June 8 to October 19, 1920). Nullarbor Plain (June 24 to November 7, 1921). Fortescue River (July 16 to November 21, 1922). Central Australia (March 16 to November 7, 1923). Kimberley, Fitzroy River (May 14, 1924 to April 20, 1925). Bunbury diary (January 1, 1948 to December 31, 1950). Among the documents there is also a copy of Robert Hall's *Key to the Birds of Australia and Tasmania,* 1899, with copious manuscript notes inserted by Mr. Whitlock.

—H. M. WHITTELL, Bridgetown.

Size of the Rock Python.—In L. Glauert's *Handbook of the Snakes of Western Australia,* 1950, it is stated that the rock or water python *(Liasis olivaceus)* attains a length of about 6 feet.

J. R. Kinghorn, *The Snakes of Australia,* 1929, gives 5 or 6 ft. as the maximum length. However the species grows to a much larger size but as precise measurements of these reptiles are not often recorded it may be of interest to set down particulars of two specimens recently examined by Mr. N. E. Stewart and myself. These two were killed at Keane's rockhole on The Hooley Station, in the Roebourne Tableland, on December 6, 1952. One specimen measured 12 feet when stretched out and weighed 19 lb.; the other was 12 ft. 1 in. and weighed 20½ lb. Both were males, had empty stomachs and were in very fat condition. The pythons were lying submerged in the water of the pool when first discovered. We were informed that considerably larger specimens are met with. F. Lawson Whitlock in his account of a visit to Millstream Station on the Forteseue River (*The Emu*, vol. 22, 1923, p. 272) describes killing an 11 ft. specimen and mentions that pythons up to 18 ft. in length have been obtained.

The name of the rock python among the local natives (the Injee-bundee people) is "pug-oon-jee."

—D. L. SERVENTY, Nedlands.

Re-discovery of *Hyperœdesipus plumosus* at Moondyne Spring. – During a trip down the Avon River at Easter 1952 our party went across the valley range to Moondyne Spring, situated on a tributary of the Avon about 30 miles from Perth. Here we collected a small crustacean which, on later examination by Mr. K. Sheard, proved to be the rare underground Phreatoicid isopod, *Hyperœdesipus plumosus,* hitherto known only from the type locality, a small pool just below the Lesmurdie Falls (Nicholls and Milner, *Journ. & Proc. Roy. Soc., W.A.,* vol. 10, 1924, pp. 23-24).

The circumstances of the original discovery suggested to the authors that *Hyperœdesipus* was "a subterranean form, which gets carried from crevices underground by the rush of water during the rainy season." It was found on two separate occasions in August 1923 and despite searches in later years was only found again in the same place in 1941 (G. E. Nicholls, "The Phreatoicoidea, Part 1," *Papers & Proc. Roy. Soc. Tasmania for 1942,* 1943, p. 56).

Moondyne Spring is bare of any plant growth, except for a clump of rushes at the outlet end. There is a large bed of bracken above and flooded gum saplings surround but do not over-shadow it. Water bubbles up from the ground in a number of holes both within and just outside of the main pool, and it was in one of these holes, about 15 in. in diameter, that the little crustaceans were found. As the water was muddy I dug out the hole a little deeper, to obtain clear water, and in doing so became aware of the Phreatoicids, which were quite plentiful. About 60 specimens were collected in less than a quarter of an hour. Some of them were whitish-translucent whilst others were of a brownish-olive tint. It is suggested that the former were individuals which were of truly subterranean habit whilst the pigmented ones were living as burrowers in the bottom mud.

—W. H. BUTLER, Inglewood.

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ADDITIONAL RECORDS OF FISHES OCCURRING IN THE FRESH WATERS OF WESTERN AUSTRALIA

By BRUCE SHIPWAY, South Perth.

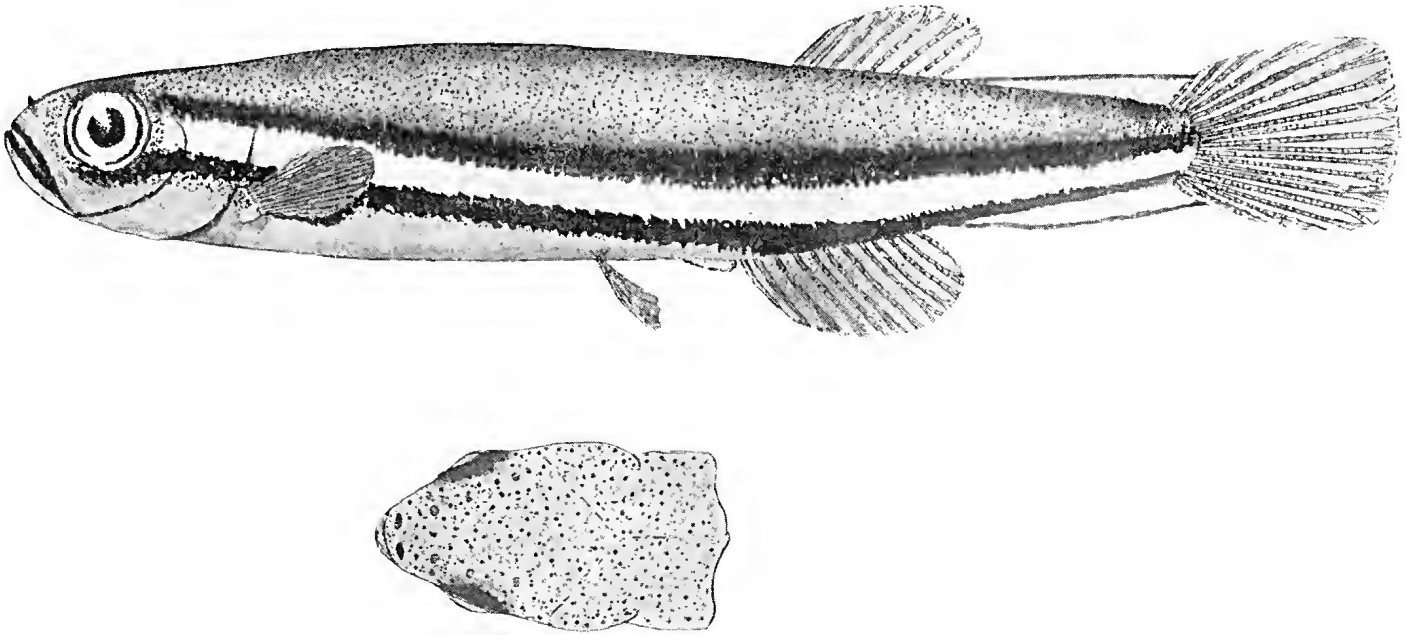
In view of the indiseriminate introduetion of exotie fresh water fishes eneouraged by the present State Fisheries administration and the likelihood of the extermination in eonsequenee of some of the indigenous speeies, data on the presenee of native fishes not hitherto reeorded at the Western Australian Museum may be of interest to future workers.

Introdueed fishes have been planted in loeal fresh waters intermittently over the past 80 years, but unfortunately very scanty reeords survive of the earlier experiments and it would appear that the Western Australian Fisheries Department has not preserved mueh information about these fairly extensive introduetions (ef. Fraser, 1948). The first sueeessful introduetion of trout into Western Australia was made at Albany in 1874, when a shipment of ova from Ballarat was sponsored by Governor Weld (*The Inquirer* newspaper, Perth, October 28, 1874). W. Saville-Kent's plantings of various speeies began in 1894 (he had a hatehery at the Vasse), to be followed soon after by the extensive introduetions of the Aeelimatisation Committee, whieh established a hatehery at Whitby Falls in 1896.

I.—THE BLACK-STRIPED MINNOW, *Galaxias pusillus.*

In June 1949 whilst sueeessfully searehing for speeimens of *Nannatherina balstoni* Regan, in a small drain feeding into Marbellup Creek, near Albany I eaught several small *Galaxias* whieh from their striped appearance were seen at onee to be unusual.

Later examination diselosed not only the remarkable deviation from the spotted or marbled eolour pattern of most Australian *Galaxias,* but also a differenee in fin alignments—the origin of the anal fin was forward of the dorsal, in eonfliet with the current definition of the genus. The fish were not found in subsequent visits to the area in January 1950 and January 1951 but were found again in a eolleeting trip in May 1951. A deseription was prepared and it was proposed to deseribe them as a new speeies, *Galaxias nigrostriatus.*



Black-striped Minnow, *Galaxias pusillus nigrostriatus* subsp. nov. x 5.
—Bruce Shipway, del.

However, on my attention being drawn to a description of new Victorian species of *Galaxias* by George Mack (1936) I saw at once that my fish were the same as one of his new species, *Galaxias pusillus,* from Cardinia Creek, about 30 miles east of Melbourne. I applied to the National Museum, Melbourne for two specimens for dissection and I am very grateful for their co-operation in supplying them. Comparison between the two samples shows that the Albany fish warrant subspecific separation, and I accordingly revive my original manuscript specific name in a trinomial sense:

Galaxias pusillus nigrostriatus subsp. nov.

Body moderately elongate, subcylindrical, its greatest depth above the ventral fin, being contained six times in the standard length (without caudal fin). The length of the head is contained five times in the standard length. Snout broad, with jaws equal in length; cleft of the mouth very narrow; the maxillary extending nearly to below the front margin of the orbit. Eye of moderate size, as long as the snout and contained 2½ times in the head. Single row of conical teeth on the upper and lower jaws, and six large recurved teeth on the tongue. Eight pores present on the top of the head in addition to the two nasal apertures. Cranial pore above symphysis of jaws, elongate, its length three times its width. Nostrils with short fleshy appendages. Gill openings separated by a rather wide isthmus. Branchiostegals present. Pseudobranchiae not seen.

Fin formula: D. 2 + 6; C. 3 + 14 + 4; A. 2 + 10; V. 1 + 5; P. 15 - 16. Caudal strongly truncate. Origin of dorsal above fourth ray of anal.

Colour in life: Olivaceus above the lateral line; a black stripe below; an orange stripe below that and then another black stripe above a white ventral surface. A black spot on the dorsal portion of the posterior section of the caudal peduncle.

Differs from *Galaxias pusillus pusillus* Mack, 1936, in the shape of the cranial pore (which is elongate in *nigrostriatus* instead of circular) and that the width of the upper lip tapers to its junction with the lower, instead of remaining at a constant width.

Length (to the caudal fork) of specimens examined: 29, 29, 30, 31, 31, 31, 33, 35 and 37 mm. (= 1¼ - 1½ in.).

Type: W.A. Museum, no. P3420.

Described from nine specimens caught on June 2, 1949 by dip-net in a small drain running into Marbellup Creek on a property owned by Mr. Byland and situated at Elleker near Albany. An additional seven specimens were netted in May 1951.

G. pusillus nigrostriatus was found in association with *Galaxias occidentalis, Nannatherina balstoni, Nannoperca vittata,* and *Bostockia hemigramma.*

The discovery of this little fish is of considerable zoogeographical interest. As Mack has pointed out, it possesses a com-

hination of eharaeters (5-rayed ventrals and the relation of the anal and dorsal fins) shared with only one other speeies of *Galaxias* —*G. bullocki* Regan from the fresh waters of Chile—and for which Eigenmann (1924) proposed a new genus, *Brachygalaxias*.

II.—RAINBOW FISH, *Melanotaenia nigrans*

The writer had seen what was believed to be *Melanotaenia nigrans* (Riehardson, 1843)—the Queensland Rainbow Fish or Pink Ear—in North-west streams sueh as the Forteseue River, but, at the time (1930-1932), did not have speeimens or a detailed deseription for comparison. The fish, under the synonym of *Neoatherina australis* Castelnau, was listed by McCulloeh, 1929, but the loeality given, off Swan River, Western Australia, is almost eertainly an error in labelling and therefore must be disregarded.

On Deeember 7, 1952 Dr. D. L. Serventy eolleeted a number of small fish in Keane's Rockhole in the Bullawarrina River (probably a tributary of the West Yule River whieh flows into the sea between Cossaek and Port Hedland), at the Hooley Station, Northwestern Australia. Dr. Serventy kindly gave me five of these fish for examination. Three were *Melanotaenia nigrans* and the remaining two were *Therapon unicolor (Madigania unicolor* of Whitley, 1948).

The eapture of *Melanotaenia nigrans* by Dr. Serventy is extremely interesting as it extends the known range into a new isolated area, namely that eharacterised by the Greyian Fluvifaunula (Whitley, 1947), and eonstitutes the first definite reeord of the speeies from Western Australia.

Melanotaenia nigrans is one of the few Australian fishes that have beeome popular as aquarium fishes and is now known overseas as the Queensland Rainbow Fish.

The shape of the fish is subjeet to a great deal of variation and the speeimens were an exeellent example of this, a variability whieh, no doubt, helped to confuse some of the early workers and build up a eonsiderable list of synonyms.

Details of the Bullawarrina River specimens are as follows:—

Speeimen No. 1. ♂ Length to eaudal fork 82 mm., maximum depth (at the origin of the 1st dorsal fin), 30 mm. Ratio of length to depth, 2.75.

Speeimen No. 2. ♂ L.C.F., 79 mm.; maximum depth, 25 mm. Ratio of length to depth, 3.15.

Speeimen No. 3. ♀ L.C.F., 84 mm.; maximum depth, 23 mm. Ratio of length to depth, 3.65.

Colour in life: Specimen No. 1. General eolour grey-brown upper parts, silvery below, with about 6 longitudinal stripes of orange-buff along the body. An orange spot on the opereulum in front of the origin of the peetoral fin. Caudal fin olive-grey, anal fin grey with olive-green tone, first dorsal olive-grey, seeond dorsal fin similar but slightly duller. Iris grey with yellow markings.

Specimen No. 2. Much more highly coloured. Stripes brilliant orange, 7 stripes, 6 of them very prominent. Fins with orange-blotched webs giving them a colourful appearance when fanned out. Orange also in caudal fin.

The sexes may be distinguished in the adults by the pointed extremities of both dorsal fins and the anal fin of the male. These fins in the female have their posterior margins rounded. The dorsal and anal fins of the male are usually darker than in the females. This is particularly noticeable during the breeding season when the males' fins are sometimes jet black, which fact, no doubt, influenced the choice of both the generic and specific names.

An account of the breeding and other habits of the species has already been published (Shipway, 1947). Many line drawings, detailed figures and photographic reproductions are available so a figure is omitted in this case.

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THE SOUTHERN INVASION OF NORTHERN BIRDS DURING 1952

By D. L. SERVENTY, Nedlands.

INTRODUCTION.

In 1952 there occurred the most widespread and conspicuous irruption of northern Australian birds into the south that has yet come under the notice of naturalists. The species participating in the movement were mostly Kimberley birds, as, for example, the Black Kite *(Milvus migrans),* the Brolga *(Grus rubicunda)* and the Pied Goose *(Anseranas semipalmata),* but others, typified by the Letter-winged Kite *(Elanus scriptus),* were nomads from central Australia.

The movements were not confined to Western Australia; the whole of southern Australia shared in receiving this phenomenal immigration and some elements of it even reached New Zealand.

The causes of these movements are obviously related to the unusual sequence of weather conditions which has obtained in both northern and central Australia. Brian Glover, who has published a similar review to the present one for South Australia *(South Austr. Ornithologist,* vol. 20, pt. 8, December 16, 1952, p. 82) has pointed out that following a series of good seasons, culminating in the filling of Lake Eyre for the first time in recorded history, bird populations must have built up to super-normal levels. This would be due mainly to an extraordinarily high rate of survival of the young produced under these lush conditions. When the extremely severe drought followed almost immediately and the carrying capacity of both the far north and the centre was drastically reduced, the excess populations of the nomadic species sought survival in emigration.

Through the courtesy of Mr. G. W. Mackey, Deputy-Director of the Commonwealth Weather Bureau, I had the opportunity of inspecting the recent weather records of the northern and central Australian regions and the following broad generalisations may serve to give the meteorological background of the phenomena to be discussed in this article.

Northern Australia: The summer of 1949-50 enjoyed good rains throughout. The summer of 1950-51 was generally good, but became dry towards its close. This dry period, beginning in March 1951, continued until the drought broke early in 1953. The summer of 1951-52 was one of distressing drought throughout the north, being claimed locally to be the worst in the history of the Northern Territory.

Central Australia: The sequence of good and dry years followed a similar pattern to that obtaining in the far north. After good seasons in 1949 and 1950 dry conditions supervened in January 1951 and continued. The floods in the Lake Eyre basin began in 1949 and culminated in 1950, the filling of Lake Eyre reaching its climax in October when the deepest soundings, of 12-13 feet of water, were recorded.

The importance of an adequate recording of as many details as possible of the movement of birdlife caused by these series of weather conditions has been generally realised. Fortunately a fairly comprehensive survey of the position was made by the South Australian Ornithological Association in South Australia (Glover, *ibid)* and by the Western Australian Naturalists' Club in Western Australia, the results being reported in the present article.

The irruption has high-lighted one aspect of bird movement in Western Australia: the probable existence of a greater amount of regular seasonal movement between the Kimberley Division and the southern parts of the State than has been realised in the past. Some of the species which were concerned in the irruption of 1952 appear each year in the south as winter visitors supplementing local populations. Their numbers were swelled considerably in the winter of 1952 which fact suggests that the centre of

origin of the visiting birds in normal years is also the Kimberley Division, a point which may be definitely established when systematic bird-ringing is under way. It would appear that in the winter, the dry period in the Kimberleys, a certain proportion of the exeess bird population moves south, a partial migration which varies in its ineidenee aecording to the severity of environmental eonditions in the far north. Further referenee to this subjeet is given in the diseussion of partieular speeies.

COVERAGE.

It was fortunate that several local naturalists were able to make journeys over various portions of the State during the year and so had an opportunity of contributing to the doeumentation of the phenomenon ineidental to the earrying out of their other duties. It would be worth while to detail more partieularly how the State was aetually eovered.

A useful preliminary tour was made by H. Tarlton Phillipps and myself between October 2 and November 5, 1951, from Perth northwards, via Paynes Find, Mt. Magnet, Meekatharra, Mundiwindi, Roy Hill, Wittenoom, Coolawanyah, Millstream, Roebourne, Onslow, Carnarvon, Geraldton and back to Perth. This survey revealed no evidenee of an irruption except in the ease of the Letter-winged Kite.

During 1952 the following journeys were made by naturalists eollaborating in the present inquiry. On February 14 I made a trip from Perth through Spencers Brook, the Dale country and Beverley. Between April 29 and May 1 V. N. Serventy travelled between Perth and Augusta. On July 1 I made a trip through the Dale country, Greenhills and Cunderdin. Between July 9 and 14 N. E. Stewart, of the C.S.I.R.O., travelled from Perth to Northampton (he reeorded mainly Blaek Kite oecurrenees). A. Douglas visited Dongara on July 23. J. H. Calaby and I made an overland trip from the Eastern States to Perth between July 20 and August 10, via Euela, Balladonia, Norseman and Kalgoorlie. Between June 24 and August 8 V. N. Serventy travelled from Perth to North-West Cape, via Geraldton and Carnarvon. H. Tarlton Phillipps made a voyage on the lighthouse tender "Cape Otway," from Fremantle to Cape Don and return between July 3 and September 5; he visited various islands and some of the coastal ports. E. J. Brownfield, of the Fisheries Department, made a motor tour from Perth to Derby between August 8 and 29, along the coast road (observations mainly on Brolgas and Ibis). Between August 31 and September 5 I made a tour from Perth around the South-west, via Bunbury, Pemberton, Nornalup, Albany, Kojonup and Perth. On September 9 I visited the Dale country, Beverley, Quairading and Cunderdin. Between September 10 and 13 J. H. Calaby made a trip from Perth to Geraldton, Mullewa, Morawa, Carnamah and back to Perth. Between September 17 and 22 he travelled from Perth to Narrogin, Nyabing, Norseman, Kalgoorlie and back to Perth. Between October 27 and 31 he visited the Northampton district, via Mullewa and Carnamah. Between November 10 and 14 he travelled from Perth to Donnybrook and return via Darkan. From November 27 to December 10 I visited Coolawanyah Station by air and was able to travel over some 600 miles of country in the vicinity of that station. The Hooley and Tambrey.

In 1953 the following territory was covered. Between February 2 and 6 J. H. Calaby and I travelled from Perth to Pingrup and Lake Magenta, via the Williams and Wagin. J. H. Calaby visited Donnybrook and Darkan between January 19 and 22; Perth to Geraldton, Northampton and Mullewa between Mareh 16 and 20, and Perth to Pemberton between April 3 and 6. Between April 13 and 17 I travelled to Bolgart, Wongan Hills, Morawa, Three Springs, Moora, Dandaragan and back to Perth.

The following ornithologists were able to make sustained observations in country centres: S. R. White (Morawa), D. N. Calderwood (Beaeon), Mrs. R.

Erickson (Bolgart), P. E. Stone (Kellerberrin), E. H. Sedgwick (Wooroloo), I. C. Carnaby (Bailup), A. H. Robinson (Coolup), H. M. Whittell (Bridgetown) and R. Aitken (Nyabing).

Information from these, what might be termed authoritative sources, was supplemented by reports solicited from the general public on species which were more or less readily recognisable. Such information was gained through press publicity *(West Australian, Western Mail* and *Westralian Farmers' Gazette)* and radio announcements. The response was considerable. Nevertheless, as will be apprcciated from Figs. 1 and 2, there were wide gaps in the coverage and the reported observations can only be considered as irregularly distributed samples of what actually took place.

The data are arranged in geographic sequence, broadly speaking from north to south, and where many reports came in these are sub-divided into convenient areas. Within each locality grouping the observations are set out in chronological order. Unless specified all the observations refer to the year 1952.

BLACK-TAILED NATIVE-HEN *(Tribonyx ventralis).*

The following reports were received:—

Carnarvon: John Lawson, of the Department of Agriculture, informed V. N. Serventy on July 4 that "these birds were in thousands a few months ago but there were none about now."

Mount Margaret (via Morgans): R. S. Schenk, of the Mount Margaret Mission reported that a few Native-Hens had appeared in the locality.

Geraldton: V. N. Serventy saw 8 birds at the Chapman River on June 28.

Dongara: A. Douglas came on small groups of up to 5 birds on July 23.

Morawa: S. R. White reported, under date August 25: "Appeared in small groups of up to 20 or 30 birds on dams scattered about the district last year [1951] after the rains in May and June. The biggest gathering I saw was just out of Three Springs to the east in salt lake country. There must have been about 50 birds there. Some are about again this year [1952], sometimes up to half a mile away from water, but as the season is a very dry one there is not the water lying about to attract large numbers."

Moore River: John Harper, of "Koorian," Gingin, saw 20 birds in April.

Guildford: H. R. Harper saw a party of about 12 on May 10, about half-a-mile east of Barker's Bridge.

Perth: At the University grounds, Crawley, on May 2, J. C. and P. E. Serventy saw one bird near a small swampy pool.

Wooroloo: E. H. Sedgwick saw one bird in the creek bed on April 25. This was Mr. Sedgwick's second observation of the species in the South-west.

Coolup: A. H. Robinson reported that the first 3 birds were observed on August 31, but later in the year as many as 7 were seen. "This is probably more than were seen in 1948, the last time they were noticed."

Kukerin: A. R. Abbott reported 2 Native-Hens around his dam on July 1.

Lake Gundaring (8 miles east of Wagin): R. Aitken, at the opening of the duck-shooting season on December 23, noted about 400-500 birds driven to the surrounding paddocks by the shooting.

Nyahing: J. H. Calaby saw 10 in one flock on September 18 at a Government dam 7 miles east. R. Aitken reported a count of 44 birds there up to October 24. They were present in one's and two's on all neighbouring dams.

Tenterden: L. S. Perkins reported one bird on May 1; "a strange bird in these parts."

Nornalup: Miss Hilda Price noticed one bird on April 27; not known in the area before.

Balladonia district: I saw 2 birds on the dam at Nanambinia Station on August 6; Mr. Fred Dimer told me they were the first seen there for about 6 years.

Remarks: This species is one of the best examples of nomadism in Western Australia. It occurs all over the State and numbers may suddenly arrive in a district, usually after rains, and may depart just as suddenly. The year 1952 was not a big irruption year, judged by the standard of several previous invasions, but it was characterised by a widespread if small influx into most parts of the South-west. None came under notice during my North-west trip in October-November 1951 or on the visit to Coolawanyah and The Hooley Stations in December 1952. The irruption into the southern parts of South Australia was on a much greater scale (*S.A. Ornith.*, vol. 20, p. 83) and the first arrivals appeared on the Adelaide Plains about May 1951, being the earliest of the many invasion birds in that State.

Meteorological conditions in the South-west and the North-west of Western Australia do not appear to have been such as to account for the invasion which took place in the South-west. Our birds may have come from much further afield but in the absence of positive records, supported by ringing experiments, one feels loth, at this stage, to suggest that the bulk of the invaders came from such distant places as the Kimberley Division or the Lake Eyre basin. Rails, however, despite their seemingly indifferent powers of flight, are notoriously extensive wanderers.

PELICAN *(Pelecanus conspicillatus)*

It is not certain whether the Pelican should be listed as a component of the irrupting species, though there is evidence that the birds were more frequent than usual in the South-west in 1952.

From Morawa S. R. White on August 25 reported as unusual a number of Pelicans seen standing in crop near the salt lake area.

On the Swan River Estuary Pelicans were more conspicuous than usual. At Pelican Point birds were present throughout the winter months of 1952 and the numbers resting on the spit were greater than in previous years. In Perth Water the birds were uncommonly frequent; L. E. Sedgwick counted 20 adjacent to the South Perth ferry jetty channel on October 24.

At Coolup A. H. Robinson found Pelicans more plentiful than usual during December (1952) and January (1953). As many as 8 birds were being seen on his property at the one time.

BROLGA *(Grus rubicunda)*

Details of the reported occurrences are as follows:—

Between the Murchison River and Broome: E. J. Brownfield, Fisheries Department, Perth, reported the following observations on Brolga occurrences as encountered on a motor run from Perth to the Kimberley Division during August. The species was first met with on August 13, at the junction of the Carnarvon and Hamelin Pool roads, when one bird alighted opposite the water tanks (Tank No. 4). No more were seen until just after leaving Yarraloola Station, some 80 miles north of Onslow, on August 20, when a few were noted. The next occurrence was a large flock 16 miles north of Roebourne and from here on the species was seen quite frequently. A group of 12 birds was seen 50 miles north of Port Hedland. Along the Eighty Mile Beach

Brolgas occurred generally in groups of two or three, and at the northern end of La Grange Bay there was a group of 15. From La Grange Bay until about 50 miles south of Broome the country along the main road is fairly thickly wooded and in consequence no Brolgas were seen but they were fairly numerous in the open country 15 miles south of Thangoo Station. The largest concentration met with on the trip was near a small dam 5 miles north of Thangoo Station when almost 100 Brolgas were seen. There were flocks of birds intermittently all the way to Broome. None was seen on the run between Broome and Derby but the day was extremely hot and the country travelled through was fairly well wooded.

Beacon: H. A. Dunne saw one bird on August 27; a photograph and detailed description were sent to C. F. H. Jenkins (Government Entomologist). The bird was also seen by D. N. Calderwood.

Remarks: The Brolga, a northern and eastern species, extends rather sparsely from the Kimberley Division and has been recorded around the North-west coast as far as Yarraloola Station, north of Onslow. It would appear that this is a more or less recent penetration into the North-west as the species was never recorded by resident and visiting ornithologists, including Tom Carter, F. Lawson Whitlock and A. H. Robinson (the last-named of whom was in the North-west from 1923 to 1934).

The 1952 records extended the known range in Western Australia by some 650 miles.

STRAW-NECKED IBIS *(Threskiornis spinicollis)*

The following reports were received:—

NORTH-WEST:

Wallal: E. J. Brownfield saw a large flock 40 miles south of Wallal on August 22.

The Hooley Station: I saw one bird at the Kyaline Pool on December 5.

Boologooroo Station: V. N. Serventy saw about 500 birds on July 17. The owner, H. Campbell, informed him that a flock of 2,000, the largest he had ever seen, had been there recently.

Carnarvon: V. N. Serventy saw 2 birds on July 4. He stated that John Lawson, of the Department of Agriculture, who had been stationed there for 4 years, had not seen any in the district before. On August 8 there were 20 Ibis near the aerodrome.

THE MIDLANDS:

Moonyoonooka: J. H. Calaby saw 1 bird on March 19, 1953.

Moora: Fisheries Inspector S. W. Bowler reported on September 2 seeing a flock of about 150 and the birds were present throughout from Moora to Geraldton. He had never seen the Ibis so plentiful before. J. H. Calaby saw 20 birds on October 27.

Walebing: J. H. Calaby on October 27 saw 7 birds at a point 17 miles south and 15 birds 10 miles south.

New Norcia: V. N. Serventy saw 4 birds on June 25.

SOUTH-WEST, COASTAL:

Bullsbrook: V. N. Serventy saw one bird on June 24.

Perth district: I saw 6 Ibis at Monger's Lake on April 22 and one at Herdsmans Lake on April 26. At Lake Karrinyup on February 24, 1953, I saw 2 birds.

Maddington: S. Taylor saw flocks of 6 to 20 from October 14 to 20.

Kelmscott: L. W. Newman saw 50 birds in June. J. H. Calaby saw 15 on November 10.

Pinjarra: I saw 1 bird on August 31, 6 miles south.

Coolup: A. H. Robinson reported on January 14, 1953: "This species was more common during the winter of 1952 than I have ever seen it before. Most of the flocks appeared to make back to a common roosting site north of Pinjarra. Approximately 300 left every morning and flew as far south as Hamel

and returned every evening along the same route. The total congregation at this roosting site certainly ran into many hundreds and probably thousands of birds. There are still up to 100 feeding around the swamps at 'Yanjettee.' " On May 17 at 5.15 p.m. I saw a flock of about 500 flying westward. On January 19, 1953, J. H. Calaby saw 9 birds.

Darkan: J. H. Calaby saw 20 birds, 10 miles S.E. on November 12.

Waterloo: D. N. Calderwood saw about 40 on March 28, 1953.

Dardanup: J. H. Calaby saw 5 on March 6, 1953.

Northcliffe: R. J. Neuzerling reported flocks of up to 7 birds on his farm in May; he had never seen the species before in the South-West.

Nornalup: Dr. B. Burnside reported 2 birds on June 6—the first he had seen in the district during his residence of 23 years there. The birds continued to be present until November 24.

Denmark: Fisheries Inspector L. G. Smith reported on June 20 that about 100 birds had been in the district for about three months.

WHEATBELT AND EASTERN:

Bencubbin: D. N. Calderwood saw one bird 6 miles north on April 28; this was the only bird of the species seen in the Bencubbin-Beacon district during the year.

Moorine Rock: Miss Margaret Nicholson reported that 13 birds appeared during September and fed on grasshoppers which were very plentiful at the time. The species had not been seen in the district previously.

Great Southern district: Brian V. Teague, of Narrogin, reported on February 3, 1953, that the first time he had seen this species was at Mt. Kokeby about five years previously. The next record was of one bird at the same place on October 21, 1952. On November 5 at Narrogin he saw a flock of 18 and then of 25; on November 1 there were 85 birds in one flock. On November 10 a flock of 8 was seen at Popanyinning; on November 12 there were about 30; on November 14 about 20 were noticed. On November 21 at Muresk 4 birds were seen. On November 27, at Youraling, two flocks of 8 each; at Popanyinning, 10. On November 30 there were about 20 at Popanyinning. No more were seen in the country between Narrogin and York until December 3 when 50 Ibis were seen in a new locality, at Josbury, 7 miles south-west of Williams; they were still there on December 8. On December 6 one bird was seen at Lake Yealering. On December 10 about 20 were again seen in Narrogin. On January 11, 1953, about 20 were seen 17 miles south of Williams.

Toolibin: Mrs. E. A. Basenberg reported on November 7 that for the past week up to 30-40 birds were present in the paddocks in the district and flying over; they were not known previously.

Tinkurrin (via Narrogin): Harold Masters reported on November 17, as strange visitors, flocks of Straw-necked Ibis; three weeks previously a neighbour had seen 200 on his property.

Mt. Barker: I saw 1 bird 20 miles north, on September 4.

Nullarbor Plain: P. M. Cornish, of Forrest, reported the species at Halg, as an unusual visitor. ("Gould League Notes. W.A., 1952-53," p. 28.)

Remarks: The Straw-necked Ibis is a resident species in the South-west but has only two main foci of occurrence, one in the Pinjarra area and the other around Gingin. In both districts breeding stations occur. Elsewhere the birds are infrequently encountered but in 1952 they were diffused in large and small numbers over a wide area in the North-west and South-west. I did not meet with any during my extensive North-west travelling in October-November 1951.

It would appear that most of the birds seen were visitors from the Kimberley Division, supplementing in the South-west the small resident population. W. B. Alexander *(The Emu,* vol. 20, 1921, p. 159) was of the opinion that the species had reached the south only within recent years and T. Carter stated that according to

his information it first appeared in the Albany district in 1892. Writing of the birdlife observed during his 11 years' stay at Point Cloates Carter stated *(The Emu,* vol. 3, 1904, p. 209): "As far as I can ascertain, the first record of this species in the district was in May, 1888, when numbers suddenly appeared, and neither natives nor settlers knew the bird, but Mr. J. Brockman informed me he had seen and shot a specimen some years earlier. After the break-up of the 1889-91 drought immense numbers were to be seen over the country. For some weeks they used to roost in thousands on some bare sand-drift hummocks behind the house at Point Cloates. In October, 1900, some hundreds of these birds bred and reared their young at Cardabia Creek, about 60 miles south-east from Point Cloates, and this is, I believe, the first record of this species having bred in Western Australia."

The recently-discovered papers of John Gilbert reveal that neither the Straw-necked Ibis nor the two Spoonbills occurred in southern South-western Australia during his collecting period (1839-43). It may quite well be that the establishment of the species in the south may have been due to periodic irruptions in the past century of the kind which took place in 1952.

WHITE IBIS *(Threskiornis molucca)*

This species had never been authoritatively identified from Western Australia south of the Kimberley Division. T. Carter in his account of the birds of Point Cloates *(The Emu,* vol. 3, 1904, p. 210) stated that "this ibis was not personally seen, but three reliable persons told me of having seen occasional specimens with flocks of *G. spinicollis.*" During the 1952 irruptions similar reports were received, as follows:—

Gascoyne district: Hugh Thomson informed H. M. Whittell on March 4, 1953, that a White Ibis was seen about March, 1952 among Straw-necked Ibis at Moogooree Station, 180 miles N.E. of Carnarvon.

Coolup: A. H. Robinson stated that among the flocks of Straw-necked Ibis there were a few White Ibis. "These birds were described as pure white except for a black face, beak and legs, and a patch of black at the base of the tail or the tip. The only individual I saw was some distance away and appeared rather a dirty white."

Bunbury: D. N. Calderwood, whilst holidaying at Bunbury, saw one bird in a shallow lagoon on "Moorlands," between South Bunbury and Picton, on March 30, 1953. The bird was not seen in flight and in repose black was noted in the region of the tail. It was in company with a White Egret and two White-faced Herons.

Busselton: S. R. White reported on January 8, 1953, whilst on a visit to Busselton, that he had been reliably informed of the presence of one White Ibis among Straw-necks. "The two persons who told me this were under the impression that it was an albino but I consider it more likely to be a White Ibis that had moved down with Straw-necks."

Remarks: The White Ibis may now be added to the avifauna of that part of the State south of the Kimberley Division. The bird is evidently a very scarce straggler to the south, accompanying the Straw-necked Ibis. In view of Carter's remarks it may occur more frequently than the available records suggest, but owing to its comparative rarity has not come under the notice of knowledgeable observers.

JABIRU *(Xenorhynchus asiaticus)*

The only previous records of this species south of the Kimberley Division are of two specimens collected by the explorer F. T. Gregory in 1861 at Breaker Inlet, near Condon, and an observation by K. G. Buller near Well 49 on the northern end of the Canning Stock Route in 1943.

The only report received of the bird during the present survey was from A. Zuvela, of the Education Department, who saw a Jabiru at the Port Hedland marshes at the end of May.

WHITE EGRET *(Egretta alba)*

The White Egret is resident in the South-west and odd birds and small parties are not infrequently seen in the winter months. It has been difficult to deduce from the reports received to what if any extent there had been any material increase in numbers during 1952. Apparently some influx in the South-west population took place but it was not on anything like the scale of that which was exhibited by the Straw-necked Ibis and the White-necked Heron.

The following reports were received:—

Perth district: P. E. Serventy saw one White Egret and one Black-billed Spoonbill at Pelican Point on August 17. I saw one Egret at Lake Karrinyup on February 24, 1953.

Bunbury: On August 31 I saw 4 birds 7 miles N. and one bird 3 miles north. On November 10 J. H. Calaby saw 3 birds. D. N. Calderwood saw one at Australind on March 29, 1953; 2 at Bunbury and one near Pleton on March 30.

Busselton: S. R. White reported on January 8, 1953, that "the Egrets are more numerous than ever and I sometimes wonder whether they will become as in Queensland the dominant heron in the well-watered grassed areas and swamp vicinities."

Nullarbor Plain: P. M. Cornish, of Forrest, reported an Egret at Reid in April, 1952. ("Gould League Notes, W.A., 1952-53," p. 28.)

WHITE-NECKED HERON *(Notophoyx pacifica)*

The following reports were received:—

NORTH-WEST and MIDLANDS:

Roebourne Tablelands: On December 4 I saw one bird at Ellawarrina Creek on Tambrey Station; on December 5 about 10 at the Kyaline Pool and one at the Bullawarrina Pool on The Hooley Station.

Carnarvon: V. N. Serventy saw one bird on July 11.

Northampton: J. H. Calaby saw one bird 2 miles west on March 18, 1953.

Geraldton: V. N. Serventy saw one bird on the Chapman River on June 28.

SOUTH-WEST, COASTAL:

Bullsbrook: V. N. Serventy saw 2 on June 24.

Baker's Hill: D. N. Calderwood saw one on September 20.

Childlows: D. N. Calderwood saw one on September 20 and one on August 13.

Perth: A bird was present for some days during April at the University pond, Crawley. It made repeated attempts at catching the goldfish there and was hunted away by the gardeners. I saw one at Mongers Lake on April 21

and one at Herdsmans Lake on April 26. The curator of Queen's Gardens reported one there at the middle of May. D. N. Calderwood saw 2 birds on the Esplanade and one near the Causeway on September 20.

Darling Range: A. Notley saw one at Carmel on April 25. L. W. Newman had a pair under observation at Roleystone for 18 weeks. I saw one at a roadside puddle 12 miles east of Midland Junction on August 10.

Maddington: I saw one on the road to the Bickley camp on August 19. S. Taylor saw the species repeatedly until December 22, 5 being observed on the one day.

Kelmscott: D. N. Calderwood saw one bird on March 28, 1953.

Armadale: I saw one bird 14 miles south on August 31.

Coolup: A. H. Robinson reported on January 14, 1953: "These birds are seen here every year but as the winter progressed there was a big influx and small travelling flocks were noticed. The species is very aggressive and each bird holds a feeding territory from which all other members of its own species are driven. Each swamp or swampy depression in a paddock which held water had its single heron, often in company with a single White-faced Heron. The big cleared swamp at 'Yanjettee' containing some 20 acres kept two herons at either end. As the small pools dried up numbers of the species were forced to concentrate on the more permanent waters and on November 19 I counted 35 White-necked Herons on a small swamp half-a-mile from Coolup. The highest number seen at the big swamp at 'Yanjettee' was 12 during December and this number is equal to the entire population during the winter scattered over numerous swamps and clayholes."

Pinjarra-Bunbury: On August 31 I saw one bird 4 miles north of Pinjarra and one 8 miles north of Coolup. On September 1 one bird was noted 20 miles south of Waroona and another 30 miles south; one was seen 7 miles north of Bunbury and 2 birds 8 miles north of Bunbury. On November 10 J. H. Calaby saw single birds at Pinjarra, Coolup, Wokalup and Bunbury. R. Hewison reported on September 22 that there were large numbers of these herons scattered around the district that were not in evidence in previous years.

Darkan: J. H. Calaby saw one bird 6 miles west on November 12.

Donnyhrook: J. H. Calaby saw one bird 8 miles N.E. on November 10.

Manjimup: J. H. Calaby on March 5, 1953, saw two groups, of 15 and 2 birds, 5 miles north.

Nornalup: Dr. B. Burnside reported, on June 26, parties of up to 6 birds —the first he had seen in the district during his 23 years' residence. They were generally distributed. None was seen after October 27. On September 3 I saw 2 birds 28 miles west of Tinglewood and one at Tinglewood. Frank Thompson informed me then that they "were everywhere in the South-west now."

Denmark: I saw 1 bird 4 miles west on September 4.

Albany: I saw 12 birds together on September 4, 11 miles north.

WHEAT-BELT and EAST.

Beacon: D. N. Calderwood saw one after the opening winter rains and found it dead on May 9.

Jingymia: D. N. Calderwood saw one on August 10.

Kellerberrin: Philip S. Stone stated, under date, May 4, 1952: "I have seen a few White-necked Herons this year. It is the first time since 1946 that I have seen them here."

Meckering: I saw one bird on September 9, 7 miles west.

Gilgering: I saw two on July 1.

Dangin: I saw one at a dam on September 9.

Beverley: B. M. Minchin saw a pair on one of his dams on June 20.

Kukerin: A. R. Abbott had one bird on his farm on June 29.

Highbury: J. H. Calaby saw one bird on September 17.

Kojonup-Williams: On September 4 I saw one bird 12 miles south of Kojonup. On September 5 I saw single birds 7 and 18 miles north of Kojonup and 15 miles north of Williams.

Nyabing: J. H. Calaby saw one bird 11 miles west on September 17 and 2 birds at Nyabing on September 18.

Pingrup: J. H. Calaby saw one bird on September 19.

Mt. Barker: I saw one bird 20 miles north on September 4.

Balladonia district: I did not see any during a visit in early August but Fred Dimer informed me that the birds "had been here in hundreds recently, at Balladonia, Nanambinia and Cantabinia." Some were seen until about the middle of July; there were about 15 in the largest flock.

Remarks: The White-necked Heron occurs all over Australia. In the southern parts of Western Australia it is rather a scarce heron, though small numbers appear every winter, usually dispersed as solitary individuals on small swamps and pools. Occasionally influxes in considerable strength occur. During 1952 no great concentrations were reported, as has been the case with some previous visitations, but there was a very widespread dissemination throughout the south and the numbers present must have been, in the aggregate, very great indeed.

In the course of my North-west visit of October-November 1951 I saw only three birds of the species altogether—one bird each at Guildford, Coorow and the upper Gascoyne River (at Three Rivers Station).

It would appear that the influx each year is of birds moving out of the Kimberley region.

There was a general movement from north Australia southwards in 1952 and all the southern States received immigrants. A bird even turned up in New Zealand, at Canterbury, in mid-April 1952, the first record of the species there (R. H. D. Stidolph, *Notornis*, vol. 5, no. 2, October 1952, p. 38).

BLACK SWAN *(Cygnus atratus)*

It is questionable whether or not this species figured in the irruption. Whether a general increase in the numbers occurred or not is uncertain. However A. H. Robinson reported from Coolup that Black Swans were more plentiful there than they had been for at least 10 years. Two pairs nested at "Yanjettee"; nesting sites appeared to be at a premium and a number of birds did not breed.

PINK-EARED DUCK *(Malacorhynchus membranaceus)*

It appears that the numbers of this rather rare duck were reinforced during 1952 by visitors which may have been part of the irruption. The following records have been reported:—

Lake Clifton: A duck-shooter, Mr. Fell, gave me a detailed description of a bird he had shot, out of a party of 5-6, on February 20, 1953.

Gundaring Lake: R. Aitken stated that at the opening duck shoot on December 23 at this lake 7-8 Pink-eared Ducks were shot out of a total bag of 240.

Karakan Swamp (via Katanning): R. Altkin reported that at a shoot on January 28, 1953, one Pink-eared Duck was shot out of a total bag of 40.

Manjimup: "The West Australian" of July 14 published a photograph of a Pink-eared Duck shot in a local swamp.

Balladonia: I saw a party of 4 birds at the rock pool by the homestead on August 7.

PIED GOOSE *(Anseranas semipalmata)*

The following reports were received:—

Broome: Inspector M. Goodlad, of the Fisheries Department, reported as follows on March 13, 1953: "The Pied Geese commenced to arrive at Broome in 1952 around the same time as the Black Kite [April] and gradually increased in numbers until around the end of June. The birds became very tame and unafraid. They stayed on in Broome until January when the heavy rains came; the majority then migrated. Rough estimate of numbers would be 300-400 in the town at one time. When I arrived back in Broome on February 8 (after an absence in Perth since December 5) I observed 12 geese. The species very seldom visits Broome."

Roebourne Tablelands: On December 4 I saw a flock of 13 Pied Geese at a rock pool in Ellawarrina Creek, a tributary of the Sherlock River, on Tambrey Station. The birds were very tame and continually came back to the pool after being disturbed, some perching in river gums. One specimen was collected: ♂, weight, 5 lb. 8 oz.; moderately fat; small gonads. I was informed by R. Parsons that in August one bird had been seen at Coolawanyah Station (Quarrina Well); one came to Millstream Station and fed with the fowls; others were seen in the streets of Roebourne. R. Knowles, of Hamersley Station, informed me that 2 geese appeared at his homestead. E. W. Parsons told me that none was seen on any of the pools at The Hooley Station.

Lowendal Island (by Barrow Island): Surgeon-Commander G. D. Wedd of H.M.S. Campania saw 2 birds on October 13.

Carnarvon: V. N. Serventy saw 8 birds fly over the town on July 11 and head eastwards.

Mullewa: S. R. White saw a party of 5 between Geraldton and Mullewa in late August feeding quietly in a wheat crop no more than 40 yards from the roadside.

Swan River Estuary: J. W. Baggs saw 3 birds at Alfred Cove on February 1, 1953 (the observer became familiar with the species during a visit to the Kimberley Division in 1951).

Madura: H. Pinchin reported (through H. Tarlton Phillipps) that at the beginning of August he was driving overland to Adelaide; when just beyond Madura he saw 2 Pied Geese at the side of the road (he was familiar with the species in northern Australia).

Remarks: The Pied or Magpie Goose is ordinarily an inhabitant of northern Australia and in this State does not range south of the Fitzroy River. Its occasional wanderings south of this river must apparently be very infrequent as the bird has been recorded by only one field ornithologist (Tom Carter) and its appearances in 1952 at even such places as Broome, Roebourne and other northern localities were hailed by the residents as very rare or unprecedented visitations.

In his account of the birds occurring in the region of North-West Cape Carter *(The Emu,* vol. 3, 1904, p. 210): "18th September, 1892, a small flock of these birds was resting on the beach at Maud's Landing and allowed me to ride past within a few yards of them without taking flight. . . . In 1900 numbers of these birds were on the flooded clay-pans near Winning." Carter is also responsible for the only published record of the bird from the southern part of Western Australia. In his paper on the birds of Broome Hill *(The Emu,* vol. 23, 1923, p. 135) he stated: "Only one Pied Goose came under my personal observation. On November 1, 1905 I walked to within five yards of one at my Broome Hill stock tank. It was evidently resting after a long flight, and flew away within an hour of my seeing it."

The present irruptions from the Kimberley region are clearly of a more extensive nature than any hitherto.

Even in the Kimberley Division and the Northern Territory, the normal home of the species, the drought conditions concentrated the bird into unusual haunts. The Perth *Daily News* in its issue of July 29, 1952 included the following report from its Darwin correspondent: "Starving geese and hawks are causing Darwin market gardeners thousands of pounds worth of losses. Denied natural feeding places because of the drought, the geese and hawks are plaguing market gardens and poultry farms. . . . Market gardener Rex McLaren said today geese had eaten 800 tomato plants, 1,000 cabbages and three plots of french beans. He estimated his loss at £500." On a visit to Darwin on July 30-31 H. Tarlton Phillipps saw some Pied Geese in the Botanic Gardens there.

SPOTTED HARRIER *(Circus assimilis)*

The Spotted Harrier has hitherto not been reported in the forested corner of the South-west of the State, the nearest known records being from Moora, Goomalling, Kellerberrin, Bruce Rock and Lake Grace. A. J. North *(Nests and Eggs of Birds . . . Australia and Tasmania,* vol. 3, 1911, p. 177) recorded it from King George's Sound, on the basis of George Masters' collecting, but the latter operated as far east as the Pallinup River and may have obtained his specimen to the east of the forested zone.

On May 17, about 3 miles south-west of Coolup railway station, A. H. Robinson and I were surprised to flush a Spotted Harrier from the ground. The locality was an expanse of open shrubby flat, surrounded by marri and jarrah timber. For an instant the grey of the upper parts of the bird suggested that it was a White-faced Heron. The characters of the bird were clearly seen, including the rufous under parts as the bird rose. Subsequently Mr. Robinson saw the species on a number of occasions.

On July 28 a specimen was shot at Bridgetown by Major H. M. Whittell This was the only other record from the forested area, apart from the Coolup observations. At Bolgart, near the edge of the South-west forested area, I saw one bird on April 13, 1953.

In a motor run during September 11-13 from Perth to Geraldton, Mullewa, Morawa, Carnamah and back to Perth, J. H. Calaby recorded single individuals of the Spotted Harrier at the following localities: 5 miles south of Moora; 1 mile north of Watheroo; 5 miles east of Geraldton; Gutha; 15 miles north of Carnamah; 18 miles south of Carnamah, and 19 miles south of Carnamah. During my travel through the North-west in October-November 1951 I met with the Spotted Harrier as follows: October 27, Kyaline Pool, the Hooley Station (1 bird). November 2, near Kandarrie Station (2); Minilya River (1). November 3, Hamelin Pool turn-off on the Carnarvon road (1); 13 miles south of this point (1).

It is difficult to state whence came the birds which had penetrated into the South-west. There may have been a reinforcement

of the more southern population from the Kimberleys or, perhaps, the arrival of the Blaek Kites in such unpreeedented numbers had had a disturbing effect on other hawks. Apparently no undue increase in the strength of the Spotted Harrier was noted during 1952 in the North-west.

BLACK-SHOULDERED KITE *(Elanus notatus).*

The following reports were received:—

NORTH-WEST and MIDLANDS:

Ashburton distriet: I saw one bird on Kandarrie Station on November 1, 1951.

Carnarvon: V. N. Serventy saw one bird on July 13.

Geraldton: J. H. Calaby saw one on September 11.

Dongara district: Between Dongara and Mingenew on November 4, 1951, I counted 4 birds. J. H. Calaby saw one at Dongara on September 11.

Gutha: Miss Laural Ross reported one bird on September 17.

Morawa: S. R. White stated, under date August 23, 1952: "The Black-shouldered Kite appeared here about 12 months ago in numbers, and has been with us ever since."

Carnamah: J. H. Calaby saw one bird on October 27.

Coorow: John Read reported one bird in September.

Maya: Specimen received by the W.A. Museum on June 24 from Mrs. H. Elliott.

Walebing: J. H. Calaby saw one on Septemher 10; on October 27 he saw 2.

Bindoon: On September 10 J. H. Calaby saw one bird 6 miles north; on October 27 he saw one 3 miles north and another 5 miles north.

Chittering: The W.A. Museum received a specimen from K. Spice on June 30.

Perth district: The W.A. Museum received a specimen from Miss J. Stevens, Guildford, on October 4, 1951 and 2 from Mr. Chapman, Bentley Park, on Mareh 6, 1952. At the beginning of April a bird was seen at Pelican Point by J. C. and P. E. Serventy. I saw 2 at Herdsman's Lake on April 26. P. E. Serventy saw one at Pelican Point on May 3. The W.A. Museum received 2 specimens on June 16 from Mrs. Bannister, of Cannington. J. H. Calaby saw one bird 9 miles east of Perth on September 10, and one 3 miles east of Midland Junction on September 23. The W.A. Museum received a specimen from H. Vaughan, of Nedlands, on October 22 and on December 31 one from Miss E. Williams, of Tuart Hill. J. H. Calaby saw 2 hovering over the Causeway on March 3, 1953, and a single bird at Bassendean on April 6. I saw one 3 miles north of Midland Junction on April 13, and one at the Causeway on April 17.

Armadale: The W.A. Museum received a specimen from J. K. McCormack on June 4, and one from Mrs. A. Pucker on August 18.

Coolup district: A. H. Robinson saw two single birds during 1952, one 2½ miles west of Coolup on June 17, and the other at Pinjarra earlier in the year.

Dardanup: R. Hewison reported 2 on April 24. D. N. Calderwood saw one on April 2, 1953.

Boyup Brook: The W.A. Museum received a specimen from M. G. Collard on February 26.

Bridgetown: H. M. Whittell forwarded a specimen shot locally on May 13. He saw one himself on May 8, commenting: "I have not seen one for several years."

Nornalup: Frank Thompson, of Tinglewood, saw one in March, which remained for some time: it was the first he had ever seen of the species.

WHEATBELT AND GREAT SOUTHERN:

Pithara-Kalannie: D. Reid saw one bird between these two centres during the period November 28, 1951 to January 16, 1952.

Beacon: D. N. Calderwood reported that the bird was present in considerable numbers at Beacon, Cleary and Bencubbin during the period February 27 to July 4. Flocks numbering up to 11 individuals were encountered. On one day he recorded no fewer than 23 birds on a 28-miles trip between Beacon and

Bencubbin. The species was also noted at Koorda, Mollerin, Wialki and Marindo.

Goomalling: The W.A. Museum received a specimen from H. E. White on March 29.

Bolgart: Mrs. R. Erickson reported the species as being about on June 5.

Kellerberrin district: Philip S. Stone reported some about 17 miles S.S.E. of Kellerberrin in January; still being seen at Kwolyin on May 15.

Burracoppin: Mrs. M. B. Mills reported that several birds had been seen in December, 1951, and which were new to the district. They were still present on October 24.

Mt. Barker: The W.A. Museum received a specimen from W. Gammon on February 14.

Remarks: The Black-shouldered Kite has an Australia-wide distribution but is not usually found further inland than about 300 miles from the coast. In the southern parts of Western Australia it appears only periodically (H. M. Whittell, *The Emu*, vol. 43, 1944, p. 294). A cycle of abundance began about 1935, accelerated since 1943 and waned by 1948. The bird became numerous again during 1952 but, from the observations of S. R. White at Morawa, the irruption must have begun some time in 1951. As detailed in the previous notes I saw only one Black-shouldered Kite in the North-west proper in October-November 1951 but came across 4 birds between Dongara and Mingenew. Of the 14 specimens received by the W.A. Museum from various correspondents during the current irruption, the first came in on October 4, 1951.

In 1952 the species spread right through the forested country of the South-west, as it did after 1943. Whence the newcomers came it is not possible to state with any certainty; the birds could be part of the surplus population of the Kimberley Division. The irrupting birds breed in the south and remain several seasons but so far they have been unable to establish permanent foothold.

LETTER-WINGED KITE *(Elanus scriptus).*

The following reports were received:—

Adele Island (about 25 miles N.W. of Yampi): H. Tarlton Phillipps on July 10 saw 10 birds circling around the light tower (field sketch of under wing pattern forwarded).

Abydos Station (Pilbara district): One bird seen by E. T. Bailey, of the C.S.I.R.O., in October, 1951, and again by the same observer on the coast between Roebourne and Onslow in the same month. I saw one on The Hooley Station on October 28, 1951 and another at Roebourne on October 31. A specimen was collected at Coolawanyah Station by R. Parsons on October 31 and forwarded to Perth for identification (W.A. Nat., vol. 3, p. 94).

Dongara: A. Douglas, of the W.A. Museum, saw one bird on July 23.

Gutha: Laural Ross, secretary of the Gutha Gould League Club, reported a bird seen in December, 1951 and which stayed for several weeks; a bird was seen on several occasions in 1952 (identification confirmed by teacher).

Pintharuka: A. Yewers reported (through S. R. White) that, about May, 7 birds appeared together at his property (description of under wing pattern provided).

Moora: C. L. E. Orton observed one bird at "Petworth Park" on April 7, 1953.

Pithara: J. C. O'Dea noted 5 birds on July 3 at East Pithara ("at first glance in the bright sunlight I thought they were sea gulls, until I noticed the broad black band, about one-third of the wing width, running the full length of the under wing. They settled quite near me, about 40 yards, and fortunately I had a telescope with me and by means of this had a very close view").

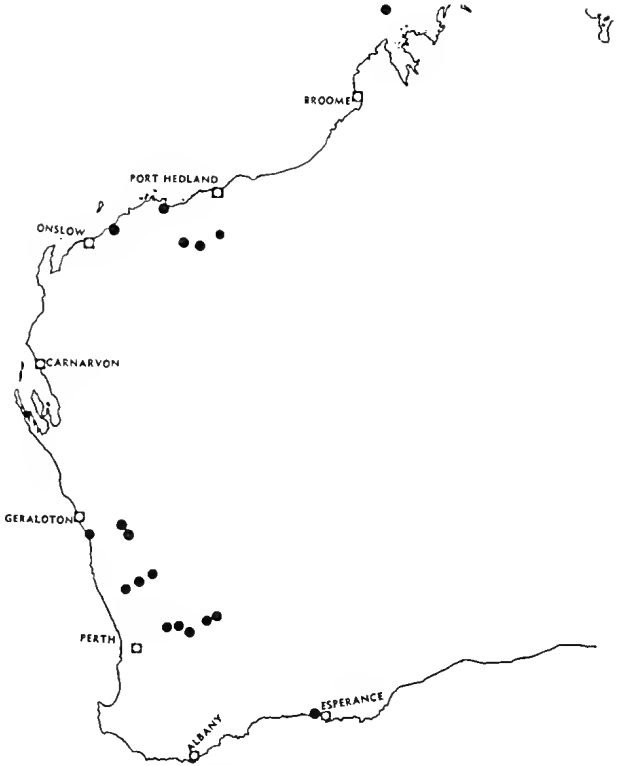


Fig. 1.—Invasion records of the Letter-winged Kite. The dots mark localities where the species had been identified in the period 1951-53.

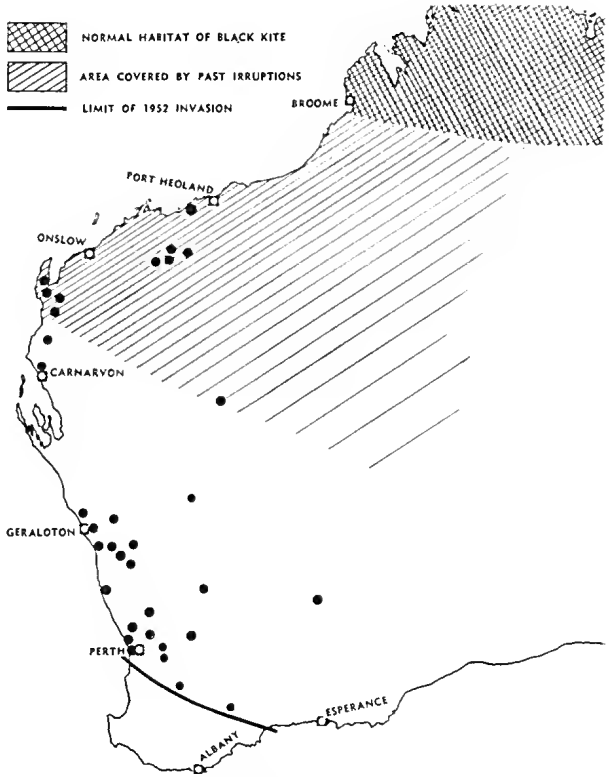


Fig. 2.—Invasion records of the Black Kite. The dots mark localities where the species had been identified in the period 1952-53.

Miling: Mrs. H. L. Jarvie forwarded a specimen to the W.A. Museum on December 14, 1951.

Booraan: Mrs. M. B. Mills reported 2 birds seen on February 3, 1953.

Burracoppin: Mrs. M. B. Mills reported that her brother saw 3 birds in September and which were new to the locality ("different from Black-shouldered Kite by having black markings underneath wings following the full length of the wings"; field sketch supplied).

Kellerberrin district: Philip S. Stone saw 5 birds about 17 miles S.S.E. of Kellerberrin in January; he saw one at Kwolyin on May 10.

Cunderdin: J. K. Griffin, of the Government School, forwarded to the W.A. Museum a specimen shot 3 miles north of Cunderdin on February 11, 1953 by B. Price.

Esperance: Mrs. J. S. Murray, of Dalyup Park, reported on December 5 that a group of 8 of these hawks appeared in the district recently; they stayed only two days. ("There was no mistaking the very distinct 'M' under the wings").

Remarks: Prior to the current irruption there was only one reliable record of the species' occurrence in Western Australia (nesting at Exmouth Gulf, 1943, I. C. Carnaby, *W.A. Nat.*, vol. 3, p. 95). The normal breeding range of the Letter-winged Kite lies within the inner arid regions of central and eastern Australia, and most of the published records are based on observations in the Lake Eyre and Cooper's Creek country. Broadly speaking the Letter-winged and Black-shouldered Kites may be said to have mutually exclusive distributions, but at times of irruption both may be found together.

The Letter-winged Kite is not an inhabitant of the Kimberley Division and so the drought in that area could not have directly influenced its movements. The remarkable invasions into Western Australia, representing a radial dispersal from its normal habitat, covered almost the whole of the State, reaching the sea coast and some of the neighbouring islands (Fig. 1). Though the numbers involved in this exodus were not as great as in the case of the Black Kite the movements of the Letter-winged Kite were probably more extraordinary in their unprecedented scope.

BLACK KITE *(Milvus migrans).*

The following reports were received:—

Broome: Inspector M. Goodlad, of the Fisheries Department, reported as follows on March 13, 1953: "The Black Kite frequents the Broome area and, being a scavenger, there was little attraction for the birds prior to the opening of the meat works some years back. The birds then, I am informed, commenced to flock to Broome in large numbers. The 2 years I was in Broome prior to 1952 I sometimes observed as many as 50 birds soaring overhead. Around April, 1952 the birds arrived in larger numbers. A rough estimate would be around 400-500 birds soaring in the air in one flock. These birds stayed on until I left Broome for Perth on December 5. I did not see any on my return to Broome on February 8, 1953. On March 11, however, I observed about 20 soaring overhead. At least the majority of the birds migrated from Broome during the early part of the wet season in January."

Mundabullangana Station (via Port Hedland): Mrs. R. F. Lukis reported on May 8: "We have Kite Hawks here now by the dozen but they do not normally live here. This is the second time they have visited this district since I've lived in the north (i.e. about 18 years). They seem to come here when things are tough in the Kimberleys."

Coolawanyah Station (via Roebourne): R. Parsons reported on June 11: "The Fork-tailed Kites have been with us about 4 months. It is not uncom-

mon to see at the homestead, as I did today, about 40 birds wheeling in the sky overhead." On September 11 he reported that the Kites were still present. They had declined in number when I visited Coolawanyah between November 27 and December 12, but some birds were about the Homestead every day, the greatest number being 13. A few were seen at The Hooley Station (fewer than 5 present at the homestead). R. Knowles informed me that there had been many at Hamersley Station but had now left.

Wittenoom Gorge: R. Nielsen reported on April 28: "They have appeared in hundreds at Wittenoom Gorge. I am a fairly recent arrival here but residents of several years say they have not previously been seen in numbers. They are not very numerous in the town of Wittenoom but seem to converge at the mine workings and settlement, 7 miles inside the gorge. Their constant wheeling in hundreds and their audacity become quite irritating and some of the men have been debating whether to make a drive on them."

Ashburton district: The following news item appeared in "The West Australian" of April 10: "Owing to the very dry conditions being experienced in the Kimberleys many thousands of kite-hawks, known as Kimberley hawks, were seen recently throughout the Ashburton district. These birds migrate in huge numbers when drought conditions begin in the Kimberleys and were last seen in the Ashburton in 1942."

Exmouth Gulf Station: V. N. Serventy saw 20 Kites on July 21.

Bullara Station: V. N. Serventy saw about 12 Kites on July 20.

Point Cloates: V. N. Serventy visited the district in July but there were no Kites present. G. C. Chittleborough, of the C.S.I.R.O., saw none whilst he was at the whaling station between August 6 and October 2.

Winning Pool: V. N. Serventy saw 50 Kites on July 19.

Mia Mia Station: V. N. Serventy saw about 50 Kites on July 19.

Minilya Station: The manager informed V. N. Serventy on July 17 that there were probably 2,000 Kites on the property. The birds first arrived in February.

Carnarvon: G. C. Chittleborough stated: "The bird was not noticed at Carnarvon during the 1951 whaling season (July-October), but large numbers (over 100 on some days) were seen on the beach and around the whaling station while I was there from June 1 to July 14, 1952. They were feeding on scraps from the factory. My daily notes on the species have been mislaid, but there was a tendency for the numbers to fall in early July. Passing through Carnarvon on August 4 I saw few Kites, but the whaling station, where the numbers were previously much higher, was not visited." V. N. Serventy reported on July 7: "Hundreds of birds are present, probably over a thousand. Usually in flocks but individuals can be seen throughout the area. Often 50-100 spiralling on rising air currents. Mixed flocks of Silver Gulls, Little (?) Crows and Kites near the Whaling Station." On November 27 I saw about 20 Kites at the aerodrome.

Bryah Station (near Peak Hill): W. Page reported that Kites were fairly numerous from about April to the middle of May; they arrived and departed suddenly. The last occasion on which they were seen locally was in 1942.

Mt. Magnet: C. Drew reported on May 5: "These birds, or birds very much like them, have been hovering over the town here for the last week. There were 5 here this morning."

MIDLANDS and SWAN COASTAL PLAIN:

Northampton: V. N. Serventy saw 20 birds on June 27.

Mullewa: S. R. White stated: "On August 22 I went up to Northampton for a run and on the way back I stopped the car about 10 miles out of Mullewa on the Geraldton side to admire a great gathering of Fork-tailed Kites soaring about on what was apparently a wind current. There must have been about 50 birds. This is the only gathering of its kind I have ever seen in W.A., but they were common enough in North Queensland."

Dongara-Geraldton area: The following observations were made by N. E. Stewart, of the C.S.I.R.O., during a visit from July 9 to 14: "On July 10 the first Kite was seen 200 yards from the Three Springs hotel. From there northwards they were seen frequently hovering over paddocks, stockyards, or even a dry tree, usually in small flocks of 6 or 7. At Northampton on July 11 P. Stuart, a farmer 6 miles east of Northampton on the Bowes River, complain-

ed of the damage the Kites were doing by killing myxomatosis-infected rabbits. There were 500 Kites on his property during the height of the disease and it was the first time local residents had noticed the birds in the Northampton area. Kites had been plentiful on the property of Mr. Williams, 3 miles N.W. of Northampton. On July 13 C. Cuiloton, manager of Glengarry Station 16 miles east of Geraldton, estimated 4,000-5,000 Kites feeding on sick rabbits close by the homestead when the myxomatosis epidemic was at its height in March."

Mingenew: D. Reid saw one bird soaring over the town on June 16; on June 19 two birds were seen flying low over the railway station. J. H. Calaby saw 20 birds on October 27.

Morawa: S. R. White reported a pair sweeping Morawa for some weeks during February and March.

Arrino: W. J. Turner saw about a dozen in mid-April eating at the carcase of a dead sheep; 4 were seen on April 26 and 2 on April 27. Forked tails noted.

Carnamah: A. N. Tapscott reported that on May 24 a Kite was seen on his property and 3 and 5 individuals were noted elsewhere. J. H. Calaby saw one bird 3 miles N.N.E. on October 27.

Cockleshell Gully (via Dandaragan): Mrs. Stella Gregson reported 6 Kites flying around on April 25, but 12 or more were seen by F. Gregson on another part of the property (forked tails clearly seen). The birds had never been seen in the district before.

Gingin: John Harper, of "Koorlan," reported on May 30: "The Kites arrived here very shortly after being reported at Lancelin. We have seen one concentration of 27 at the one time and I saw a flock which I consider was larger. There always seems to be an odd one about with an occasional bigger concentration. They have been here about a month."

Yanchep: Miss C. Drummond, of Claremont, saw between 30 and 40 Kites whilst returning to Perth from Yanchep on April 27. They were flying approximately 50 feet above the ground over an area, within the Yanchep reserve, which had recently been burnt by fire.

Perth: V. N. Serventy reported: "On April 14 Peter Slater informed me that the previous weekend (April 8-9) he had seen 3 Black Kites flying over Mongers Lake. They kept together while he watched them. I passed the information on to Don Reid on April 18 and on April 19 he saw 9 birds (forked tail noted). With my brother I paid three visits to the area (on April 21, April 22 and April 26), but it was not until the last date that one solitary Kite was seen at the western edge of the lake. A broadcast request for information brought a report that one bird had been seen at Mosmans on the Swan River on May 2. On May 4 I also saw one in the same area." B. J. Hutchinson, of Claremont, saw 12 Kites over Dalkeith on April 29, his attention being drawn to them by the cries of pursuing Magpies. The Kites came from a northerly direction and split up over Dalkeith, 4 headed east and 8 continued on south. The forked tails were clearly seen.

WHEATBELT and EAST:.

Beacon: D. N. Calderwood reported that between March 3 and July 17 a single bird was observed on 18 separate occasions—there were at least two individuals.

Wyening: Father Michael, of the Wyening Mission, saw one Kite between Wyening and Callngiri on May 4.

Toodyay: A specimen was shot on June 29 and forwarded to the W.A. Museum by J. R. Masters.

Kellerberrin: Phillip S. Stone observed one on May 3 (forked tail noted); it was being chased by two Whistling Eagles.

Kalgoorlie: Peter C. Slater saw a bird on May 28 (forked tail noted). The Kite was also identified by Arthur G. Matthews.

Coonana (110 miles E. of Kalgoorlie): P. Slater, of the Government School, reported that in September 7 Kites were seen by local residents, the birds feeding on the rubbish tips. Mr. Slater saw one bird on February 20, 1953, and about 32 on March 26, after several inches of rain. (This information arrived too late for incorporation in Fig. 2.)

Gwambygine: D. Reid saw 3 birds on June 7, flying low over cleared ground.

Gilgering: On July 1 I saw a Black Kite in a paddock ¾ mile south of Gilgering railway siding.

Narrogin: J. H. Calaby saw one bird on September 17.

Pingrup: I saw one bird 30 miles east of Pingrup on February 4, 1953.

Remarks: The regular haunts of the Black Kite in Western Australia are in the Kimberley Division. Occasionally irruptions south occur, into the North-west pastoral country, where some individuals may stay to nest. Hitherto the extreme southerly limit of such visitations has been a line from about Point Cloates trending south-easterly to the Peak Hill district. Carter *(The Emu,* vol. 3, 1903, p. 33) refers to an invasion in the Point Cloates area in 1891 and another in 1900. On his visit to Millstream Station on the Fortescue River in 1922 F. Lawson Whitlock saw one Black Kite inland of Roebourne on July 23. Along the Canning Stock Route O. H. Lipfert collected specimens at Well 8 (near Weld Spring and 154 miles north of Wiluna) in May 1930 and others in the vicinity of Godfrey's Tank between January and March 1931.

K. G. Buller travelled along the Canning Stock Route in 1942 and 1943. On the southern section, from Wiluna to Well 22 (McKay Ranges) he met with the Black Kite only once, at Well 16 (270 miles north of Wiluna), where a small flock was seen on September 16, 1942. On the northern section, from Hall's Creek south to Well 23 he met with the species constantly as far south as Well 31 (473 miles north of Wiluna) between June and November 1943, most being seen in the vicinity of Godfrey's Tank in July. The birds appeared to follow droving parties south from Moola Bulla Station in the Kimberleys.

In 1942 there appears to have been a considerable visitation generally in the North-west. In May 1944, C. F. H. Jenkins recorded the species at Marble Bar (*Emu,* vol. 47, p. 38).

The 1952 irruption, as detailed in the preceding paragraphs, was on an unprecedented scale. The Kites swarmed throughout the North-west, the earliest being reported in Febuary and before the middle of April had reached Perth. This invasion of the south was the first on record since the State was founded in 1829, and advanced the known southern limit of the species' occurrence by some 500 miles (Fig. 2).

Breeding in the south in 1952 has not come under the notice of any observer; this has, however, been reported in South Australia.

It will be interesting to study the future of this invasion. In the past no permanent settlement has followed the irruptions, which may no doubt be partly due to the competition of other raptores when normal environmental conditions returned. The big invasion of 1952 has, however, brought the Black Kite in strength to areas where human settlement has considerably changed the pre-existing ecological set-up. Not only have habitats been drastically altered but the relative abundance of some of the resident raptores has been affected. Whether the Black Kite may, in the new situation, find its survival prospects better than heretofore is an interesting speculation.

FROM FIELD AND STUDY

Wire in Nest of Senegal Dove.—A nest of the Senegal Dove (*Streptopelia senegalensis*) collected from its site in a vine at Nedlands, was examined. Like some nests of this species it was considerably thicker than the usual frail structure and was identical with some nests of the Indian Turtledove (*S. chinensis*). The interesting feature was the material used in the construction of the nest. This proved to be 238 pieces of twigs and rootlets and 46 pieces of wire, including two hair pins, still bent. Several pieces of the wire measured more than 12 inches in length. This is the first occasion on which I have found wire used in the composition of a nest of this species.

—D. N. CALDERWOOD, Beacon.

Occurrence of *Hyperoedesipus plumosus*.—The announcement by W. H. Butler (*W.A. Naturalist*, vol. 3, p. 172) of the recent rediscovery of the rare isopod crustacean, *Hyperoedesipus plumosus*, at Moondyne Spring in the Darling Range, warrants mention of another unpublished record of the species.

When collecting at Darlington on September 13, 1923, I examined a stream which I referred to in my field notes as Brook "A". In it I collected two specimens of *Hyperoedesipus plumosus*. One is still in the W.A. Museum collections (no. 10663), the other one was sent to the late Professor C. Chilton, at the Canterbury Museum, Christchurch, New Zealand. This find was in the same season as the discovery of the type material by Nicholls and Milner at Lesmurdie Falls. It was made known to Professor Nicholls at the time but he omitted to mention it in his various writings on the species.

—L. GLAUERT, W.A. Museum, Perth.

Probable Breeding of Red-capped Robin at Wooroloo.—On October 26, 1952, following up a detailed report received from Mrs. W. Banks, of Wooroloo, I located a cock Red-capped Robin (*Petroeca goodenovii*) in a pear orchard on the Banks's property 1½ miles north of the townsite.

A week later I again located a cock robin in the same tree as before. A quite young bird with striated breast was also noted and after some time the cock bird was observed to feed it on several occasions. Twice a bird which may have been a hen approached the juvenile, but this bird was not clearly seen. The cock was heard uttering the reeling (? territorial) call.

On November 16 accompanied by my son, Lindsay, I again heard and saw a cock bird in the pear trees. A juvenile appeared and for some time apparently fed in the adult manner, but eventually it called and was evidently fed by the cock, though the feeding seemed to be followed by a show of aggression. No hen was seen. We concluded that the juvenile was almost independent. Finally a second cock Red-capped Robin appeared, and what may have been a territorial brush took place.

A pair of Scarlet Robins *(Petroeca multicolor)* were moving about just to the west of the Red-capped Robins' territory. The Red-capped Robins appeared to resent their presence, but made no active attempt to drive them off.

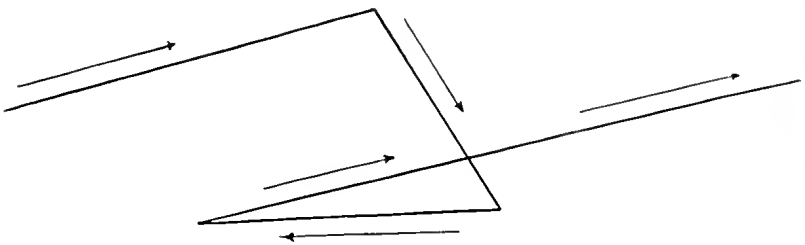
Later attempts to locate the Red-capped Robins failed.

Although the evidence obtained is incomplete in a number of respects, it appears reasonably certain that the birds were: (a) holding territory, and (b) feeding young.

—ERIC H. SEDGWICK, Wooroloo.

Re-discovery of the Ground Parrot at the Bow River.—It is a pleasure to be able to record the continued existence in this State of the Ground Parrot *(Pezoporus wallicus)* which in the *Handbook of the Birds of Western Australia* (Serventy and Whittell) is referred to as possibly extinct locally. The last recorded individuals were seen by Mr. F. Lawson Whitlock in wet blackboy flats around Denmark in 1913.

I spent the Christmas holidays in a walking tour around the south coast. On December 17 at 8 a.m. I started to walk from Bow River to Peaceful Bay, 6 miles away, the general locality being about 25 miles west of Denmark. In the first mile or two the country was typical coastal jarrah formation with sheoak and an odd karri. Then the track came to flat semi-swamp black sand with paperbarks, etc. The road had been graded leaving wide spoon drains on either side, black and damp. Ahead of me I suddenly noticed a small parrot walking in the drain. It was larger than a Budgerygah and smaller than a Twenty-eight, with a dark grey or brownish back and the side of the breast seemed to be a light green and yellow. It had a long tail. When I moved the bird flew on a little way, the wing form being like that of a dotterel with a yellow band showing the full length of the wing. As I walked along I again disturbed the bird and it, with three others, flew off about 20 feet above the ground in a very erratic manner, thus:



I did not see the birds again. I had not noticed the other three birds until they rose. I mentioned the incident to Mr. H. T. Saw, an old Bow River resident, and he was surprised "that I should have seen these birds again." Mr. Saw was living in the district when Sydney William Jackson collected here in 1912-13 and saw one individual of the Ground Parrot *(W.A. Nat.,* vol. 3, 1952, p. 75).

—J. W. BAGGS, Victoria Park.

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TWO NEW SPECIES OF THE GENUS *CYRTOPELTIS* (HEMIPTERA) ASSOCIATED WITH SUNDEWS IN WESTERN AUSTRALIA

By W. E. CHINA, M.A., Se.D., F.R.E.S., British Museum (Nat. Hist.), London.

Thanks to the courtesy of Mr. L. Glauert, Curator of the Western Australian Museum, Perth, I have been permitted to study a series of capsid bugs found living on various species of sundew *(Drosera)* at Lesmurdie and Kalamunda. The interesting point about these bugs is that they appear to be able to move freely over the sticky glandular hairs of the leaves without being entangled. Following this paper is a contribution by Mr. M. C. Russell, in which he gives an account of the habits of these bugs.

In 1951 China and Carvalho *(Ann. Mag. Nat. Hist.* (12), 4, p. 221) described a new ant-like Dicyphinid, *Setocornis bybliphilus,* living on the insectivorous plant *Byblis gigantea* at Cannington near Perth in Western Australia, which had been submitted to me by Prof. Francis E. Lloyd in 1937. In his book, "The Carnivorous Plants", 1942, Prof. Lloyd not only records and figures (Plate 13, fig. 1) the capsid on *Byblis* but refers to others on *Drosera* which are presumably the species dealt with in the present paper. He writes:

> "While small insects in general are caught by the mucilage secreted by the stalked glands, this capsid moves about freely without difficulty, just as do similar insects, also capsids, over the surface of Drosera leaves in Australia. . . . How the insect manages this is a bit puzzling. It is noticeable that it prefers to walk on the upper leaf surface where there are very few and usually smaller glands but when alarmed it progresses rapidly in any direction without becoming entangled with the mucilage. Full sized insects (adults) are perhaps too big to be readily encumbered, but the smaller ones move about just as freely. Their food consists of freshly captured flies, the juices of which they suck."

The bugs associated with *Drosera* comprise two new species belonging to the cosmopolitan and composite genus *Cyrtopeltis* Fieber, but these two species are not restricted to any one species

of sundew and each one occurs on both *Drosera pallida* and *Drosera erythrorrhiza*. Mr. Russell in his notes records specimens from *Drosera stolonifera* but none from this plant was sent to London and it is probable that both species of bug occur on this plant also.

The taxonomy of the genus *Cyrtopeltis* is so complicated that China and Carvalho in 1952 (*Ann. Mag. Nat. Hist.* (12), 5, p. 158) decided to lump a number of closely related genera, from all parts of the world, together as subgenera of *Cyrtopeltis*, the so-called *Cyrtopeltis* complex, rather than to keep them as distinct genera. The present two sundew species appear to belong to the typical subgenus of this complex which is Palaearctic in distribution. Before going on to describe them a few words about the habits of the tribe Dicyphini will help to show how the ability to live on an insectivorous plant has been acquired.

Although probably the majority of capsid bugs (Miridae) are phytophagous many are known to be carnivorous and probably some are both phytophagous and carnivorous. In the evolution of these bugs it would be easy to pass from piercing plant tissue and sucking sap to piercing smaller insects such as Aphides and sucking the plant sap ingested by the prey. In this way the primitive phytophagous bugs must have become carnivorous. Some capsid bugs feed on the eggs of both insects and mites and in this way are highly beneficial to the farmer. It is probable that the Dicyphini* are all carnivorous. It is certain that they mostly live on plants with densely pubescent leaves or with leaves bearing sticky glandular hairs. In Europe *Dicyphus epilobii* lives on the hairy willow-herb (*Epilobium hirsutum*) and *D. pallidicornis* on the hairy underside of the leaves of the fox-glove (*Digitalis*). The widely distributed *Cyrtopeltis (Engytatus) tenuis* is associated with tobacco plants while in Brazil, *Cyrtopeltis (Tupiocoris) nigroculatus* lives on *Cassia cathartica* which possesses glandular, sticky hairs. The final step from life on a hairy leaf where delicate insects are only occasionally entangled in the hairs to life on a really sticky insectivorous plant such as *Drosera* or *Byblis* has been taken by *Setocoris bybliphilus* and the new species described below. As mentioned by both Lloyd and Russell the insects avoid the glandular hairs as much as possible. If accidentally caught they may lose a leg as suggested by Russell or they may rapidly pull themselves free and clean themselves of the mucilage. They appear to be aware of the danger of becoming entangled. All the species are covered with strong bristles which may be an adaptation to prevent the body of the insects from coming into contact with the secretion. The bristles would be readily broken off if they became stuck to the plant.

The eggs will be almost certainly inserted into the tissue of the underside of the leaves and stems and it is possible that the tiny newly hatched nymphs may be vegetarian in the early stages.

* Formerly regarded by Van Duzee and Knight as a subfamily of the Miridae but more recently regarded by Carvalho (1952, *Ann. Acad. Brasileira de Ciencias*, 24, p. 33) as a tribe of the subfamily Phylinae.

Genus *CYRTOPELTIS* Fieber

Fieber, 1860, Europ. Hemipt., pp. 76 and 323. China and Carvalho, 1952, Ann. Mag. Nat. Hist. (12), 5, p. 159.

The two species described below run down in the key published by China and Carvalho *(loc. cit.)* to the typical subgenus *Cyrtopeltis* which has hitherto comprised only the two Palaearctic species *C. geniculatus* Fieber (Europe) and *C. canariensis* Lindberg (Canary Islands). They agree with this subgenus in the structure of the pygophor in which the ventral margin is without a distinct process and in which the dorsal margin possesses a distinct prominence a little to the left of the middle line. In the Palaearctic species this dorsal projection is in the form of a spatulate rounded lobe but in the Australian species the process is acuminate or only slightly rounded apically. These species also agree with the typical subgenus in the large anal segment and in the type of theca which embraces only one side of the penis and projects outwards through the mouth of the pygophor so that its apex is visible without dissection. In addition the Australian species agree with the Palaearctic species in the absence of the short vein which normally divides the membranal cell into two, so that there is only one membranal cell as in the Bryocorinae. In spite of some hesitation, therefore, in view of the discontinuous distribution and the very strong bristle armature, the Australian species have been referred to the typical subgenus. All the members of the subgeneric complex can be distinguished by the structure of the pygophor and if a new subgenus was erected for the Western Australian species it could not be so differentiated.

Cyrtopeltis (Cyrtopeltis) droserae sp. nov.

Colour, ♂ and ♀. Bright yellow with white, black and red markings and a regular arrangement of black bristles.

Head above black with four white, elongated, triangular spots margined with bright red, one in middle of apex of vertex, one in middle of base of head and one on each side at inner margin of eye, extending backwards towards base of head; underside of head white with a red stripe down each side of the middle line; rostrum with basal segment white with base red on each side, second and third segments dirty yellow, apical segment black; clypeus and labrum black; antenna with basal segment shining black, second segment white at base and pale yellow in middle with a broad black annulation immediately above basal white region and another at the apex; third and fourth segments fulvous with base and apex of third infuscate. Pronotum bright yellow, apical collar and basal area black, the latter split into two apically by an elongate rhomboidal white spot. Mesonotum greenish yellow. Scutellum with centre and apex shining white and with the basal angles broadly black. Hemielytra bright yellow with the basal margin and apex of clavus infuscate and a broad black band across base of cuneus; an elongate spot in middle and at inner angle of corium and apex of corium, broadly, above black base of cuneus and apical half of cuneus all shining white; membrane pale

infuscate with end of cell vein at cuneus, black. Underside bright yellow with a black spot at base of each coxa covering apex of acetabula, some infuscate markings on the front and middle coxae —including spots at base of paired coxal bristles; left hand genital clasper and a spot on opposite side of pygophor black. Mesosternum in female, brown, ovipositor sheath white. Hairs of abdomen fine and pallid, slightly infuscate towards apex of abdomen. Femora white densely mottled with bright red and with large black round spots at base of black bristles and a sub-apical red annulation spotted with black; tibiae white with evenly spaced black rings and some red markings; tarsi fulvous with the apical segment

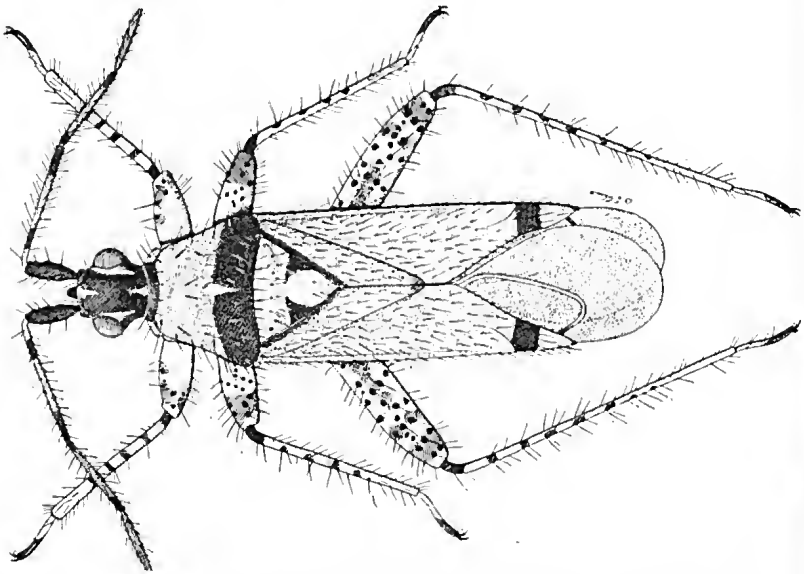


Fig. 1.—*Cyrtopeltis (Cyrtopeltis) droserae* sp. nov. A predatory species associated with Sundew *(Drosera* spp.) and living on the insects caught by the Sundew leaves.

and claws black. The colour is somewhat variable especially as regards the red markings which in some specimens are much more extensive. The yellow colour is sometimes replaced by white in such specimens and there is infuscation of the anterior lobe of the pronotum except for a middle white line, while the black of the head may be largely replaced by red.

Structure, ♂ Head from above, excluding clypeus, slightly shorter than width including eyes (38:44); distance between eyes more than twice width of an eye seen from above (22: 10); a pair of bristles widely spaced between antennal tubercles, another pair close together on each side of head near anterior margin of eye and a row of six bristles across base of head (neck) just below posterior margins of eyes; first antennal segment rather swollen and nodular at bases of the rather short, stout bristles, without fine hairs, remaining segments with dense fine hairs as well as long bristles except basal third of second; relative length of seg-

ments:—30: 66: 50: 35; rostrum extending a little beyond apiees of middle eoxae, armed with short bristles, relative length of segments 30: 30: 30: 15; elypeus and labium with short bristles. Pronotum about one and a half times as wide aeross the humeral angles as long in middle (78: 50); anterior eollar six times wider than deep (30: 5); anterior lobe slightly more eonvex than posterior lobe with a shallow depression between the two lobes; humeral angles broadly rounded; eollar with six bristles and posterior margin of pronotum with a regular row of 16 bristles; lateral margins and posterior lobe with bristles. Mesonotum with the oblique earina from eaeh basal angle well defined, with six or seven bristles. Seutellum strongly eonvex with 3 pairs of bristles in middle and others at sides. Hemielytra extending just beyond apex of abdomen, the veins obsolete; membrane with only one basal eell; surfaee regularly eovered with long semi-ereet bristles. Legs relatively long, eovered with stout bristles. Abdomen with fairly dense pale deeumbent pubeseenee.

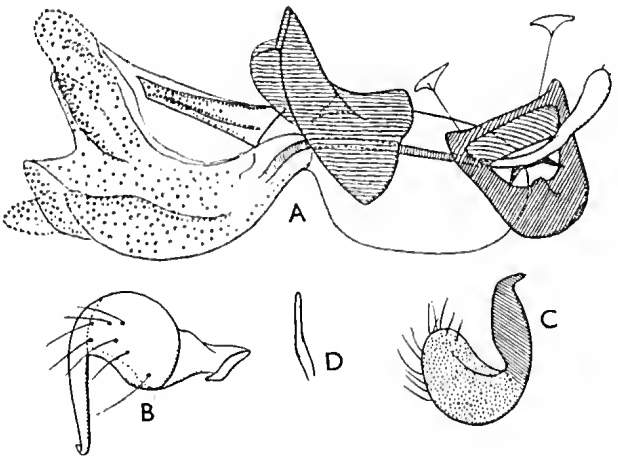


Fig. 2.—*Cyrtopeltis (Cyrtopeltis) droserae* sp. nov. ♂ genitalia. A—aedeagus showing tubereulate vesiea, selerotised theea and basal plates. B—terminal view of left-hand elasper (upside down). C—right-hand view of same. D—right-hand elasper.

Male genitalia figured. Base of left elasper very broad, its apieal half blade-like with tip bent. Aedeagus with vesiea separated into five tubereulate lobes. Pygophor with dorsal proeess short and rounded at apex.

Total length: ♂ 3.8 mm., ♀ 3.7 mm. Width aeross humeral angles; ♂ 1.2 mm., ♀ 1.1 mm. Female slightly smaller than male measuring to tip of membrane but in females the hemielytra are shorter and in fresh speeimens barely reaeh the apex of the abdomen.

Habitat: Western Australia, Lesmurdie, Sept. 1952, 1 male holotype, 5 male paratypes (ineluding one slide), 2 female paratypes and 1 female paratype and 8 nymphs in spirit; all on

Drosera pallida (M. C. Russell Coll.). Lesmurdie, Sept. 1952, 1 female paratype and 1 male paratype, 1 female paratype and 3 nymphs in spirit, on *Drosera erythrorrhiza* (M. C. Russell Coll.). Kalamunda, Sept. 1952, 1 male paratype, on *Drosera pallida* (A. M. Douglas Coll.).

Type and paratypes in British Museum (Nat. Hist.), London; paratypes in Western Australian Museum, Perth.

Cyrtopeltis (Cyrtopeltis) russelli sp. nov.

Colour, ♂ and ♀. Bright yellow with brown, black, red and white markings and a regular arrangement of black bristles.

Head above white with a red, tinted fuscous, V-shaped mark in middle, the arms of the V extending to bases of antennae: a broad red stripe behind each eye extending from eye to extreme base of head; antenniferous tubercles black; extreme base of head yellow with a fuscous spot at base of V-mark; underside of head white without markings; rostrum white with apex black and commissure and labrum infuscate especially at base; clypeus white,

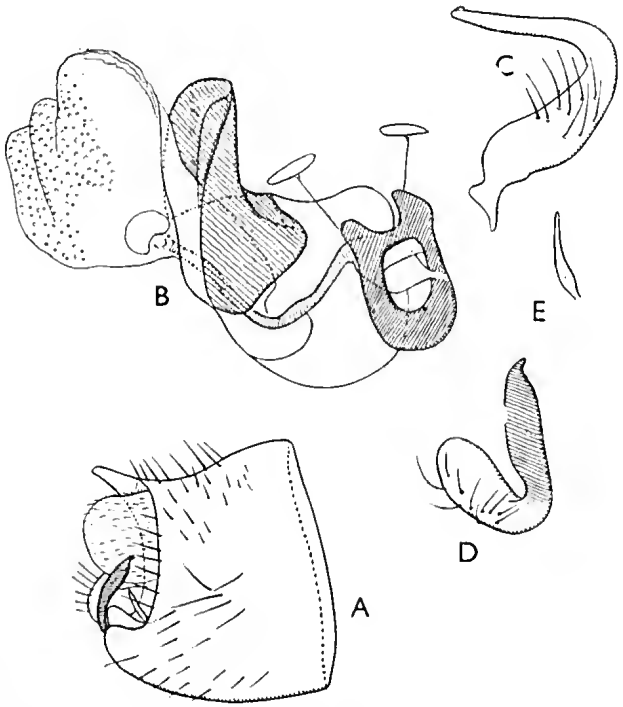


Fig. 3.—*Cyrtopeltis (Cyrtopeltis) russelli* sp. nov. ♂ genitalia.

A—right-hand view of pygophor (9th. abdominal segment) showing dorsal process, large anal segment, right-hand view of left clasper and right clasper. B—aedeagus, showing tubereulate vesica, selerotised theca and basal plates. C—terminal view of left-hand clasper. D—right-hand view of same. E—right-hand clasper.

with a red band down middle; antennae with basal segment white with base and apex infuscate and some red mottling on the white middle area, the black bristles with small black spots at bases; second segment fulvous with a glabrous white ring at base followed by a narrower ring of dark red, bristles with black spots at bases; second and third segments dark fulvous, the third with minute white base. Pronotum bright yellow with the apical margin of the collar, narrowly, a spot at each side anteriorily, behind eye, the posterior margin rather broadly and a small obscure mark on each side near lateral margin and slightly anterior to middle transverse impression all dark brown (fuscous). Mesonotum pale yellow at sides but somewhat infuscate in middle. Scutellum bright yellow with basal angles broadly infuscate. Hemielytron bright yellow with inner margin of clavus along scutellum broadly, apex of clavus minutely, a large transverse, crescent-shaped, spot on each side of corium, slightly below level of apex of clavus, all fuscous (brown); base of cuneus with a black transverse band; apical third of cuneus white; membrane infuscate with dark brown cell vein. Underside bright yellow with a black spot at base of each coxa covering apex of acetabula, an irregular brown spot at middle of each of front and middle coxae and another on anterior margin of basal third of hind coxa; left hand genital clasper pale yellow at base with apex reddish brown. Female with a large brown spot on each side of the mesosternum and a smaller transverse one in middle of posterior margin of propleuron. Hairs of abdomen fine and pallid. Femora white mottled with bright red with small black spots at base of black bristles, and without the subapical red annulation of *C. droserae;* tibiae white with base and apex and five intermediate narrow annulations bright red, the black bristles arising from small blackish spots; tarsi infuscate with apical segment and claws black.

The colour is quite variable. In some specimens (females) the claval suture is infuscate and the brown coloration extends basally on to the clavus and apically on to the corium. In others the red colour is replaced by yellow or is entirely absent in which case the fuscous tinting of the red marks remain.

Structure, ♂ and ♀. Head from above, excluding clypeus, about as long as wide including eyes (36: 37); distance between the eyes more than twice width of an eye seen from above (20: 9); a pair of bristles between antennal tubercles, another pair, one on each side of head, towards apical fourth of eye and a row of six bristles across base of head (neck) just below posterior of eyes; first antennal segment less thickened than in *C. droserae* and without the nodular swelling at base of bristles, without fine hairs but the remaining segments with dense fine hairs as well as bristles; relative lengths of segments:—27: 70: 68: 44; clypeus and labium with short bristles. Pronotum about one and a half times as wide across humeral angles as long in the middle (70; 47); anterior collar nearly seven times wider than deep (27; 4); anterior lobe less convex than in *C. droserae;* anterior angles broadly rounded; collar with a row of six bristles and posterior margin

of pronotum with a regular row of 16 bristles (sometimes broken off); lateral margins and posterior lobe with bristles. Mesonotum with a distinct oblique carina from each basal angle to scutellum, also with six or seven bristles. Scutellum strongly convex, with a few bristles in middle and others at the sides. Hemielytra extending just beyond apex of abdomen the veins obsolete; membrane with only one basal cell; surface regularly covered with long semi-erect bristles. Legs relatively long covered with stout bristles and a few pale hairs. Abdomen with a fairly dense pale decumbent pubescence.

Male genitalia figured. Base of left clasper much narrower than in *C. droserae* but its apex similarly bladed with the tip bent at a more acute angle. Aedeagus with vesica showing three tuberculate lobes. Pygophor with dorsal process much longer and more acute (Fig. 3a) than in *C. droserae*.

Total length: ♂ 3.3 mm., ♀ 4.1-4.6 mm. Width across humeral angles: ♂ 1.0 mm., ♀1.2 mm.

Habitat: Western Australia, Lesmurdie, Sept. 1952, type male, paratype male, 3 paratype females and 2 nymphs on *Drosera pallida;* 2 females (in spirit) on *Drosera pallida* (M. C. Russell Coll.). Kalamunda, Sept. 1952, 4 paratype females on *Drosera erythrorrhiza,* 2 paratype males and 2 paratype females on *Drosera pallida* (A. M. Douglas Coll.).

Type and paratypes in British Museum (Nat. Hist.), London, paratypes in Western Australian Museum, Perth.

These two species appear to be very variable but usually *C. russelli* can be readily distinguished from *C. droserae* by the narrow, posterior marginal, brown band on pronotum, the brown crescent-shaped mark in middle corium, the more slender first antennal segment with black markings reduced to base and apex, the V-mark on pale head, the left genital clasper in male with base narrow and pallid in colour and the longer more pointed process on dorsal margin of mouth of pygophor.

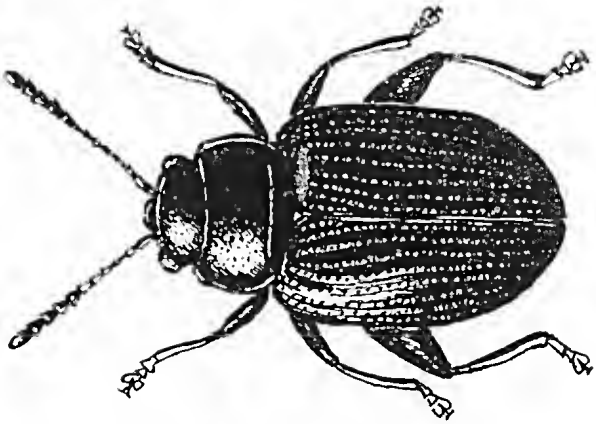
A NEW SPECIES OF *EPITRIX* (COLEOPTERA HALTICINAE) FROM WESTERN AUSTRALIA

By G. E. BRYANT, Commonwealth Institute of Entomology, London.

Epitrix australis sp. nov.

Oblong-ovate, black, the basal segments of the antennae and tibiae fulvous, the prothorax feebly and not closely punctured, the elytra irregularly punctate-striate, underside with very fine short pubescence. Length, 3 mm.

♂ and ♀ head shining black impunctate, a feeble transverse impression between the eyes, the mandibles fulvous, antennae extending nearly to the middle of the elytra, the six basal segments tinged with fulvous, the five apical fuscous and more pubescent, the first segment the longest, and more dilated, the five



Epilrix australis sp. nov.

apieal segments more dilated. Prothorax shining blaek, about twiee as broad as long, very finely and not elosely punetured, the sides slightly rounded and margined, the anterior angles blunt, a transverse impression in front of the hasal margin. Seutellum very small. Elytra blaek slightly broader than the base of the prothorax, widest ahout the middle, thenee rounded to the apex, irregularly punetate-striate. Legs with the femora blaekish and all the tibiae and tarsi fulvous, elothed with very fine short pubeseenee. Underside with the ventral segments of the abdomen tinged with fuseous, and pubeseent.

♂ with the anterior tarsi more dilated.

W. Australia, Lesmurdie. 5 speeimens eolleeted by M. C. Russell and forwarded by L. Glauert, on *Drosera pallida*. Holotype and 4 paratypes.

This speeies is allied to *E. picea* Waterh. from W. Australia, King George's Sound, collected by C. Darwin, whieh was originally deseribed as *Haltica,* and transferred by Weise in 1923 to *Epitrix*. It differs in being twiee the size and ehiefly in the shape of the prothorax whieh is not so eontraeted in front.

NOTES ON INSECTS ASSOCIATED WITH SUNDEWS *(DROSERA)* AT LESMURDIE

By M. C. RUSSELL, Como.

As a supplement to the foregoing papers by Dr. China and Mr. Bryant I append the following notes from my field observations on speeimens diseussed by them, together with a brief note on the Seorpion Fly, *Harpabittacus australis*. At the time the field notes were written I was not aware that the Mirid bugs were of two different speeies so that the following notes must be read as applieable to both, at least until further work reveals speeifie differences in their habits.

Cyrtopeltis spp. from *Drosera pallida* Lindl.

Drosera pallida, one of the climbing species, appears above ground in the latter part of May and grows steadily to a height of about three feet before the terminal inflorescence develops. The lower, older, leaves tend to dry and redden with age and the bugs are found near the younger green parts at the top of the plant, sometimes on the inflorescence.

In September 1952, when the bugs were first collected, the plants were well developed and, from the fact that the insects by this time were all fairly mature (mostly fully winged), I conclude that development is parallel with the growth of the plant. To find young nymphs one would probably have to examine the younger plants earlier in the season.

These insects commonly take up a position on the under surface of the goblet-shaped leaf but movement over the sticky tentacles of the upper surface is also quite common and seems to be but little restricted by the mucilage which is such an effective trap for other insects. One winged adult was seen under the lens to place a tarsus directly on a gland and later move away without difficulty. Another specimen, *D. erythrorrhiza,* became thoroughly covered with mucilage as I attempted to collect it from the upper surface of a leaf and it was soon after seen cleaning its antennae, one at a time, and its proboscis, by systematic use of its first pair of legs in the manner adopted by a housefly.

The usual capacity of these insects for free (or almost free) movement over the sticky surface of the leaves may be due in part to the fact that rarely are more than two legs placed at one time on glands. The others are placed on the non-sticky surface of the leaf or on the pedicels of the tentacles. With four legs thus free the other two can be readily extricated from the mucilage in which they were placed.

Although they seem never to be permanently trapped like other insects by the leaves of the Sundew it is nevertheless true that their movements are often impeded by the secretion, particularly when they are alarmed.

Two adults have been seen, each with a leg missing. Perhaps some emergency mechanism provides for the forfeiture of a leg irretrievably stuck.

In no case was feeding definitely observed although on one occasion the proboscis of an adult winged form seemed to be inserted in the tissues of a sepal on *D. pallida.* This observation is subject to confirmation, particularly in view of Dr. China's authoritative assertion that the adult, at least, is carnivorous. It should be remarked that the proboscis is exceedingly fine and difficult to observe with certainty in the field.

Several of the insects were seen to take flight from *D. pallida* and their flight seemed relatively strong for the very short distance they could be observed against a background of bush.

Cyrtopeltis spp. from *Drosera erythrorrhiza* Lindl.

The insects live in a somewhat different setting on *D. erythrorrhiza* which possesses a flat rosette of leaves, green with red glands when young but rapidly reddening throughout as the plant matures (except in shaded localities). The axis of each leaf is nearly free of tentacles and covered only with short downy hair. The young bugs may sometimes be seen in this region, protected by an archway of tentacles, but it is more usual to find them at the central axis of the rosette where the leaf petioles converge to form a depression. Here, too, adults are found, but they may also be seen running freely over the tops of the tentacles which cover most of the upper surface of the leaf.

The bulb of *D. erythrorrhiza* gives a strongly positive reaction for starch which must be built up by translocation of sugars from the leaves. The centre of the rosette might therefore be expected to be a rich feeding site for sap-feeding insects. For predatory insects it would be a tactical site like the centre of a spider's web.

D. erythrorrhiza appeared above ground at Lesmurdie in late July 1952, and died off in October except for a few plants in shaded localities which carried over to the next month. During September many of these plants were found harbouring both nymphs and adults, suggesting the existence of at least two broods, one much later than the other. On October 12 two winged adults were found in the gravel near one of the few remaining fresh plants and as late as November 9 one specimen was seen beside a wilting plant. A particular interest attached to this specimen in that its wings were by no means fully developed despite the lateness of the season.

Cyrtopeltis spp. from *Drosera stolonifera* Endl.

Unfortunately specimens collected from this Sundew were not forwarded for identification but Dr. China has suggested (p. 1) that both species probably occur on this plant as on the two foregoing.

D. stolonifera is an erect, sometimes branched, plant found at Lesmurdie from the end of July to the end of October. It is characterised by vivid green and red colouring until late in its season when the above-ground parts begin to brown. Only small flightless nymphs were at first seen on this species (early September) but on October 4 winged forms were found.

Cyrtopeltis nymphs are usually found near the base of *D. stolonifera* from which position they drop to the ground for shelter among stones when disturbed. Both nymphs and adults move over and among small stones with agility but they are easily caught by picking up the stones to which they cling.

The red markings of these insects match the red glands of *D. stolonifera* and the general red coloration of the more exposed specimens of *D. erythrorrhiza* in a striking manner.

Epitrix australis Bryant.

While collecting *Cyrtopeltis* from *Drosera pallida* in September, 1952, it was noticed that the white petals of the plant were being eaten by the black beetle, *Epitrix australis,* described in this number by Mr. Bryant. Although damage to *D. pallida* was extensive adjacent specimens of *D. macrantha* were untouched.

Scorpion Fly, *Harpabittacus australis.*

This predator has been seen more than once feeding on small insects caught on the leaves of *D. pallida.* Its long, unusually prehensile legs enable it to grasp the stem and petioles of the Sundew, keeping its body clear of the leaf. This is obviously a casual commensalism not without danger to *Harpabittacus.*

BIRD-LIFE AT CARON

By E. H. SEDGWICK, Government School, Wooroloo.

THE ENVIRONMENT

Caron is situated in the wheat-belt, 168 miles to the north and slightly east of Perth.

During 1947 13 in. of rain were recorded, but 1948 was much drier. Exact figures for 1948 are not available because the official rain gauge was damaged by a storm early in the year. Winters were mild but periods of extreme heat were experienced in summer.

Native vegetation is of the scrub-plain type and comprises dense thickets of *Acacia* and *Casuarina* in parts. Other areas which have apparently been cleared and then allowed to revert, or which have, perhaps, been swept by fire, are less densely vegetated and produce a great variety of shrubs including *Acacia, Casuarina, Hakea, Grevillea, Verticordia* and *Calothamnus.* There are occasional mallee *(Eucalyptus* sp.) thickets and scattered groups of *Callitris.*

The Railway Dam catchment area was situated in a "breakaway," the floor of which supported York Gum *(Euc. foecunda)* and more nearly approached forest than any other locality in the study area. This catchment area was rich in bird-life and a favoured resort for breeding birds. Pools sometimes remained in the catchment channels for some time after rain, but the dam itself, being entirely roofed, had little influence upon bird-life.

Most arable land was at some distance from the siding, and comparatively little of the land adjacent to the townsite was under cultivation.

SCOPE OF OBSERVATIONS

Observations were made largely within two miles of the townsite during the years 1947 and 1948.

NOTES ON INDIVIDUAL SPECIES

At the time of leaving Caron I did not propose publishing an annotated bird-list for the area, hence a number of observations

have been published as short notes in the *Western Australian Naturalist*. There appears, however, to be a case for a comprehensive list, so the following notes on the 76 species observed are placed on record:—

Emu *(Dromaius novae-hollandiae)*.—I saw only a few Emus myself, but reliable reports indicate that the birds are numerous, at times, in many parts of the district and that they cause damage in wheat crops. This damage is caused by the progress of flocks through the crops and is not a direct consequence of feeding. During both 1947 and 1948, breeding appears to have been well advanced by the end of July.

Mallee Fowl *(Leipoa ocellata)*.—Reports show that the species has decreased rapidly before the spread of settlement and that birds are now only sparingly encountered. I located a probable old nest and found the plumage of a bird killed, probably by a fox, but did not encounter birds in the flesh. I have reason to believe that eggs were taken from a nest in October, 1947.

Little Quail *(Turnix velox)*.—I once flushed a small covey of quail from low heathland. These were not positively identified. An egg picked up in the same locality in July 1947 was identified by Dr. D. L. Serventy as that of a Little Quail. The egg was empty when found, the contents having apparently been lost through a small opening in one side.

Common Bronzewing *(Phaps chalcoptera)*.—Cultivation reverting to heathland appears more favourable to this species than the less open types of heathland. Birds were encountered at all seasons.

Crested Pigeon *(Oeyphaps lophotes)*.—These pigeons could usually be observed on the townsite, water, no doubt, being an attraction, though the rail yard provided grain in plenty. These birds display frequently, both on the ground and perched in trees. In a number of displays noted, there were differences in detail but the displaying bird invariably indulged in a bowing with wings drooped and tail spread and usually uttered a "woo-woo-woo" call meanwhile. In two instances the bird bowing appeared larger than the bird to which it was displaying. In one instance the bird approached crouched slightly with head, body and tail parallel to the ground and crest only semi-erect. I am not clear as to the function of these displays. They were noted mainly in spring and summer. My only breeding evidence is a reported nesting in July 1948.

Banded Plover *(Zonifer tricolor)*.—This species occurs mainly on the cultivated areas. Though these are not confiding birds, I found individuals sheltering under the school and under the house during the excessively hot weather of early February 1947. Shade temperature at the time of one of these observations was 116° F.

Australian Dotterel *(Peltohyas australis)*.—See *W.A. Nat.*, vol. 2, p. 195 for record of breeding.

White-headed Stilt *(Himantopus leucocephalus)*.—Though I received frequent reports of this species on the Bunjil lakes, I encountered it only once—a single bird at a temporary pool near Perenjori.

Australian Bustard *(Eupodotis australis)*.—These birds were reported occasionally. Evidence of their presence in the district was provided by feathers, some from a supposed fox-kill and one found singly in a paddock.

White-faced Heron *(Notophoyx novae-hollandiae)*.—I saw only one individual, but this is not surprising as I had little opportunity of observing suitable habitats. A bird seen by my son, Lindsay, at a silt trap above the Railway Dam appears to have been a White-necked Heron *(N. pacifica)*.

Chestnut-breasted Shelduck *(Casarca tadornoides)*.—These birds apparently occurred on the Bunjil lakes: I inspected plumage from a bird shot as game.

Collared Sparrow-hawk *(Accipiter cirrocephalus)*.—An *Accipiter* seen on March 2, 1947 was identified with reasonable certainty as being of this species.

Australian Goshawk *(Accipiter fasciatus)*.—A pair of these birds was seen in York Gum forest on September 5, 1948.

Little Falcon *(Falco longipennis)*.—Individuals were seen on several occasions and a dead bird, shot locally, was brought to me for identification. Length, 13.25 in.; wing, 10.5 in.

Brown Hawk *(Falco berigora)*.—This proved one of the more frequent birds of prey, occasional individuals being noted throughout the year.

Nankeen Kestrel *(Falco cenchroides)*.—Kestrels proved to be the most plentiful of the birds of prey, though they were present only during the late winter and the summer months. Breeding took place during September and October.

Boobook Owl *(Ninox novae-seelandiae)*.—Calls were heard on several occasions.

Red-tailed Black Cockatoo *(Calyptorhynchus banksii)*.—Flocks of up to 60 birds were noted in passage at all seasons.

Pink Cockatoo *(Kakatoe leadbeateri)*.—See *W.A. Nat.*, vol. 2, p. 143 for note regarding status.

Corella *(Kakatoe tenuirostris)*.—I found it impossible to identify with certainty any of the flocks of Corellas which I saw in this district. Of four captive birds, possessed by three different owners and all said to have been captured locally, three were *K. tenuirostris*, but the fourth more nearly resembled *K. sanguinea*.

Galah *(Kakatoe roseicapilla)*.—This is perhaps the most conspicuous bird of the district and the species is one which does actually occur in large numbers, flocks of up to two hundred birds being common. Twice, once in May 1947 and once in June 1948, I saw a large bird of prey, which remained unidentified on each occasion, harried by a flock of perhaps 100 Galahs. Breeding in

the Caron district appears to take place in August, September and October.

Regent Parrot *(Polytelis anthopeplus)*.—I did not record this species until May 15, 1947. Thereafter I saw flocks fairly frequently until August 1947. A few birds were seen in November 1947 but it was not until late March 1948 that the species was again represented in numbers.

Port Lincoln Parrot *(Barnardius zonarius)*.—These birds were plentiful and well distributed. Birds were observed nibbling fruits of York Gum and apparently eating the seeds. Seeds of a Cape Lilac *(Melia azedarach)* proved a great attraction.

Mulga Parrot *(Psephotus varius)*.—This species, like the foregoing, appeared to favour the townsite, water, food scraps, wheat in the rail yard, and the cleared areas, perhaps, proving attractions. Flocks of up to 17 birds were noted. The sex ratio in all parties noted was invariably as evenly balanced as possible, it being assumed that all the duller plumaged birds were hens. See *W.A. Nat.*, vol. 2, p. 144, for account of Mulga Parrot striking at a window.

Tawny Frogmouth *(Podargus strigoides)*.—A nest with two eggs was located on August 2, 1947. This was kept under intermittent observation. Both eggs hatched, but on October 12 there was only one young bird in the nest. A second nest was found partly constructed on August 22, 1948. A bird was sitting on August 29 and again on August 31, but when I next visited the nest on September 6, the nest was on the ground with the remains of one —perhaps two—eggs. The use of green nesting material in this nest has already been recorded *(W.A. Nat.*, vol. 1, p. 152). Both nests were in York Gums. One bird, apparently injured, was noted resting on the ground in open heathland. All other records were made in open forest, or on the townsite where there were some trees.

Owl Nightjar *(Aegotheles cristata)*.—On July 28, 1948, I was given several breast feathers and three primaries of a bird described as "a small but apparently fully-grown owl" which had fallen down a chimney late the previous evening. The feathers were those of an Owlet Nightjar.

Spotted Nightjar *(Eurostopodus guttatus)*.—On August 29, 1948, I thrice flushed a nightjar from a stony ridge in breakaway country. On one occasion in particular, the bird was seen very plainly. Later searches for birds or nest in the same area proved fruitless, though two birds flushed on September 5 from the limits of the area searched might well have been nightjars.

Fork-tailed Swift *(Micropus pacificus)*.—One flock only was noted. This occurrence was reported in some detail in the *W.A. Nat.*, vol. 2, p. 141.

Pallid Cuckoo *(Cuculus pallidus)*.—Present from July 4 until mid-September, 1947 and from July 27 to mid-September, 1948.

Black-eared Cuckoo *(Misocalius osculans)*.—I first noted this species at Caron on August 3, 1947 on the Railway Dam catch-

ment area. I re-visited this area on several occasions and was always able to locate the bird until September 6. However, on September 21 I heard a bird calling near Bunjil Rocks. On August 1, 1948, I heard a cuckoo calling in the old locality at Caron, but could not again locate the bird until August 31, after which it was not seen or heard. The 1947 bird was always seen in a very restricted area—about 2.7 acres—but the 1948 bird on the two occasions that it was encountered seemed restless and unsettled. Redthroats were fairly frequently in the area occupied by these cuckoos.

Horsfield Bronze-Cuckoo *(Chalcites basalis)*.—These cuckoos were present and calling from June 22 until September 1947 and from July 25 until September 1948. However, Brown Thornbills were noted feeding a young cuckoo on November 7, 1948.

Welcome Swallow *(Hirundo neoxena)*.—Present in fluctuating numbers over the railway, about the townsite and at the Railway Dam. Birds were observed entering buildings, as though seeking nesting sites, late in July, building nests during August, feeding young in mid-September and sitting on a second clutch in mid-November.

White-backed Swallow *(Cheramoeca leucosterna)*.—Flocks of up to 15 birds were noted from time to time during all months except December, January, February and March. Attempts at nesting were observed in September 1948.

Tree Martin *(Hylochelidon nigricans)*.—Flocks numbering to between 100 and 200 birds were noted at various times, usually over the townsite. Nest building was observed in late August.

Black and White Fantail *(Rhipidura leucophrys)*.—A few pairs were located. Occupied nests were noted in August (first brood), September and October (second brood) and November (third brood). A nest said to have been blown down from under the roof of the Railway Dam was 3.5 in. in diameter and 4.75 in. outside depth. From its appearance I should say that additions had been made five times, i.e., that the nest had been used six times.

Red-capped Robin *(Petroica goodenovii)*.—Robins were not very frequent. Most of my records were made on the Railway Dam catchment.

Hooded Robin *(Melanodryas cucullata)*.—This species was recorded only once—a cock bird perching on shrubs at the edge of a cultivation reverting to heathland. A bird which may have been a hen was present, but was not definitely identified.

Golden Whistler *(Pachycephala pectoralis)*.—This species proved rather infrequent. It was noted thrice in March 1948—twice in the same locality—and once in July 1948. The presence of *P. inornata* was suspected, but a satisfactory identification was not made.

Rufous Whistler *(Pachycephala rufiventris)*.—This species was more frequent than the foregoing, occurring mainly on the Railway Dam catchment.

Western Shrike-Thrush *(Colluricincla rufiventris).*—Though silent and inconspicuous during the summer and autumn months, i.e. from November until late June, the birds were, at other times, vocal and easily located.

Magpie Lark *(Grallina cyanoleuca).*—Magpie-larks were not frequent but a few birds were present on the townsite and on the Railway Dam catchment. Young birds left a nest, completed during the first week in September, on or about October 18, but I saw young being fed at another nest as early as August 25. This brood was successful and the same nest was used for a second brood which was reported to be on the wing early in November. A third nest was occupied on August 31. The first nest was in the same tree as nests of the Black-and-white Fantail and Black-faced Cuckoo-Shrike and was only 15 yards from the nest of a Frogmouth in an adjacent tree. The second nest was also in the same tree as that of a Black-and-white Fantail.

Crested Bell-bird *(Oreoica gutturalis).*—These proved fairly frequent on heathland. During periods of extreme heat a bird was several times observed sheltering under our house with wings half raised and bill open. I found bell-birds decidedly more vocal after rain than at other times.

Black-faced Cuckoo-Shrike *(Coracina novae-hollandiae).*—The number of Cuckoo-Shrikes present fluctuated. From July to October 1947 the number of birds present was relatively high. There was probably a similar but much less marked increase in 1948. Breeding was observed in September and October. See *W.A. Nat.*, vol. 1, p. 87, for breeding details.

Southern Scrub-Robin *(Drymodes brunneopygia).*—This species was noted on only eight occasions.

White-browed Babbler *(Pomatostomus superciliosus).*—Flocks appeared occasionally on the heathland, often remaining in the same area for some weeks. No nests were observed.

White-fronted Chat *(Epthianura albifrons).*—This species was definitely identified on only four occasions.

Western Warbler *(Gerygone fusca).*—Western Warblers were present from June to September 1947 and from late April until September 1948 on the Railway Dam catchment. On October 3, 1948 I heard the call of this species on heathland.

Weebill *(Smicrornis brevirostris).*—This species is probably closely associated with the eucalypts. It was not, however, confined to the trees on the Railway Dam catchment, but occurred also on the heath where mallees were present. An occupied nest was noted on August 24, 1947.

Brown Thornbill *(Acanthiza pusilla).*—This was one of the most frequent species on heathland. Breeding apparently took place during July and August, but my evidence on this point is rather fragmentary.

Chestnut-tailed Thornbill *(Acanthiza uropygialis).*—These Thornbills occurred both on heath and in forest.

Yellow-tailed Thornbill *(Acanthiza chrysorrhoa)*.—This species was recorded on the Railway Dam eatehment and on the townsite, but it appears to avoid the heathland.

Redthroat *(Pyrrholaemus brunncus)*.—Redthroats were much more frequent at Caron than in any other locality that I have examined.

Shy Ground-Wren *(Hylacola pyrrhopygia)*.—Noted on only three occasions, twice in the same locality.

Striated Field-Wren *(Calamanthus fuliginosus)*.—Probably quite frequent on heathland, but not often observed exeept when calling from a bush top.

Brown Song-Lark *(Cinclorhamphus cruralis)*.—Present in a wheat crop adjaeent to the townsite during August, September and perhaps October 1947.

Blue-and-white Wren *(Malurus cyanotus)*.—Reeorded oeeasionally in a paddock reverting to heathland. I saw a fully plumaged coek only once—in July 1947.

Masked Wood-Swallow *(Artamus personatus)*.—One flock only was observed. See *W.A. Nat.*, vol. 2, p. 141.

Black-faced Wood-Swallow *(Artamus melanops)*.—Individuals, pairs and small flocks were seen from time to time, but the species was not frequent.

Red-tipped Pardalote *(Pardalotus substriatus)*.—I did not record this species until May 17, 1947, on which occasion I encountered several—there were perhaps as many as 20—loosely associated with other small birds. Thereafter I encountered the species oceasionally on the Railway Dam catchment, but not in summer—November to mid-Mareh. If the birds call little during summer they could be easily overlooked, but I am inclined to suspect a migratory movemcnt.

Brown-headed Honeyeater *(Melithreptus brevirostris)*.—Floeks were noted very oecasionally on heathland and somewhat more frequently on the Railway Dam catchment.

Tawny-crowned Honeyeater *(Gliciphila melanops)*.—These birds appeared on heathland early in May 1947 and remained in force until September. A few birds appeared in May 1948. The number increased in July but the birds disappeared early in September. I discovered no nests but the behaviour of certain birds led me to suspeet breeding. See *W.A. Nat.*, vol. 2, pp. 30-33, for information, obtained at Caron, on the food-plants of this and other honeyeaters.

White-fronted Honeyeater *(Gliciphila albifrons)*.—This, like the preceding species appeared in May 1947, but although numbers declined sharply in mid-November, odd birds were recorded until the following September, when numbers again increased. Birds, apparently juvenile, were noted in November and Decemher 1947.

Brown Honeyeater *(Gliciphila indistincta)*.—Brown Honeyeaters were present from June to November 1947 and from May to October 1948.

Singing Honeyeater *(Meliphaga virescens)*.—In October 1947, I noted two birds of this species indulging in some form of display. Unusual calls attracted my attention to a chasing flight. Both birds flew to a bush and perched facing one another. The birds then began to peck at each other's throats. This pecking was a swift, rhythmic alternation continued until each bird had pecked, say, 15 times, when the pursuit flight was resumed. There was no apparent animosity between the birds.

White-eared Honeyeater *(Meliphaga leucotis)*.—A few birds were usually present on the Railway Dam catchment area.

Yellow-fronted Honeyeater *(Meliphaga plumula)*.—This species was definitely identified only once—on August 8, 1948, when one, perhaps two, birds were encountered.

Yellow-throated Miner *(Myzantha flavigula)*.—A flock of miners on the townsite comprised at least 20 birds. There were two flocks on the Railway Dam catchment area conservatively estimated at 20 and 30 birds respectively. I twice found miners nest building in mid-July and in four cases young were on the wing about the end of August. However, I observed another nest in which the young hatched on or about October 25—possibly a second brood.

Red Wattle-bird *(Anthochaera carunculata)*.—On July 12, 1948 while observing one bird perched in a grevillea, a flock of seven other Wattle-birds flew by. One of these joined the bird on the bush which fanned its tail and half raised its wings. The new arrival then threw back its head and uttered the loud, clear "quock" note of the species. This sequence was repeated three times. Some form of greeting ceremony appears possible. A nest located on September 6, 1948 contained two eggs and one located on October 12, 1947 contained two eggs, one of which hatched on or about October 19.

Spiny-cheeked Honeyeater *(Acanthagenys rufogularis)*.—The number of birds in the vicinity fluctuated considerably. None was recorded until September 7, 1947, but on February 22, 1948, I noted 25 of these birds while traversing the Railway Dam catchment area. A fortnight later I made a similar traverse without locating a single bird.

Australian Pipit *(Anthus novae-seelandiae)*.—Pipits were noted from time to time in the Caron railway yard and on cultivations, but only rarely in undeveloped areas.

Zebra Finch *(Taeniopygia castanotis)*.—Small parties of up to 10 birds were noted occasionally.

"Crow" *(Corvus* sp.).—The local "crow" was not identified to my satisfaction. *C. coronoides* is probably the common species. Breeding was observed in August-September 1947.

Grey Currawong *(Strepera versicolor)*.—Currawongs were not frequent but were occasionally noted near the townsite and in both 1947 and 1948 bred on the Railway Dam catchment area during September and October.

Grey Butcher-bird *(Cracticus torquatus)*.—I believe that there were usually several Grey Butcher-birds in the vicinity of Caron, but individuals were not often sighted.

Pied Butcher-bird *(Cracticus nigrogularis)*.—These birds proved quite frequent. A nest with three eggs was located in August 1947 and a nest with young in mid-October. This is probably the more frequent of the two butcher-birds at Caron.

Western Magpie *(Gymnorhina dorsalis)*.—Four or five flocks were located within a mile of the town. Breeding took place in the August-October period.

FROM FIELD AND STUDY

Orchids in Dry Country.—Orchids are usually associated with areas of sure rainfall and their occurrence further inland is always a matter of interest. The following note records two species east of Southern Cross. On July 30, 1952, while travelling on the Great Eastern Highway, we stopped at "The Rock," a vast granite outcrop near the road about 310 miles east of Perth. In the mosses at the base were growing many leaves of *Spiculaea ciliata,* a plant which flowers after the leaves disappear. As we could not be positive of their identity we took sods of the moss with the orchid leaves, and the plants flowered in October. Growing with these orchids and in most of the moss-beds from the base to the summit were innumerable rosettes of a tiny Greenhood *(Pterostylis* sp.), while near the top of the rock in a narrow crevice was found an extensive colony of flowering Donkey Orchids *(Diuris longifolia)* of small stature.

—(Mrs.) RICA ERICKSON, "Fairlea," Bolgart.

Land-birds of Garden Island.—These notes may be useful for comparative purposes, following the note by Ken Buller *(W.A. Nat.,* vol. 2, 1949, p. 48). The observations were made during a visit to the island on March 27, 1953. Rock Dove *(Columba livia)*.—Fairly numerous; the species is now feral on the island. Indian Turtledove *(Streptopelia chinensis)*.—One seen. Senegal Turtledove *(S. senegalensis)*.—Four observed. Kestrel *(Falco cenchroides)*.—One seen. Sacred Kingfisher *(Halcyon sanctus)*.—One seen at the northern end of the island. Welcome Swallow *(Hirundo neoxena)*.—Common. Tree-Martin *(Hylochelidon nigricans)*.—Two seen. Willy Wagtail *(Rhipidura leucophrys)*.—Eight noted. Grey Fantail *(R. fuliginosa)*. Seven seen. Golden Whistler *(Pachycephala pectoralis)*.—Several birds observed, in both male and female plumage; others were calling but were not seen. Western Warbler *(Gerygone fusca)*.—Two seen; these were singing as were three other individuals not located. Western Silvereye *(Zosterops australasiae)*.—The commonest bird on the island. Singing Honeyeater *(Meliphaga virescens)*.—One seen. Australian Pipit *(Anthus novae-seelandiae)*.—One seen. Grey Butcher-bird *(Cracticus torquatus)*.—Two seen, both giving the typical rollicking laugh-like call. Western Magpie *(Gymnorhina dorsalis)*.—A party observed near the post office.

—D. N. CALDERWOOD, Beacon.

Bird-life at Yoting.—Yoting is a siding 14 miles east of Quairading on the York-Bruee Roek railway. The annual rainfall is 14 inches. Most of the land has been eleared for wheatgrowing, and within a mile of the siding fewer than 200 aeres still earry natural vegetation. The latter mainly eomprises strips of York gum with jam. Only a few aeres of the salmon gum-gimlet assoeiation remain. In addition there is a remnant of sandplain vegetation, known here as "tamma," whieh is dominated by a low, bushy *Casuarina.*

Only two arboreal speeies showed any habitat restrietion; the Sittella was confined to salmon gums, and the Brown Honeyeater to tamma.

The following list is that of birds seen within a mile of the siding during my visit (from Deeember 2, 1952 until January 16, 1953). After eaeh resident species eomparative abundanee is indieated by an index (up to 10), whieh is based on rough population eounts. Visiting speeies are marked "V".

Banded Plover (4), Black-fronted Dotterel (V), White-faeed Heron (V), Whistling Eagle (1), Brown Hawk (1), Boobook Owl (seen; numbers unknown), White-tailed Black Cockatoo (V), Galah (V), Port Lineoln Parrot (9), Smoker Parrot (4), Mulga Parrot (3), Bee-eater (1), Pallid Cuckoo (V), Blaek-eared Cuekoo (V), Wcleome Swallow (V), White-baeked Swallow (3), Tree Martin (2), Willy Wagtail (4), Red-eapped Robin (3), Rufous Whistler (2), Western Shrikc-thrush (1), Magpie-Lark (3), Blaekfaeed Cuekoo-shrike (1), White-browed Babbler (5), White-fronted Chat (6), Weebill (1), Chestnut-tailed Thornbill (3), Yellow-tailed Thornbill (10), Black-faced Wood-swallow (8), Black-eapped Sittella (1), Red-tipped Pardalote (1), Brown-headed Honeycater (V), Brown Honeyeater (2), Singing Honeyeater (4), Yellow-throated Minor (1), Red Wattle-bird (1), Pipit (7), Zebra Finch (3), Little Crow (7), Grey Butcher-bird (1), Western Magpie (2).

Around Pantapin Siding, 4 miles east of Yoting, there is eonsiderably more scrub, espeeially of mallee and sandplain. Here were seen Brown Thornbills, Crested Bell-birds, and White-eared Honeyeaters, in addition to most of the species listed for Yoting. The Common Bronzewing and the Kestrel were observed at Pantapin and also at Badjaling (5 miles west of Yoting), but neither, strangely enough, were noted at Yoting.

—GLEN STORR, Floreat Park.

Birds and Intense Heat.—On January 21, 1953, we experieneed an exeeedingly hot day. The shade temperature reeorded was 115° F. A number of instances of how birds reaeted to the eonditions eame under my notiee. Several individuals sheltered under my house, entering through a small opening, 1½ in. high and 2 ft. long, whieh was on the east side and in the shade during the heat of the day. Here Yellow-tailed Thornbills *(Acanthiza chrysorrhoa)* sheltered between 1.30 and 6 p.m. One Red-tipped Diamond-bird *(Pardalotus substriatus)* and one Singing Honeyeater *(Meliphaga virescens)* were also there for a short period. One Yellow-tailed Thornbill flew

into the house, two were sheltering in a shed for a considerable time, and 14 individuals were found in a small deep burrow-like hole in the ground about 8 in. in diameter and 30 in. long. As I walked past the "stand-pipe" where the farmers fill up their water tanks I noticed two Miners *(Myzantha flavigula)* on the ground beneath the slowly dripping pipe; they were trying to keep cool by standing in the mud, often lying right down and dipping their beaks in. A third bird flew in from a nearby mallee to join the birds on the wet patch which was no more than 5 in. in diameter. At 4 p.m. I found a dead Red-tipped Diamond-bird in the Post Office near the door and which must have succumbed since 2 p.m. At 4.40 p.m. a neighbour brought in a dead immature Black-throated Butcher-bird *(Cracticus nigrogularis).*

February 21 was another day of intense heat, the shade temperature rising to 112° F. The following observations on birds were made at the Beacon Hall, a galvanised iron building situated over a half-a-mile from the township, in tall jam scrub. Several birds were sheltering under the hall though there was little clearance between the floor and the ground. A Willy Wagtail *(Rhipidura leucophrys)* was seen to fly from under the building to the shade under jam trees, occasionally calling the harsh metallic "chitti-chitti-chitti" call. A Singing Honeyeater sheltered under the hall. An Australian Pipit *(Anthus novae-seelandiae)* flew out from under the hall at my approach. I went to the tank for a drink and allowed some water to run into an upturned tank lid under the tap. Later six Magpies *(Gymnorhina dorsalis)* were seen drinking from the lid. Chestnut-tailed Thornbills *(Acanthiza uropygialis)* were quite common, both sheltering under the hall and in the nearby jam scrub, "crouching" at the bases of the jams in slight depressions surrounded by a large amount of dead plant debris. Several of these thornbills were noted under a small woodheap near the hall.

—DONALD N. CALDERWOOD, Beacon.

The Distribution of the Bee Genus, *Trigona.*—In 1935 the author demonstrated that the tiny stingless bees in the Tribe Meliponini were confined to a narrow zone within the Tropics of Cancer and Capricorn throughout the world. All of the species are very small indeed, only a mere two or three millimetres in length, but they are nevertheless extremely interesting, because they have a social organization comparable with that of the domestic hive-bee, *Apis:* that is there are queens, drones and "workers", building numerous cells of a primitive chocolate-coloured wax. Honey and pollen, also certain kinds of resin, and kino, are gathered for common use by the colony.

In a broad way one can say that the hive bee, *Apis,* is not "happy" in the equatorial zone. The stingless *Trigona* are equally "unhappy" in the temperate zone. Consequently they are seldom found below 32° South, the latitude of Perth and Broken Hill. There are rare records of one coal-black species, *T. carbonaria* Sm., being taken as far south as Sydney.

The brown species, more or less ornamented with ivory colour, are, however, confined to the far north of Australia and New Guinea. Strangely, the presence of *Trigona* in Western Australia was not established until January 1931, when Dr. H. T. Webster, of Wyndham, presented to the author a number of typical workers of *T. carbonaria angophorae* Ckll. The second record, a very recent one, is from Dr. D. L. Serventy, of Perth. On November 25, 1952, at Quarrina Well, Coolawanyah Station, on the Fortescue River, he collected a number of workers of *T. essingtoni* Ckll., one of the prettiest of the brown group. When forwarding the specimens to me the collector stated they were abundant and asked: what is the southern limit of their range?

Rica Erickson, of Bolgart, has collected a large number of bees from her district, which is 90 miles or so north of Perth, but so far the author has not received any specimens of the social *Trigona*.

T. essingtoni was described from Port Essington, in Arnhem Land, and the Coolawanyah record represents a huge extension of range. Dr. Serventy and Major Whittell (1948) have discussed Baldwin Spencer's terms, Bassian Eyrean, etc., for certain geographical regions in Australia, but they prefer to apply them to faunal groups rather than regions, and this concept has much to commend it. With birds the tropical Torresian fauna ends abruptly at the southern boundary of the Kimberley Division, and comparatively few Torresian elements penetrate south among the predominating Eyrean avifauna. With the native bees it is unknown to what extent the Torresian fauna extends south of the Kimberley. *T. essingtoni* is evidently one such element intruding into the Pilbara country, but future collecting must show how far further south it ranges and how many of its fellow-Torresian insects accompany it. Insect zoogeographical studies still lag far behind those on birds.

—TARLTON RAYMENT, Sandringham, Victoria.

Aggregations of Whistling Eagles and Other Birds.—That the Whistling Eagle *(Haliastur sphenurus)* occasionally congregates into large flocks in the non-breeding season is a familiar enough fact, but few actual field observations of such occurrences have been published.

On March 5, 1953 on a trip to the South-west with Mr. D. L. McIntosh, two large flocks of Whistling Eagles were observed together with large flocks of the White-faced Heron *(Notophoyx novae-hollandiae)*, and other birds, on some drying-off swamps about five miles north of Manjimup.

The first swamp visited still contained a few acres of shallow water and the following birds were seen there:—Whistling Eagle (45 individuals), White-faced Heron (32), Pacific Heron *(N. pacifica)* (15), Little Pied Cormorant *(Phalacrocorax melanoleucos)* (31), Black Cormorants *(P. carbo* and *P. sulcirostris)* (1 of each), Ducks *(Anas gibberifrons* and *A. poecilorhyncha)* (ca. 40, mostly the

former species). When first observed all of the birds were either in the water or perched on trees growing in and around the swamps, and all flew on our approach. The day was sunny with some large cumulus cloud and was apparently ideal for soaring. The ducks, most of the White-faced Herons and a couple of Pacific Herons soon returned to the swamp, but all of the eagles and cormorants and the remainder of the herons soared upwards in a tight spiral until almost out of sight, and stayed aloft for all of the time (about half-an-hour) that we were there.

Another swamp, of about ten acres approximately two miles from this first one, was completely dry and on one part of it was a flock of 35 White-faced Herons and 2 Pacific Herons. On a somewhat smaller recently dried-off swamp close by, was a flock of approximately 30 White-faced Herons. Feeding close to them and within a few feet of an area of dense *Typha* were 8 Swamp-hens *(Porphyrio porphyrio)*.

The last swamp visited was a very large one still containing many acres of shallow water, bordered by wide mud-flats. Here were counted 95 Whistling Eagles, approximately 40 White-faced Herons, a number of ducks (too far away to be identified or counted accurately), and a solitary Pelican *(Pelecanus conspicillatus)*. When first seen about half of the eagles were soaring together in a close group directly above some trees growing in the swamp and on which the rest of the eagles were perched in groups. On our approach all of the perching eagles took to the air together with the Pelican and some of the herons. The eagles all kept to the one soaring group for quite a long time and then gradually descended one by one to their tree perches.

On March 6, over a swamp near Dardanup a soaring column of approximately 80 White-faced Herons and 5 Straw-necked Ibis *(Threskiornis spinicollis)* was observed.

Presumably an abundance of food consequent on the drying-off of the swamps attracted the aquatic birds, and such aggregations always attract Whistling Eagles. A large dead tree-stump near the first swamp was covered with the plucked feathers of at least 6 different Grey Teal although it was not possible to say that these were killed or eaten by Whistling Eagles.

The similarity of these soaring groups of Whistling Eagles to soaring flocks of Black Kites *(Milvus migrans)* was striking, and in fact when seen without optical aid from even a fairly short distance, it was impossible to say which species composed the flocks. Not only is the slow buoyant flight and carriage of the wings similar in both species, but the aerial behaviour of the eagles, consisting of a fair amount of seemingly playful chasing and swooping at one another, was very reminiscent of the Black Kite. The Pelican was chased on a couple of occasions by single eagles, its only reaction being to increase speed.

—J. H. CALABY, Nedlands.

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AMANITAS FROM KING'S PARK, PERTH

By J. GENTILLI, Nedlands.

The genus *Amanita* Persoon ex S. F. Gray includes some of the best known and most conspicuous gilled fungi. It includes some good edible species as well as the only deadly ones, for which no antidote is known. It is characterized by a double veil, i.e. an outer (general) veil which encloses the whole specimen in its very young stage, and an inner (partial) veil which encloses the gills and the lower face of the cap. Remnants of the outer veil may persist as a volva (cup) at the foot of the stem and as warts on the cap. Remnants of the inner veil may be found as a ring around the upper part of the stem. In the older classifications ringless species were placed in a separate genus *Amanitopsis,* but this genus has now been discarded because it was found that both ringed and ringless individuals could occur within the same species. In all Amanitas the spores are white or nearly white in mass, hyaline (translucent) when viewed singly. In many species the spores turn purplish-bluish when stained with an iodine reagent.*

It is quite possible that South-western Australia may have been a secondary centre of evolution and dispersal for the Amanitas. The writer has record of 10 to 15 different forms from South-western Australia, some of them certainly new, and since collecting has mainly been done within a few miles from Perth and during a few years only, there is good reason to believe that more species may be found in the future.

By combining the lists given by Cooke (1892), McAlpine (1895), Cleland (1934), Willis (1950 and *in litt.)* and Aberdeen *(in litt.)* one finds records of 14 species of *Amanita* (including *Amanitopsis)* for South Australia, 13 for Victoria (of which Willis questions 3), 5 for New South Wales, 6 for Queensland, and 3 for Tasmania. These figures mean very little, because the intensity of mycological collecting and the publication of data vary considerably from State to State. However, it is not unreasonable to assume that there is a decrease in the number of species from west to east. This is even more so if one omits from the South Australian and the Victorian lists the typically European red-capped form of *A. muscaria,*

* Melzer's reagent as described by Singer (1949) has been used on our specimens.

found under European trees, and from the South Australian list the Northern Hemisphere's *A. rubescens,* found under chestnut trees on Mount Lofty. These are obviously introduced mycorrhizal species, which do not belong to the original Australian flora, and which might also be found in the remaining States at some future time.

The forms described in this paper have all been collected in King's Park, but some of them are quite widespread, as is shown by the list of localities given in each case.

Taken as a group, these Australian Amanitas present an aspect notably different from that of any corresponding group in the Northern Hemisphere. White is dominant. Caps are very often bare. Stems often lack ring and volva, or only vestigial flakes are present.

All species are infested by hundreds of spore-feeding Collembola (Spring-tails, *Hypogastrura* sp.) to a degree not even remotely approached by other fungi. Cleland (1934) mentions *H. armata* as having been found once on "a small toadstool" in New South Wales, but there is no explicit mention of any Collembola found on Australian Amanitas. Why the spores of Amanitas should appeal so much more than those of any other gilled fungus is not known. These insects may also act as spore-carriers. Fly maggots on the other hand are not common in the caps of Amanitas—if they are found at all, they prefer the fleshy base of the stem—whereas they are very plentiful in the thick caps of several species of *Boletus.*

All species have in common a peculiar smell which gradually develops in the process of decay. Slow drying brings forth a strong smell as of sweet flour, but if moisture is not thoroughly removed a nauseous yet sweetish characteristic smell soon develops, probably due to some peculiar fermentation—a decaying Amanita can be recognized even when unseen, from a few yards away.

No tests for edibility have been made. There is record of a double case of poisoning from *Amanita preissii* (see below), and on the other hand European practice shows that *A. spissa* is edible. However, with a genus like *Amanita* experiments are out of the question.

Amanita preissii Fries

About 1839 Preiss collected an Amanita in South-western Australia, presumably near Perth. The description was given by Fries (1846) and a translation of the Latin original would read as follows:—

> *Agaricus (Amanita) Preissii* Fr., *cap* fleshy, convex-expanded, sticky, edge even; *stem* stuffed, mealy, pallid, rooting with turnip-shaped *volva* narrowed at the tip, with a free persistent edge, *ring* placed high on the stem and pendulous, *gills* adnate, crowded. In sandy places in forests, May. Preiss's Herb., No. 2665.
>
> A very noble species, clearly distinguished from all other known species by the nature of the volva. The size is that of *A. porphyrius* but the species should rather be compared with *A. ovoideus* and *A. solitarius.*

Why Cooke (1892) should translate Fries's *arenosis umbrosis sylvarum* into a rather misleading "sandy soil, woods, etc." and why he should omit Fries's concluding remarks will never be known. Dennis (1953, *in litt.*) states that to the best of his knowledge "no figure exists or was published of *Ag. preissii* Fr. and it is most unlikely that any material of it still exists." This is why the remarks on the characteristic shape of the volva are so important.

Cleland (1943) relates a case of poisoning after the ingestion of fungi which were identified as *Amanita preissii* by the Government Botanist of the time (1921). Since the species is only found in forests, and the two victims lived in Subiaco, it is likely that the fungi were actually collected in King's Park, the nearest forest.

The symptoms of the poisoning were already apparent *half an hour* after the meal, and consisted of watering at the mouth with nausea, and half an hour later colic, collapse, *profuse sweating, cold clammy skin,* and *very slow pulse.* Injections of atropine sulphate and a strong emetic brought both victims back to normal within a few hours. Dr. W. H. Nelson, who treated them, correctly diagnosed the symptoms as those of muscarin poisoning. According to Maublanc (1946) the toxicity of the Amanitas so far studied in the Northern Hemisphere is never due to muscarin, which even in *A. muscaria,* where it was first discovered, occurs in negligible quantity; *A. preissii* may be unique in having such a high muscarin content as to be toxic.

The most common Amanita of King's Park (Fig. 1) could be described in the following terms:—

Cap 2-3 cm. in diameter when at the button stage, almost hemispherical (1a), gradually expanding to 5-8 cm., convexo-expanded (1e) and finally slightly depressed at the centre when adult (1g), slightly viscid in wet weather, usually smooth (1g), but at times with irregular flat warts which are hardly noticeable (1h), especially when the cap is loaded with soil (as is nearly always the case), colour white with a faint biscuit tinge towards the centre, the white always rather cream or ivory like, never chalky. A specimen with a pale salmon-coloured cap probably belongs to this species. The cap is of medium thickness, always definitely fleshy (1g).

Gills adnate to adnexed, moderately crowded, straight at first (1h) then ventricose (1g), white at first, tending to a creamy colour later on.

Stem 8-12 cm. high from its junction with the cap to its lower end. Over a length of 5 to 8 cm. from the top the stem is subcylindrical, tapering slightly upwards, with a diameter of 8 to 18 mm. at the top and 8 to 24 mm. at the bottom of the subcylindrical portion (stem proper). Below this is the bulbous portion, more or less turnip-shaped, nearly always with pointed apex, 3-5 cm. high and with a maximum diameter of 22 to 43 mm., usually located between the upper third and the upper half. The surface of the stem is always more or less mealy. Two specimens had rust-coloured marks on the stem.

Ring superior, membranous (1h) to friable (1g), at times with faint striations left by the gills on its upper face (1i), often evanescent. A specimen had the ring stained burnt sienna, apparently not from the soil, which was much paler.

Volva as a distinct upper edge to the bulbous portion of the stem, initially as a free membranous border which in one specimen extended up to 11 mm. upwards but was already torn (1h). In a few specimens the volva extends only for 2 to 5 mm. upwards (1j), and in many specimens no volva is visible even in the young stage (1a,c). If the stem is sectioned

the place where the volva has been is usually marked by a sharp edge (1d). The volva is always membranous.

Spores (1i) broadly elliptical, at times subovate or subspherical (in a young specimen distinctly cylindrical), some of them obliquely apiculate, hyaline singly, white in mass, turning bluish-grey when stained with an iodine reagent.

Similar specimens have been found in April at Scarborough, in June at Churchman's Brook, Kelmscott, Wungong and Merredin, and in July at Chittering Brook and Bickley.

Drawings of *A. preissii* and its *levis* form (see below) have been submitted to Willis for comparison with Victorian species, and it is confirmed that neither has been found in Victoria so far, and that they differ from the nearest Victorian species, *A. farinacea*.

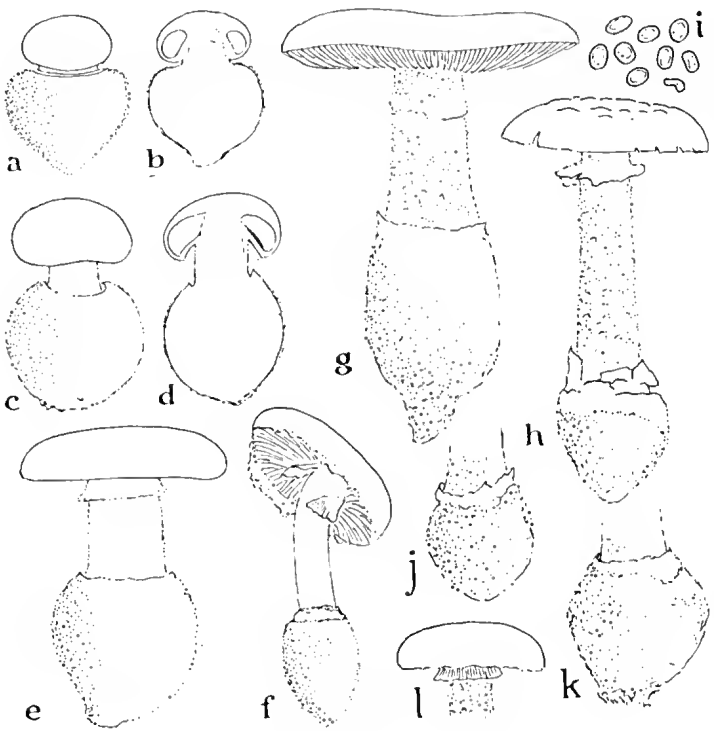

Fig 1.—*Amanita preissii* Fries.

(*a*) Very young specimen and (*b*) section of same. (*c*) Young specimen with cap well raised and distinct volval rim. (*d*) Section of same showing thickness of partial veil below the gills, and volval rim. (*e*) Young specimen with veil. (*f*) Young specimen with torn ring and cortina remnants. (*g*) Adult specimen with evanescent ring. (*h*) Adult specimen with unusually large ring and volval remnants, and warts on cap. (*i*) Spores, x 300. (*j*) and (*k*) Typical rooting portions of stems showing volval remnants. (*l*) Young specimen showing shape of cap, striated ring, and mealiness of stem.

—Illustrations half natural size throughout, excepting those of spores.

Amanita preissii Fr. forma *levis* nov.

A number of specimens found in King's Park (Fig. 2) could be described as follows:—

Cap 2.5 to 7 cm. in diameter, plano-convex to plane (2 e-c) with a slightly depressed centre when fully developed (2 d-g), damp but not quite viscid in wet weather, usually smooth, rarely with hardly noticeable whitish warts, white, at times with a faint biscuit or brownish tinge towards the centre. One specimen was coffee brown. The flesh is relatively thin (2 c,h).

Gills adnexed to free (2h), moderately crowded (2c,f), soon ventricose (2h), white, perhaps tending to a yellowish cream colour when old.

Stem 6 to 11 cm. high from its junction with the cap to its lower end. Over a length of 5 to 9 cm. from the top the stem is cylindrical or very slightly tapering upwards, with a diameter of 4 to 10 mm. near the top and 5 to 10 mm. at the bottom of the stem proper. Below this is the bulbous portion, olive or cherry shaped, usually rounded below, 10 to 25 mm. high

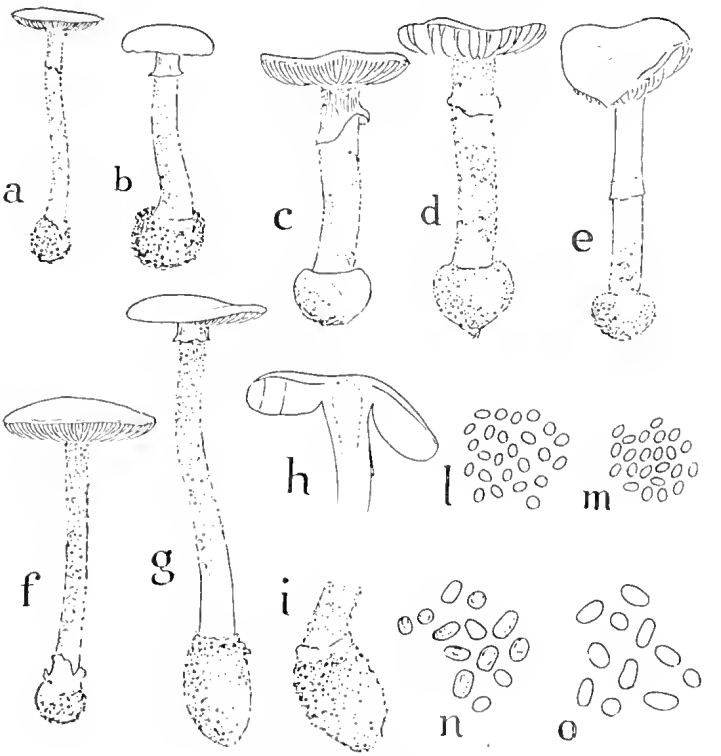

Fig. 2.—*Amanita preissii* Fr. forma *levis*.

(*a*) Small mature specimen with evaneseent ring. (*b*) Young speeimen with well developed ring and evaneseent volva. (*e*), (*d*), (*e*) Specimen probably from same mycelium but of different age —notiee differenees in ring and mealiness of stem. (*f*) Mature speeimen with no ring and exeeptionally well developed volval remnants. (*g*) Mature speeimen, exceptionally tall, with membranous ring and olive-shaped rooting portion. (*h*) Seetion of cap of old speeimen showing normal and rudimentary gills, and junetion of tissues at centre of eap. (*i*) Rooting portion of same, showing distinet volval rim and mealiness of stem. (*l*) and (*m*) Spores, x 150. (*n*) and (o) Spores, x 300.

and with a maximum diameter of 10 to 20 mm., usually located near the middle or the upper third. The surface of the stem is mealy, but the mealiness varies considerably (2e,f).

Ring superior (2b-d), sometimes median (2e), membranous (2b,d) to friable (2a,b), at times with faint striations on the upper face (2b,e) at times evanescent (2f).

Volva, membranous as a distinct upper edge to the bulbous portion of the stem (2g,i), in one specimen as shreds up to 6 mm. high (2f), often lacking except as a sharp edge (2b-e).

Spores elliptical to subspherical (2l-o) some quite spherical, with no noticeable apicule, hyaline singly, white in mass, turning bluish-grey when stained with iodine reagent.

It is possible that this may only be a form of *A. preissii* living in mycorrhiza with *Banksia* or *Casuarina* and differing from the type in the characters printed in black above, whereas the typical *A. preissii* has usually been found not far from *Eucalyptus* trees. On the other hand the undergrowth consists of many shrubs, which could support mycorrhizal growth. The specimens described above have nearly all been found in the vicinity of *Banksia* or *Casuarina* trees, and in some instances there were no *Eucalyptus* trees nearby.

Amanita preissii Fr. forma *ochroterrea* nov.

Two specimens collected at an interval of two weeks in different parts of the Park were outstanding in size (Fig. 3), and with a distinctly earthy-buff cap. The colour was also noticeable on the stem. Most strikingly, the spores of the darker specimen also showed a distinct buff tinge.

Cap 10-11 cm. in diameter, matt, earthy buff in colour, becoming darker with age, in one specimen with rough patches which might be termed depressed angular warts, and were especially noticeable near the centre of the cap (3e).

Gills as in the typical form but earthy buff in colour, becaming dark buff in time.

Stem 16 to 19 cm. high, subcylindrical attenuated (20 to 28 mm.) just above the middle, 23 to 30 mm. thick at both ends of the stem-proper portion (which is 10 to 13 cm. long) and 42 to 55 mm. thick in the upper quarter of the bulbous portion, which is about 7 cm. high and turnip-shaped. Exposed part mealy.

Ring superior, evanescent, just noticeable in one specimen (3c) and absent from the other (3a).

Volva only noticeable as the upper rim of the bulbous portion of the stem.

Spores subcylindrical, very elongate (3b,d), not apiculate, hyaline singly, very pale buff in mass, turning bluish-grey when stained with an iodine reagent.

This species or variety differs from typical *A. preissii* because of its colour, its size, and the shape and colour of the spores, and from *A. ochrophylla* Cke. et Mass. in the more earthy colour of the gills, the coloured spores, the evanescent ring, and the shape of the bulbous portion.

General remarks on the *Amanita preissii* complex

A few specimens show characteristics which are intermediate between those of the forms described above. A specimen has cap and stem proper of *A. preissii* and bulbous portion of *A. preissii*

forma *levis*, except for the size. Another specimen has cap and stem proper of *A. preissii* forma *levis* at least as far as size goes, and bulbous portion of a typical *A. preissii*. It seems reasonable to suggest that all these may be mere forms due to variations in the environment, possibly in the host plant. *A. preissii* forma *ochroterrea* however has spores which are quite distinctive in shape and colour.

Are we dealing with species, varieties, or just forms? What is a valid criterion for the distinction of fungal species? Certainly not the individual peculiarities which so delighted the early taxonomists.

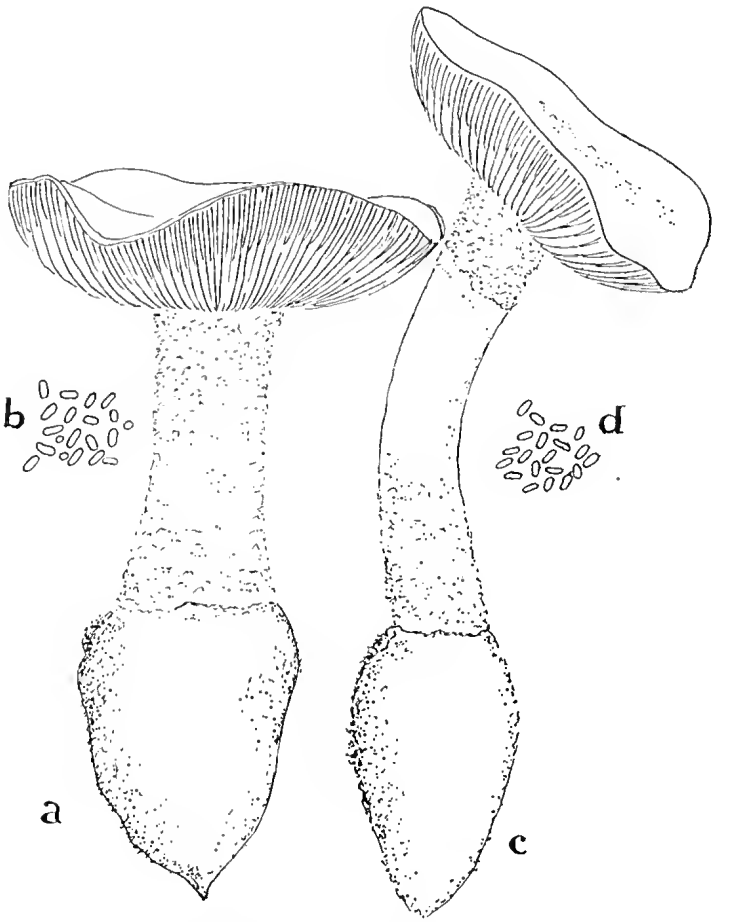

Fig. 3.—*Amanita preissii* Fr. forma *ochroterrea*.

(*a*) Fully grown specimen which was earthy-buff in colour when collected, and grew darker while drying. Notice mealiness of stem, absence of ring, and shape of rooting portion. (*b*) Spores of same, x 150. (*c*) Mature specimen which was tinged with earthy-buff on the cap, showing remnants of evanescent ring, shape of rooting portion of stem, and small warts on cap. (*d*) Spores of same, x 150.

Specimens from King's Park (Fig. 4) are as follows:—

Cap 35 to 65 mm. in diameter, depresso-hemispherical at first (4a), then plano-convex (4e,g) and finally with edge slightly raised (4d), moist but not quite viscid in rainy weather, often smooth (4e) at times with irregular raised warts (4d,f,g) (often hidden by the soil that covers the cap), chalky white, at times with tinges of grey near the centre. The flesh is of medium thickness (4e).

Gills adnexed (4e), free later on, slightly ventricose, crowded (4d), white, tending to pale straw yellow or cream colour later on.

Stem 10 to 17 cm. high from the lower end, cylindro-conical tapering upwards for a length of 5 to 9 cm. from the junction with the cap (stem proper), and tapering downwards for 4 to 8 cm. (rooting portion). The

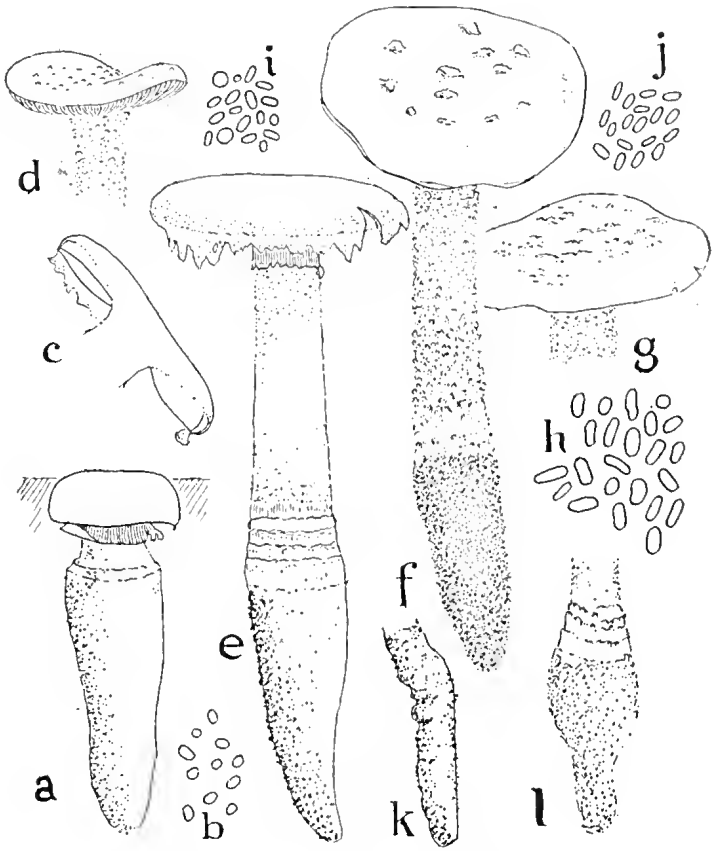

Fig. 4.—*Amanita conico-bulbosa* Clel.

(*a*) Very young specimen with whole ring, and (*b*) partly developed spores. (*c*) Section of mature specimen showing details of torn veil and ring. (*d*) Adult specimen with remnants of veil, striated ring, mealy stem, and volval remnants of ring at the foot of the stem proper. (*f*) Mature specimen with large warts and very mealy fibrillose stem. (*g*) Mature specimen with numerous small warts. (*h*) Spores, x 300. (*i, j*) Spores, x 150. (*k*) and (*l*) Atypical rooting portions of stems.

stem proper varies in diameter from 7 to 13 mm. near the top to 10 to 19 mm. just above the beginning of the rooting portion, which varies in diameter from 10 to 25 mm. at the top and extends downwards, usually tapering off very gradually, in rare cases without tapering off until the rounded end is reached. Usually the lower end is almost pointed. The stem proper is always more or less mealy (4e,f), seldom mealy-scaly.

Ring superior striate (4e), evanescent and often lacking (4d,f,g), very friable even when well developed.

Volva friable, only noticeable as a series of two (4a), three or more (4e,b) **rings or fibres** around the top of the rooting portion. Usually there is **no sharp edge** to mark the transition from the stem proper to the rooting portion (4f), and even the change in diameter may be insignificant (4k). A section shows that the cortical tissues of the rooting portion are encrusted with soil particles in a characteristic way.

Spores subcylindrical to subelliptical (4h,i,j), definitely elongate but odd ones subovate, not apiculate, hyaline singly, white in mass, turning bluish-grey when stained with Iodine reagent.

The description given above agrees with Cleland's (1934) description of the South Australian type, except that according to Cleland there may be a "*biscuity* tint" on the cap, and the spores are given as "*elliptical,* white, 9 to 11.5 x 5.5 to 7 μ." Could Cleland have included specimens of *A. preissii* among his collections of *A. conico-bulbosa?* The shape of the spores, the nature of the volva, the shape of the rooting portion of the stem differentiate these species.

Besides being quite common in King's Park, *A. conico-bulbosa* has been found at Yanchep, Chittering Brook, Mundaring and Kelmscott. There is no record from the Eastern States, and Willis *(in litt.)* states that drawings of this species are unlike any Victorian species.

It is interesting to remark that the closest ally in the Northern Hemisphere is *A. solitaria* Bull., a species which is most variable and which in its extreme degree of wartiness has even been described as a separate species under the name of *A. strobiliformis* Vitt. This resemblance had already been noticed by Fries (1846). Atkinson (1901) gives photographs of 9 specimens of *A. solitaria* collected in North Carolina. These specimens resemble our specimens of *A. conico-bulbosa* very closely, but seem to have tougher veils, if one may judge from the rings and cortinas shown in the photographs.

Bresadola (1927) states that *A. solitaria* has a white cap with greyish centre, and is covered with flat angular grey warts; its edge is beset with white flaky-mealy shreds. The stem has large flaky-mealy scales which soon fall off, leaving a flaky surface. The rooting portion of the stem may be root-like with a distinct edge, or subovate, or globose. Ring and volva are evanescent. The illustration given shows two specimens which, if one ignores the deciduous warts and scales, resemble *A. conico-bulbosa* and *A. preissii* respectively.

On the other hand Maublanc (1946) states that the warts of *A. solitaria* are variable, being at times flat, angular, ashy grey, and at times truncated-pyramidal. The stem when young is covered with mealy scales which fall off. The base is swollen to form an ovoid bulb with some scales or some more or less definite concentric

knobs. The specimens illustrated have very little in common with those shown by Bresadola.

Singer (1949) accepts *A. strobiliformis* but omits *A. solitaria* from his list.

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(To be continued)

SEX RATIO AND VARIATION IN *APUS AUSTRALIENSIS* SPENCER AND HALL

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I. SEX RATIO

In the absence of comprehensive works on Australian natural history local field workers are forced to use overseas texts. Commonly used text-books all mention that the males of *Apus* are rare. Examples of such statements are as follows:—

"Males are rare, reproduction being normally by parthenogenesis" (Borradaille *et al.,* p. 362). "The large majority of individuals of *Lepidurus* and *Apus* are females, males are of comparatively rare occurrence" (Parker & Haswell, vol. 1., p. 395). "One species has been shown to be hermaphrodite; in others males are occasionally found, but reproduction appears to be, as a rule, parthenogenetic" (*ibid,* p. 396).

The statements appear to relate to *Apus caneriformis* the common *Apus* of England and Europe but while these

texts are locally used as standard references the statements above are generally construed to indicate that the local species of *Apus* probably follow the European pattern.

Well-known Australian faunal works tend to support this view. Thus Spencer (1896, p. 228) writing of *Apus australiensis* says: "It is worth noting that every species yielded specimens of both males and females. In the Estheriadae the numbers may, roughly speaking, be said to be about equal and amongst 58 specimens of *Apus*, 6 are males."

He adds (p. 234): "It will be noticed that male specimens are not relatively infrequent, though their number is considerably less than that of the females." On this same page it is mentioned that serial sections of gonads revealed no trace of sperm in the ovaries thereby eliminating the possible existence of hermaphrodism in these specimens.

On a visit to Morawa during the period May 6-13, 1953 *Apus* were found to be abundant in the salt lakes system then flowing strongly as a result of rains brought by a cyclone of northern origin late in March. These rains had been supplemented by further falls in April. The resulting floods filled salt lakes from Austin in the north to Yarra Yarra at Three Springs. The waters had receded from their highest level but were still flowing strongly.

In the shallow water *Apus* were common and judged by the number of copulating pairs males appeared to be frequent. A sample taken by hand at one situation yielded the following:—

	By container.				Total no. of animals	Limits of deviation, for small samples, which agree with equality (from Simpson and Roe, Table 9).	
	♀	%	♂	%		Size of sample	
1.	81	65.3	43	34.7	124	—	— —
2.	12	70.5	5	29.7	17	15	14 : 1
3.	12	60.0	8	40.0	20	20	17 : 3
4.	17	68.0	8	32.0	25	25	20 : 5
	122	65.6	64	31.4	186		

Deviation from 50%, 29 or 15.6%.

Spencer (p. 228) has females, 52, 89.6%; males, 6, 10.4%.

The samples above were not truly random. Consequently there may be bias in the figures, but even so males seem to be too abundant to be called rare. Certainly the Morawa figures do not agree with Spencer's but what do these figures really mean in relation to the presence and abundance of males in the Australian species? Further, in this connection, the Kurrawang figures (see below) show rough agreement with those from Morawa.

Apus has one generation per season and in any sexually reproducing animal where sex is controlled genetically it is a reasonable assumption that male and female gametes should be equal, namely 50% males and 50% females. If we make the assumption that at the time of sampling the sexes should also be equal we

ean proceed to a test to determine whether the figures previously given support this assumption, in a statistical sense, by the formula for Standard Error (see Weatherburn, 1949) which gives:

$$SE = 6.8 \text{ or } 3.68\%$$
$$\text{Deviation} = 29 \text{ or } 15.6\%$$

i.e. the *deviation* is more than four times the standard error. Inspection of Tables show that the chance of an error of this magnitude being due to errors of sampling is 16,000 : 1. Clearly this indicates that the figures do not agree with the assumption that males and females should be equal.

Inspection of Table 9 (in Simpson and Roe, 1939, as shown by Mayr, 1953, p. 129) tells us that in a single sample, samples nos. 2-4 are within the limits of error for the numbers used and therefore individually do not invalidate the assumption in regard to sex frequency. However, the samples no. 2-4 all deviate in the same direction and since they are consistent the deviation cannot be due to errors of sampling, i.e. the deviation is real.

To what may we ascribe the deviation? One possibility is that there is a differential death rate between the sexes, i.e. males may not be as hardy or survive as long as females. In this connection it should be remembered that the waters had been present since March 20-21, i.e. the *Apus* were almost 7 weeks old. (We have the observation of Spencer (1896), supported by other field observers, that these crustaceans are sexually mature within 2 weeks of hatching.) A different mortality in the sexes, therefore, cannot be ruled out as one cause of the observed discrepancy in the sex ratio; a higher mortality among males is a common and widespread phenomenon in many animals.

A second possibility is associated with the existence of parthenogenesis. The statement from Borradaille *et al.*, already quoted, may only apply to *A. cancriformis* at the latitude of Europe and that from Parker and Haswell may be a generalisation based on familiarity of the life history of too few species. Hesse *et al* (1949, p. 361) state: "Parthenogenetic development in Entomostraca is more and more limited towards the equator, though scarcity of males in tropical Cladocera is reported. This is not true of the phyllopods and the ostracods. Although there are species of euphyllopods in the colder regions among which males have never been found or are very rare, males are in the majority in the collections thus far made of African species *(Limnadia, Lepidurus, Apus,* etc.)."

This passage would indicate that the extracts quoted from Borradaille and Parker and Haswell need not apply to the Australian species of *Apus.*

White (1945, p. 285) gives details of the parthenogenetic polyploid races of *Artemia* and (p. 286) discusses the polyploid races of the isopod *Trichoniscus* in which the parthenogenesis is associated with resistance to drought (Southern France), or extreme cold (Scandinavia, Iceland, where the bisexual races are absent). In the polyploid races males are few (1-2% of the population).

Parthenogenetic raees of *Cypris fuscata* (Ostraeoda) appear to be triploid. Those of *Daphnia pulex* (Cladoeera) may be hexaploid *(op. eit.,* p. 287).

White, writing on the sex determination of the oeeasional males of the polyploid raees of *Artemia,* says: "No doubt the bisexual raee represents the original eondition; unfortunately, nothing is known about its method of sex determination, so that it is seareely worth while speculating as to the way in whieh oeeasional males are produced in parthenogenetie raees."

Makino (1951, pp. 47-59) indieates that the above is essentially the state of knowledge at present. Polyploidy is apparently especially important in produeing eold-hardiness in plants, e.g. all the grasses of Spitzbergen are polyploids (George, 1953).

Parthenogenesis is the only manner in which polyploids ean reproduce, for assuming that one female inereased the ehromosome eomplement then sperm from normal (diploid) males will be inviable with the polyploid, reproduction without the male is the only way in whieh the strain ean propagate. Beeause the speeimens obtained at Morawa were not suitably prepared no ehromosome eount has been made but the presenee of a reasonable frequeney of males in the population indieates that polyploids are not abundant or dominant in the population.

II. VARIATION

Speneer (1896, p. 231), in the definition of *Apus australiensis,* states the number of apodous abdominal segments to be "about twelve" and reeords the speeies from Coolgardie and Hannans as well as from Central and South Australia and plaees east of this. Henry (1924, p. 124) discusses the variability in *Apus australiensis* but makes no mention of apodous segments. Wolf (1911, pp. 260-263) restriets the definition of *A. australiensis* to females and males having twelve apodous segments, he then ereets two additional speeies as follows:—

Speeies	Loeality	Apodous segments
A. gracilis	Hannan's Lake Kalgoorlie	female, 8 or 9; male, 12.
A. strenuus	Finke River, Hermansburg	female, 10 or 11; male unknown

In view of the faet that meristie eharaeters are usually variable it is of interest to list the variability of the Morawa speeimens, a random sample from these gave:—

Locality	Sex	Number of apodous segments 7	8	9	10	11	12	Total no. of animals
Morawa	females	26	33	3	—	—	—	62
	males	—	6	11	3	—	—	20
Kurrawang	females	12	15	2	9	13	6	57
	males	—	1	7	10	2	6	26

The Kurrawang figures are a random sample taken from a collection made by Dr. D. L. Serventy in March, 1937.

From these figures it is apparent that the Morawa population is relatively homogenous and about the figures for *A. gracilis* females. However, the figures for males do not agree.

The figures from Kurrawang are more informative. Here the female range is complete and the males show a range from the lowest Morawa figure to that typical for *A. australiensis*. It should be pointed out that this sample included a great variation in absolute size of the animals. However females carrying eggs indicated that there is no correlation observable between size and number of apodous segments.

Mayr *et al* (1953) regard meristic (i.e. countable) characters as good taxonomically because (a), they are discrete, and (b), are less liable to error than measurements or ratios. However, before these characters can be used in a definition it is important to have an idea of the range and cause of variation in the population. Taning (1952), in a review, has assembled evidence that the number of vertebrae in certain fish species vary according to the temperature conditions to which the embryos are subjected; also other factors such as oxygen content and salinity of the water may affect such meristic characters. From this it is clear that experimental work is necessary to determine the genotypic control of such characters.

In the case of *Apus* it is interesting to refer to Alexander's report on a collection he made at two localities in the Kalgoorlie area:

Site	Source of water	Composition	Species present
Lakeside	Fed from Mundaring pipeline	Chlorine 0.01% Solids 0.05%	*A. australiensis*
Hannan's Lake	Depression in lake	Chlorine 0.69% Solids 1.40%	*A. gracilis*

These data, read in conjunction with the review of Taning, would indicate that chlorine, at least, may be one of the causes of variability in the genus *Apus*. The small size of Wolf's samples cannot give a reasonable picture of population variability and, taking into account the variation recorded above, it is clear that the evidence available at present does not support the existence of more than one species of *Apus* in Australia. The evidence indicates that 7 to 12 apodous segments fall within the range of *A. australiensis* and that the forms described under the names of *A. gracilis* and *A. strenuus* are only phenotypic variants. The names must be considered as pure synonyms of *australiensis*.

The eggs of *Apus* are presumably wind distributed during drought and there is, therefore, likely to be a good deal of admixture between western and eastern Australia. Under such conditions it seems unlikely that the geographic isolation necessary for speciation would be present. Thus *Apus* would agree with *Lepidurus*, which has one species, *viridis*, throughout Australia, and with *Artemia salina*, where the one species is world-wide.

Observations in the field on the variability in the number of apodous segments in *Apus*, in conjunction with environments and seasonal conditions are highly desirable.

SUMMARY

1. Males are considerably more common in *Apus* than has been reported in the literature quoted.
2. The samples discussed do not indicate that males and females are equally abundant.
3. The discrepancy observed in the samples when measured against the expectancy of equality cannot be due to error in sampling.
4. The marked difference in frequency of males and females may be due to difference in mortality in the two sexes. This cannot be checked because samples of the crustaceans over the history of this flooding were not taken.
5. Reference to literature would indicate that parthenogenesis and absence of males is characteristic of phyllopods in high latitudes with lower temperatures.
6. Further work needs to be done, by conveniently situated naturalists, on the biology of *Apus* so that the life history and other details of this characteristic local form are better known.
7. It is suggested that there is only one species of *Apus* in Australia, namely *Apus australiensis*.

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EVIDENCE OF ABORIGINAL HABITATION AT YANDANOOKA

By G. F. U. BAKER, East Fremantle.

In May 1950, aboriginal stone artefacts were discovered at Yandanooka by a party from the University Geology Department engaged on fieldwork in this area. The actual site of the discovery is near a Government windmill about two miles south-west of the Yandanooka railway siding. The artefacts were found over an area of about a quarter of an acre on the edge of the sandplain, which here lies only a short distance from the main Perth-Geraldton road.

Several types of stone artefacts were originally present, the most common being the so-called "top-grinders." These usually have a flattened grinding surface and fit comfortably into the palm of one's hand, while indentations on some of them show that they have also been used as hammer-stones. Such stones were used by the aborigines for crushing seeds and berries.

Another similar type, the "bottom-grinder", is somewhat larger but relatively rare. Specimens observed are about the size of a small dinner plate, and have a flattish appearance, being approximately oval in plan. One side, the grinding surface, has a shallow concavity, and seeds placed in this were crushed with the help of a "top-grinder."

F. D. McCarthy ("The Stone Implements of Australia," *Aust. Mus. Mem.*, IX, 1946) divides abrading stones into two groups:—(a) Millstones and (b) Mullers, which correspond to the lower and upper grinders respectively. According to this writer, millstones bear two types of grinding depressions; one which occupies the total surface, the other being in the form of a narrow groove. So far, only specimens of the former type have been found at Yandanooka. The presence of more than one grinding face on one surface of some mullers was noted by McCarthy, but as yet, no examples of this have been found here.

Other interesting fragments at the site are stone flakes and chips. Though these appear to have been produced during the fashioning of spear heads and other weapons, it is possible that some of them are themselves actual implements. A single, almost perfectly rounded stone was found, having a diameter of about two inches and bearing a curious deep T-shaped indentation. This may be some form of magic charm, possibly part of a medicine-man's tools of trade.

Unfortunately, many of the best artefacts were collected as souvenirs by students of the field-party, and therefore lost to science. On a subsequent visit to the spot it was difficult to find any worthwhile pieces. As the stones are scattered over a particularly sandy area, however, it is likely that many have become buried in the course of time due largely to wind action, and they may similarly reappear in the future.

Of great interest are the many different kinds of rock from which the artefacts were made. Such a varied assortment would

not normally be found. However, there exist nearby glacial strata of Permian age in which occur numerous boulders originally dropped into a sea from floating icebergs. It is from these boulder beds that the aborigines probably obtained their supply.

In this locality, the eastern margin of the sandplain is bordered by low cliffs about thirty feet high, and a number of permanent springs issue from the slopes. In winter this water finds its way to the lower ground where an absence of good drainage results in very wet conditions.

This plentiful supply of ground-water which owes its origin to underground drainage from the sandplain, has been utilised by both the white man and the aborigine. The former has tapped the supply by means of a Government windmill located near the site of the present discovery, while the presence of artefacts shows that, in the past, Yandanooka Springs must have been of some importance as a native watering-place.

The restricted size of the collecting area with its relatively small numbers of artefacts, indicates the probable transitory nature of aboriginal habitation at this site.

OBITUARY

O. H. SARGENT

Oswald Hewlett Sargent, Western Australian botanist, was born in England, on December 5, 1880, at Selly Oak, near Birmingham. At the age of six years he with his younger brothers and sisters were brought to Australia by his parents. During the long voyage to Australia, in the steamship *Elderslie,* Oswald was nearly washed overboard, an incident that remained vividly in his memory to the end of his long life.

After a short stay in Perth the family moved to York where the father, Obeithio Sargent, established a pharmacy. There the children received their education at the State School. After leaving school Oswald, the eldest, studied in preparation for his destined career as a chemist. He was coached for the Pharmacy Entrance examination by Mr. Walker, a retired school teacher and a very able man. Apart from this and the very real assistance of his father, Oswald gained his education by persistent reading and thought. He was extremely interested in botany, collecting a large number of texts, and applying his knowledge of classical languages and chemistry to further this study in every detail. Later when he found that many interesting botanical monographs are written in German he succeeded in teaching himself that language also. In 1902 he passed the final examinations of the Pharmacy Board, winning the first Webster Memorial Gold Medal to be awarded. His examiner, Alexander Purdie, Director of Technical Education in W.A., Lecturer in Chemistry at the Perth Technical School, and a fine botanist, was much impressed with the ability of the young examinee. He found himself referring to texts to verify some of Sargent's statements in the botanical section of his examination. Thereafter they became firm friends and Purdie's death in 1905

left his protege much bereaved. When his father died in 1916, Oswald took over the York Pharmacy. He spent several periods in Bruce Rock relieving the local chemist, interludes which he much valued. In 1925 he married a fellow chemist and settled in Perth where he conducted a pharmacy, until finally returning to York in 1934, where he and his wife continued in business. On his death on March 4, 1952 he left a widow and one son.

In these bare facts concerning his material progress there is only a hint of his absorbing interest in botany. Throughout the centuries, chemists (or herbalists) have been botanists. The old cures prescribed the use of certain plants and the first known

O. H. Sargent, 1925.

scientific descriptions of plants were made by chemists. Botany remains a prescribed subject for pharmaceutical examinations. It would therefore be easy to trace a fanciful development in O. H. Sargent from chemist to botanist, but the foundations for his love of wildflowers were laid before he studied chemistry.

From earliest childhood his great joy was to wander through the bush studying everything that came his way, from the tripping of the trigger-plants' columns, to the sensitive labella of certain orchids, from the manner in which the Christmas Tree grew, to the way in which birds sipped nectar from different flowers.

York in those days was a botanical paradise in which native flora and fauna abounded. Though slightly built, Sargent was capable of very long marches, declaring that a collector travelling on horseback or in a sulky could miss many a treasure. This leaning towards a study of natural history may have been a family characteristic. A cousin, the late Dr. F. W. Edwards, F.R.S., was deputy keeper of the Department of Entomology at the British Museum (Natural History) and this link may have been useful on the several occasions that Sargent sent material to be compared with original collections held at that institution.

During the early years of the century Western Australia was visited by many eminent botanists; and several keen workers were resident in the State. In such company Sargent took his place naturally, earning a reputation as a sound botanist that persisted to his later years.

The meeting of the British Association for the Advancement of Science held in Perth in 1914 was a highlight for local naturalists. Sargent joined the botanical group and after the meetings they toured various parts of the State in search of interesting plants. It was then that his experience in long bush walks stood him in good stead, and many a time he found himself sole companion of a great botanist who, like himself, insisted that a true collector must go on foot. These overseas visitors encouraged him to make additional studies of the many unusual plants in this part of the world.

One of his first published papers, "The Pollination of *Caladenia barbarossae*" (1907), gave him more satisfaction than any of his later writings. Orchids remained his lifelong interest and the majority of his publications deal with this family. Yet a student after reading a collection of work from Sargent's pen is struck by the eager interest and perception that he brought to the study of all wildflowers. He excelled in biological studies and made very detailed life histories of many plants, with almost poetical pen pictures of their appearance and habitat. The bird and insect associations were noted and many hours were spent in watching and recording results. Mr. C. A. Gardner recalls that once at Pinjarra he sat for about two hours in one spot looking for the flowers of *Drakaea jeanensis,* which could be seen only when the sun hit them at a certain angle in the long grass. Such patience is second nature only to true observers.

Those earlier years were the most fruitful. He wrote many popular articles for the newspapers. He described several new species of wildflowers. His notebooks overflowed with records and observations. Those which he published commanded the attention of botanists at home and abroad. Those which he stored away were to have occupied the idle days of his retirement when he no longer would be able to walk so far afield.

He had a strong interest in systematic botany and intended writing a Flora of Western Australia, employing a somewhat unusual but convenient basis, such as divisions of plants into herbs, shrubs and trees, size of leaves etc., but this work was never done.

To this end he had amassed a fairly large herbarium which he gave into the charge of the Western Australian Museum about 1928. The collection was not mounted and must have deteriorated considerably. Sargent himself perhaps felt unequal to the task of reducing it to order and seems never to have consulted it after it left his hands.

His life in Perth had given him the desired contact with fellow naturalists. He joined the Western Australian Naturalists' Club in December 1924 and was soon active in its affairs, becoming vice-president in October 1925 and was president for the following terms: 1928-1929 and 1931-1932.

Sargent, however, had a singularly independent attitude of mind that was not always acceptable to fellow botanists. Later his obstinate backing of an unworthy associate lost him the sympathy of many club members. His return to York in 1934 marked his dissociation from many of his former activities and failed to reunite him properly with the well-head of his inspiration, the bushland itself. He had lost his old fervour and York was no longer the happy hunting ground of his youth.

He turned instead to studying the propagation of wildflowers, an activity that strongly appealed to one who prided himself on his "green fingers," and who felt so keenly the loss of wildflowers caused by the inroads of civilisation. The destruction of native plants grieved him and to the end he condemned Progress, Thoughtlessness and Wanton Vandalism, three factors that so rapidly denude any district of its native treasures.

Sargent experimented much with the cultivation of native orchids. They were transplanted to his greenhouse with some success, but his ambition was to grow them from seed. He worked on this problem under a grant from the Council for Scientific and Industrial Research, but did not succeed.

Although the latter part of his life failed to fulfil the bright promise of his youth, Sargent's achievements as they stand today are considerable. His studies laid the foundations for future research in several fields. Those plants that commemorate his name are a fitting memorial to one who spent a lifetime studying them.

The following species commemorate Sargent's name:— *Pterostylis constricta* Sargent, *Caladenia doutchae* Sargent, *Actinotus superbus* Sargent, *Helipterum eryptanthum* Sargent, *Hemiandra rubriflora* Sargent, *Hemiandra coccinea* Sargent, *Hemiandra gardneri* Sargent, *Hemiandra rutilans* Sargent, *Drosera strieticaulis* Sargent, *Pterostylis sargenti* Andrews, *Thelymitra sargenti* Rogers, *Eucalyptus sargenti* Maiden.

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—RICA ERICKSON.

FROM FIELD AND STUDY

Oeeurrenee of Black-tailed Godwit in Kalgoorlie.—A party of five Blaek-tailed Godwits *(Limosa limosa)* was observed on a dam in Kalgoorlie on Deeember 21, 1952. They were identified by the white wing stripe and rump, and the long legs, trailed in flight. A loud squeak, like that of an immature White-headed Stilt, was emitted prior to flight. Unfortunately, at least three of the birds were destroyed and left floating in the dam. This enabled a photograph to be taken, and measurement of the tarsus, 67 mm. One bird remained on the dam and was still there when I left Kalgoorlie on February 5, 1953. —P. SLATER, Coonana.

Early Appearance of Jewel Beetle.—The beautiful green jewel beetle, *Stigmodera gratiosa* Chevrol. *(W.A. Nat.,* vol. 3, 1952, p. 145, eol. pl.), eommonly found on flowers of *Hakea, Leptospermum,* ete., first appears in early September and early Oetober. This year (1953) a speeimen was collected alive and sent to the Museum at least over two months before it usually appears free.

Master Andrew Clarke found this jewel beetle on July 5 at Lesmurdie, and it arrived at the Museum in a very active condition next day. This is our earliest reeord of jewel beetles being found free in the South-west. Of eourse individuals may be eut out of their host trees and shrubs while they await satisfaetory

conditions for emergence, but this was not the case with Andrew Clarke's capture.

—ATHOL DOUGLAS, W.A. Museum, Perth.

Addenda to Published Notes on *Cyrtopeltis* spp.—It is apparent from the descriptions by Dr. W. E. China *(W.A. Nat.,* vol. 4, no. 1) of the colouring of *Cyrtopeltis droserae* and *C. russelli* that some minor changes took place in the type specimens in transit. No expert description from living material has yet been made but green colours occur on most specimens and it appears certain that some of those parts described by Dr. China as yellow, dirty-yellow, greenish-yellow, etc., were originally shades of green. On recently collected specimens I have found a distinct fading and yellowing of areas which were bright green in life and this appears to be due to the preservative used. Dr. China has accordingly asked that it be made known that his observations were made on spirit preparations.

I should like to add to my own notes, which were appended to Dr. China's paper, a belated but none the less sincere acknowledgment of the assistance in plant identification given me by Mr. R. D. Royce, of the Government Botanist's staff.

—M. C. RUSSELL, Como.

The Dollar Bird in Western Australia.—Serventy and Whittell *(The Handbook of Birds of Western Australia,* 1951, p. 45) list the Dollar Bird *(Eurystomus orientalis)* among those species not found in Western Australia south of the Kimberley Division.

On June 14, 1953, I was returning from a trip to the North-west, accompanied by Messrs. K. G. Buller and N. E. Stewart. While we were driving slowly up the southern bank of the eucalypt-lined creek immediately south of Winning Pool, a strange bird flew at radiator height across the path of the truck and only about ten feet in front of it. The closeness of the bird made possible the following observations which in my opinion leave no doubt whatever that it was a Dollar Bird. (It should be mentioned that I have had considerable field experience of the Dollar Bird in New South Wales and the Australian Capital Territory.)

The bird was of the size and had the characteristic flight of the Dollar Bird. It had a bluish-grey body, big dark-bluish wings with a single large white circular spot in the centre of each, and a short bright red bill.

Mr. Buller who has observed the Dollar Bird in the Kimberleys is also quite sure that the bird seen at Winning Pool was of this species.

It seems inconceivable that so distinctive a bird could have been overlooked by such resident and visiting ornithologists in the North-west as T. Carter, F. L. Whitlock, A. H. Robinson and I. C. Carnaby, and the obvious conclusion is that the presence of the bird at Winning Pool is a probable consequence of the unusual climatic conditions in the Kimberleys which produced the recent general irruption of birds.

—J. H. CALABY, Nedlands.

Further Records of *Hyperœdesipus plumosus*.—Further to my note on the occurrence of this interesting Phreatoicid crustacean at Moondyne Spring in the Darling Ranges *(W.A. Nat.,* vol. 3, p. 173) additional observations may be recorded.

On September 7, 1952 I visited Moondyne Spring when the water level was low, with the spring just trickling. No *Hyperœdesipus* were found.

On January 25, 1953 the crustaceans were abundant and I collected about 30 individuals in some 20 minutes, using a stockinette strainer. All were subterranean. The day was clear and sunny. I also discovered *Hyperœdesipus* in the next watershed in a permanent spring there, about half-a-mile N.N.E. from Moondyne, but the creatures were sparse and I saw only four individuals altogether.

During a walk down the Avon Valley at Easter, 1953, our party visited the springs and at Moondyne *Hyperœdesipus* was abundant, and though the day was similar being clear and sunny, individuals were found both at the surface and subterranean. The former were pigmented, blue-brown. Pairs in copulation were discovered on this occasion and all these came from the mud at a depth of about 10 inches, right in the flow of the spring. No copulatory pairs were seen at the surface. In the copulatory embrace the larger female was coiled about the male and holding him with her legs. The specimens were collected on April 4 and held alive for the remainder of the trip in a test tube of spring water. They remained alive until April 7 when they were inadvertently exposed to direct sunlight, which was apparently a contributing factor in their death. The specimens were given to Mr. Keith Sheard, of the C.S.I.R.O.

—W. H. BUTLER, Museum Classes, Perth.

Records of Rare Parrots.—Because the Bourke Parrot *(Neophema bourkii)* is considered a rare species it may be of interest to record the following recent observations.

Accompanied by Messrs. K. G. Buller and N. E. Stewart, I recently (1953) visited the North-west via the Great Northern Highway. On May 23, approximately 50 Bourke Parrots were seen in several groups over an area of about a third of a mile square, 4 miles north-west of Nannine. A specimen (♂, testes small, W.A. Museum No. A 7159) from this locality was collected by Mr. Buller. On the same day, a single group of 6 birds was seen 73 miles northwards from Meekatharra. On the following day 2 further groups of 3 and 5 birds were seen at points 86 and 49 miles southwards from Mundiwindi, respectively.

On May 24 at a point 94 miles southwards from Mundiwindi I observed what I believe were a pair of Alexandra Parrots *(Polytelis alexandrae)*. A pair of parrots flew directly overhead at a fairly low altitude and their elongated shape, long tail, swift non-undulating flight and characteristic wing-beat, and occasional soft call, left no doubt that they were of the genus *Polytelis,* a genus of which I have had considerable experience having studied both of the other species *(anthopeplus* and *swainsonii)* in the field.

The general colour underneath appeared light grey and this together with the geographieal location would rule out *P. anthopeplus*. The only other species with which this pair of birds might possibly be confused is the Weero *(Leptolophus hollandicus)* as this species has a similar flight and wing-beat and calls of the same general type as *Polytelis*. However, the birds seen in the Mundiwindi region were too large and the colour underneath far too light for *Leptolophus*.

—J. H. CALABY, Nedlands.

Further Record of the Little Whimbrel in South-western Australia.—On February 14, 1953, Mr. T. M. Smith of "Ardersier," West Coolup informed me that there were two birds in company with a flock of Banded Plovers on his farm. These birds had been seen a few times feeding with the plovers and he described them as being similar to a Curlew Sandpiper with a bill about 2 inches in length. However, from his description and the habitat in which they were seen I felt reasonably sure they were Little Whimbrels *(Numenius minutus)*. These two birds disappeared the same day so I did not have an opportunity of seeing them.

On February 27, Mr. Smith informed me that one of the birds had arrived back and I went out to see it. It was a Little Whimbrel and was in company with a flock of Banded Plovers. Though not so quiet as the individual I saw in 1949 *(W.A. Nat.*, vol. 2, p. 24) it was easily recognised by the dark brown wing tips, length of beak, buff eyebrows and median line on head. It was in a dry pasture paddock which was matted with short couch grass which, owing to heavy rain during the first week of February, was still green. The bird did not crouch but owing to the shortness of grass it would have been useless as a means of hiding itself, and it was kept very much on the alert owing to the plovers' behaviour. Mr. Smith said the birds were more wary than usual, possibly due to my presence.

On March 3, Mr. Smith reported that there were two Whimbrels again with the plovers. One of these birds was darker on the neck and their feeding behaviour gave the impression they were catching grasshoppers or some similar insects. There is little doubt that these two birds were the same as seen originally on February 14. They disappeared about the end of the first week in March and have not been seen since.

It is interesting to note that these birds made their appearance under similar weather conditions to those obtaining in 1949. They were first seen during an abnormally cool spell about a week after heavy rain and disappeared finally after rain following a cyclone in March. Did the heavy rain in February set in train a natural cycle causing the birds to travel northwards towards their breeding grounds? Did the following dry weather cause a sudden interruption of the cycle, and so anchor the birds where they were temporarily, until the March cyclone caused its resumption?

—ANGUS ROBINSON, "Yanjettie," Coolup.

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NATIVE SNAILS OF THE GENUS *BOTHRIEMBRYON* IN KING'S PARK, PERTH

By A. R. MAIN, Zoology Department, University, Nedlands, and M. A. CARRIGY, Kewdale

INTRODUCTION

Iredale's (1939) review of the Western Australian land snails reveals that two species of *Bothriembryon* occur in or adjacent to the Perth area. These are *Bothriembryon bulla* (Menke, 1843; type locality Darling Range), and *Bothriembryon indutus* (Menke, 1843; type locality Darling Range and Mount Eliza). The original material was collected by Ludwig Preiss, a German naturalist, who worked in Western Australia from 1838 to 1842.

Dead shells of these snails can be found in numbers after the periodical controlled burns which are a feature of forestry practice in King's Park. One would expect, therefore, that local naturalists would be aware of their presence. However no field studies have been done on the life histories, status, or inter-species relationships within the area adjacent to Perth.

Difficulties associated with naming specimens may have deterred would-be workers in the field. Iredale *(op. cit.)* lists over forty species for South-Western Australia. Within the genus one can clearly define species groups, and, within such groups one is forced to depend on locality rather than morphology for determining specific names. Populations are also found which show a great range of colour and shape of shell. It is apparent that this is a taxonomically difficult group and if one defines species in biological rather than morphological terms, i.e. as populations rather than as structurally different animals, one may, within this genus, have an opportunity of studying speciation processes.

One of the authors has collected live specimens (i.e. coloured shells containing the animal) over the geographic range of the genus from Sharks Bay to South Australia. As a preliminary to a broader approach to the species relationships of the whole genus, work of an observational nature has proceeded in King's Park and this is recorded here.

DISTRIBUTION OF THE SNAILS IN KING'S PARK

Extensive collecting in the Park shows that *Bothriembryon indutus* occurs on the cliffs facing the Swan River, and that

Bothriembryon bulla occurs on the high land away from the cliffs and the river. Closer examination of the area away from the river reveals the presence of another form having a black body and a strikingly striped shell. The three forms are shown in Fig. 1.

There is no doubt that the coloration of the shell and the secretive nature of the animal make it difficult to collect an adequate number of live animals for mapping distributions. However, by collecting during the first autumn rains, when animals

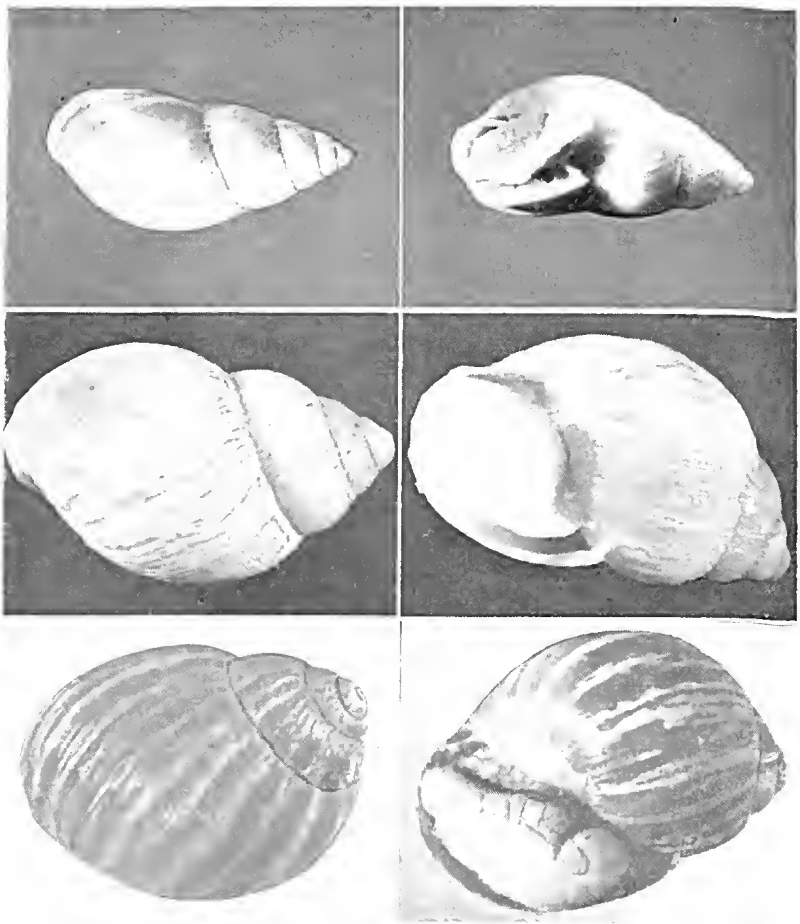

Fig. 1.—The three forms of *Bothriembryon* found in King's Park. Top row. *Bothriembryon indutus* x 1; left, dorsal view; right, ventral view showing foot. Centre row. *B. bulla,* typical form, x 2; left, dorsal view; right, ventral view. Bottom row. *B. bulla,* melanic form, x 2.5; left, dorsal view; right, ventral view; note the dark foot and pigmented and striped shell.

—Photos E. Walsh.

appear above the leaf litter in the day time, or by turning over litter and soil under shrubs to a depth of several inches, one may obtain specimens of the black form and *B. bulla*. Such methods applied to the search for *B. indutus* have yielded only a small fraction of the number collected of the other species. Perhaps this indicates a real difference in the density of the populations, but this is difficult to reconcile with the commonness of dead shells. Shells of *B. indutus* are relatively uniform in colour and shape. It is worth noting that in extensive collecting outside the Park, e.g. on the Darling Scarp, *B. indutus* is widespread though common only in small, apparently favourable sites. Here *B. indutus* prefers to aestivate under stones on scree slopes. Distribution of the three forms based on all collections made within King's Park is shown in Fig. 2. From this it is clear that there are three apparently distinct populations in the area under discussion. This statement is not entirely true as four black-bodied individuals were found in 1953 within the area marked as *B. bulla*, at the sites shown on Fig. 2. With these exceptions in mind the populations can be typified as in Table 1.

TABLE 1.—CHARACTERISTICS OF POPULATIONS OF BOTHRIEMBRYON IN KING'S PARK.

Character.	Population 1 Bothriembryon indutus	Population 2 Bothriembryon bulla	Population 3 melanic form
Body	Pale yellow	Pale yellow	black
Shell			
Height. Max. observed*	38 mm.	25 mm.	18 mm.
Width. Max. observed	19 mm.	16 mm.	14 mm.
Height:Width. Max. observed	2.00	1.56	1.28
No. of whorls	5½	5	4½
Colour, alive	Red-brown or greenish-yellow.	Straw, faintly striped.	Yellow stripes.
Dead shell	Opaque. Very well calcified.	Opaque. Well calcified.	Thin translucent brown. Poorly calcified.

There is no chance of confusing the long narrow-spired *indutus* with either of the other populations but population 3 differs from *bulla* only in body colour, and in having a more globose and less calcified shell. Even so, a striped black-bodied form occurs among the typical *bulla* and although distributions (see map), are so discrete, one has no hesitation in stating that these are only polymorphs of the one species. However, with the very unequal distribution in the small area of the Park, one is immediately conscious of the subtlety of causal factors in the distribution observed.

We consider that the peculiar distribution of the two forms of *B. bulla* is best interpreted as an interaction of the animals' natural history with environmental factors such as the nature of the vegetation, soil, forestry management, and predation, and these factors are considered in the following sections.

*A statistical analysis of this genus is to be published elsewhere.

NATURAL HISTORY OBSERVATIONS

(a) VAGILITY.

The following observations relate to the period from the winter of 1951 to 1953. Because the area occupied by the black-bodied population was readily available to one of us it was chosen for observation. Thirty animals were marked by sticking a numbered tag on to the body whorl of the shell, and covering it with a clear nail polish lacquer. Numbers attached in this way showed no sign of deterioration after several months of field conditions. None of these tagged specimens were collected in 1953.

By constantly observing marked animals over a period of nine consecutive days (from June 27 to July 6, 1951) it was found that the maximum distance covered in 24 hours was 10 feet, while over the same period, the average daily movement was 3 feet. Movement was not strictly random but seemed to favour clumps of *Scaevola paludosa*. Other observations indicated that this plant was particularly favoured by the melanic snail early in the morning. None of the leaves of this plant showed signs of having been eaten by snails, but since the leaves are hairy and hold water in the hairs, it is suspected that it is the water that the snails find attractive. *Scaevola* also forms a good leaf litter and may thus provide cover during the day. When kept under observation in the laboratory, snails will feed on the dead leaves of this plant.

With the marked animals an attempt was made to estimate population density in this area by a technique of mark and recapture. However this was unsuccessful due mainly to vagaries of weather to which snails reacted, so that only on dull wet days without wind, could one expect to obtain a reasonable number of animals on the surface. The typical *B. bulla* is even more difficult to census than the day-moving melanic form, since it seems to feed very rarely in daylight, and even when feeding is commonly deep in vegetation, or if on the sand surface only under relatively dense vegetation up to four inches in height. This preference for cover while feeding and during daylight is reflected in the preference for the dense *Jacksonia gracilis* and makes any census method extremely difficult and inaccurate.

Because of the difficulty of making an accurate census it seems undesirable to guess at the relative abundance of the two polymorphs in the Tuart Association but it seems probable that the melanic form may vary from between 5 per cent. and 10 per cent. of the total population. On the other hand, the melanic form in the Jarrah-Banksia Association is easily visible and here even though the under sides of shrubs and other sites have been carefully searched a pale-bodied form has never been seen.

Under dry conditions snails were observed to bury themselves in the sand beneath leaf litter or under shrubs and the typical

B. bulla frequented *Jacksonia gracilis*. This burrowing was done with the foot while the animal slowly revolved. *B. bulla* generally burrowed only deep enough to cover the shell to the top of the spire. Indications are that under summer drought conditions the typical *B. bulla* does not bury as deeply as the melanic phase. This may be due to behaviour differences or characteristics of the sand (see later), or both. Under summer conditions, buried animals seal the aperture with an epiphragm.

(b) REPRODUCTION

Copulation proceeds as follows: One snail crawls on to the body whorl of another. The lower animal comes halfway out of its shell, the eyes and tentacles being withdrawn and the body twisted so that the genital aperture faces upwards. The upper animal comes out to its full extent but with eyes and tentacles withdrawn. The body is twisted so that the genitals face downwards. During copulation there is a mutual exchange of sperm.

The male organs are white and thread-like, and protrude, in copulation, from the right hand side of the body just behind the eye stalks. In the melanic form the penis is about 7.5 mm. long when extruded.

Copulation takes more than 20 minutes and during this time large quantities of mucus are secreted. During 1951 copulation was observed in the melanic population on the following days: May 6 and 7, June 10, 20, 24, 27 and 28 and July 5. Observations on marked specimens showed that individuals copulated more than once in a season. At no time were the melanic forms seen to copulate with the typical *B. bulla*, but this may be due to infrequency of this polymorph in the typical *bulla* area and the fact that most of the observations on the melanic were central and not peripheral to the melanic area.

In the first season of investigations no egg laying was observed, but on August 16, 1953, eggs were found in King's Park in two shallow closely adjacent holes, $\frac{1}{2}$ in. in diameter by $\frac{3}{4}$ to 1 in. deep. In the sand at the bottom of these two holes 22 eggs were collected (from observations made outside of the Park the range per individual hole is from 11 to 14 eggs). Eggs are nearly spherical, 3 mm. in diameter, opaque white, and with white granules in the outer part. Small snails can be seen within the egg membranes after 30-35 days at a temperature of 60 deg. F. At hatching, the embryo shell has $1\frac{1}{2}$-$1\frac{3}{4}$ whorls.

DESCRIPTION OF AREA AND GEOLOGY

King's Park is native woodland entirely surrounded on the north and west by built up areas and on the south and east by the Swan River. The total area is approximately 1,000 acres. The shape and topography is given in Fig. 2. The rocks of the area are consolidated calcareous dune rock, Pleistocene aeolianite, originally composed of comminuted shell fragments, echinoderm spines and plates, some tests of foraminifera, and rounded and

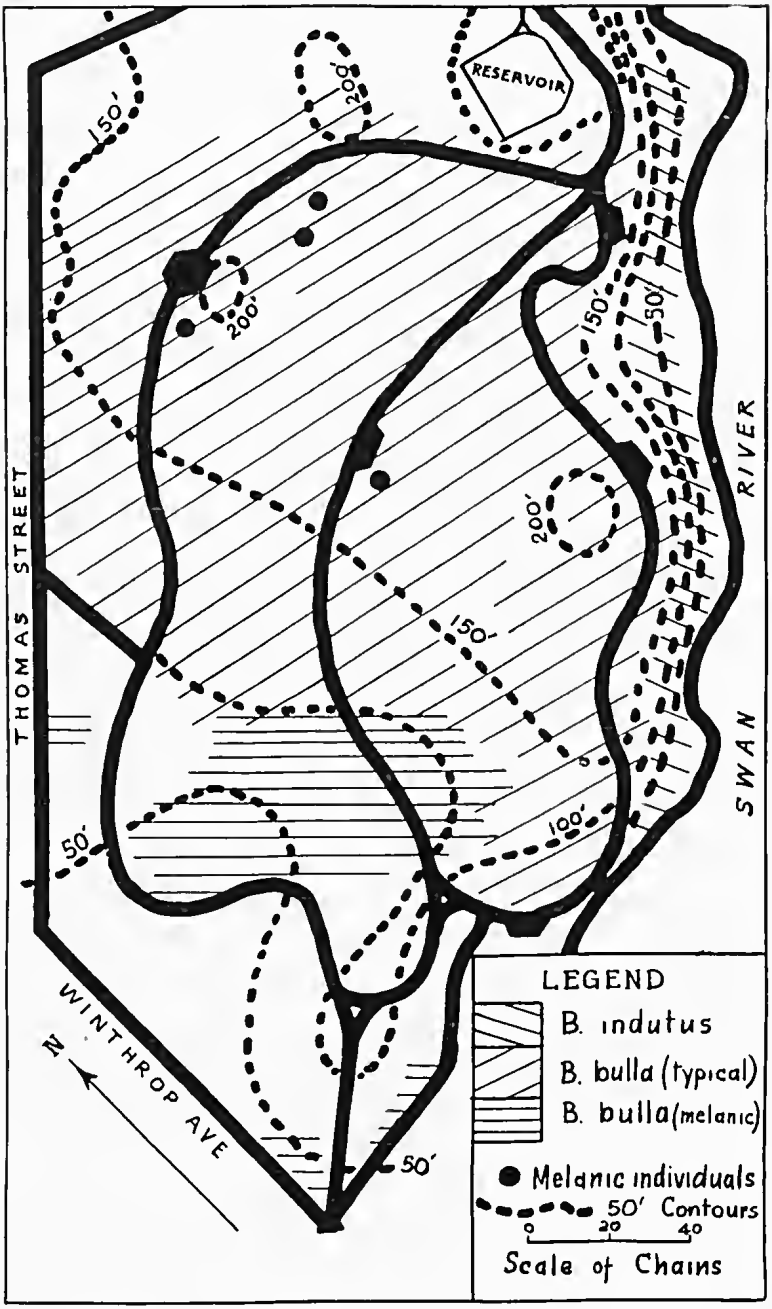

Fig.. 2.—Map of King's Park, showing roads, contours and the distribution of the snails of the genus *Bothriembryon*.

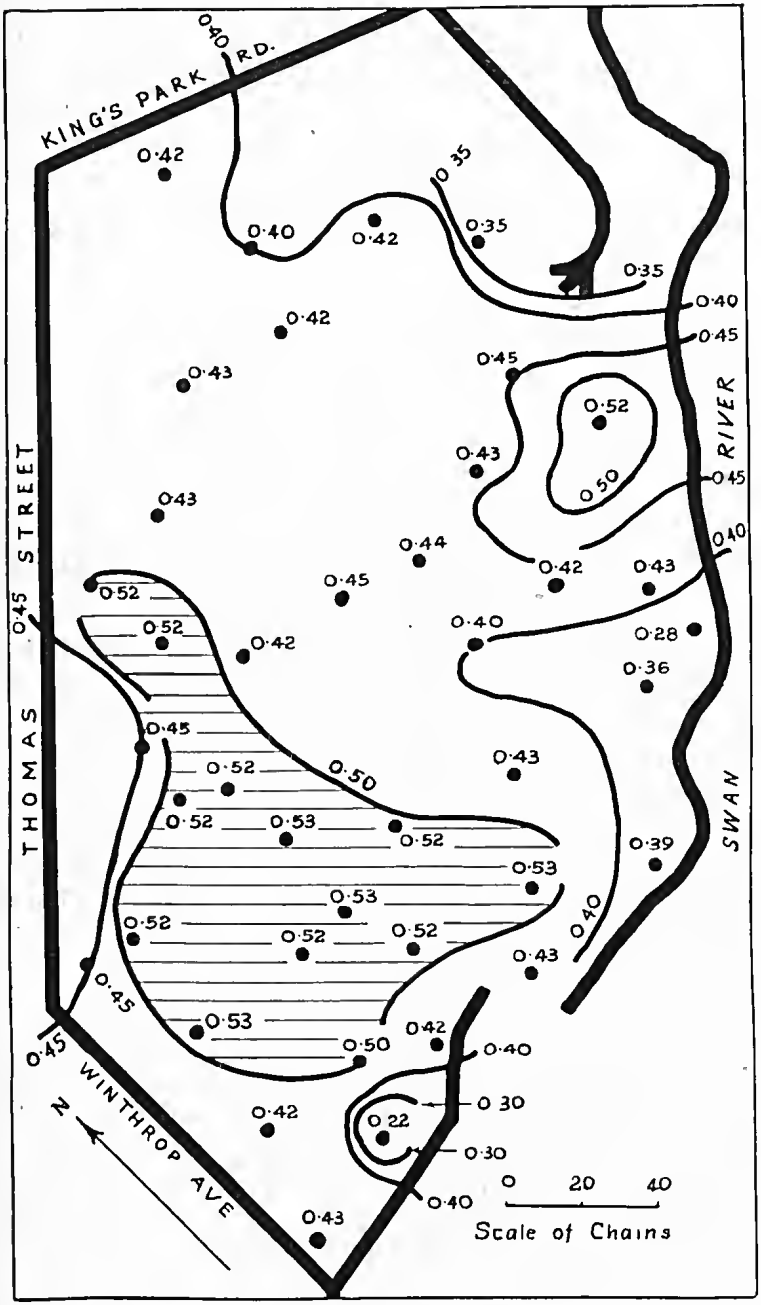

Fig. 3.—Map of King's Park, showing distribution of sands of equal particle size; plotted by using median diameters of sands in millimetres and lines of equal size extrapolated for values of 0.50, 0.45, and 0.40 mm. The hatched area shows the main occurrence of sands with a particle size exceeding 0.50 mm.

frosted quartz grains. This rock outcrops on the steep cliffs facing the Swan River. Over aeolianite a deep siliceous soil has developed, which is leached for about 12 inches and passes down into a yellow zone where the quartz grains have a thin coating of limonite (iron oxide). This zone is of variable thickness, exceeding ten feet in places and rests on a thin, dense travertine layer of reprecipitated calcium carbonate developed on the surface of the indurated dune rock below which it still retains its original bedding.

Sieve analyses of 40 samples of the surface sand from selected sites enabled lines of equal particle size to be drawn (using median diameters in millimetres, see Fig. 3). Inspection of Figs. 2 and 3 reveals that the coarser grain sizes of 0.50 mm. and over are favoured by the melanic population. The coarser particles are nearly all below the 100 foot contour line, i.e. at the base of the old dune. Vegetation boundaries also seem to be related to this change (see later). Many factors, e.g. pore space, moisture holding capacity, permeability, and rate of drying may control the presence of characteristic snails and vegetation. The voids ratio of the coarser sands will be greater than the fine sands, which means that they will hold more water when saturated but have greater permeability and a faster drying rate which will cause more rapid loss of moisture. Finally, coarser sands reach a lower equilibrium moisture content during the dry months. From this it is apparent that the resistance to desiccation of an aestivating snail on this soil would have to be greater than on a finer soil which holds less water when saturated but also loses it more slowly. To test this hypothesis sites have been selected at which winter and summer moisture contents will be measured, along with a parallel laboratory programme to compare the resistances to desiccation of the three populations of snails. As already suggested the coarser sand may allow the melanic form to burrow deeper.

VEGETATION

Miss A. M. Baird, of the Botany Department, University of W.A., has kindly made available a complete list of the flora in the Park. The flora is classified into two associations; one dominated by *Banksia* spp. and Jarrah *(Eucalyptus marginata)*, and the other by Tuart *(E. gomphocephala)*. These correspond respectively with the area below the 100 foot contour having coarser sand and that above the 100 foot contour with fine sand as already discussed. Tuart areas are known to have limestone beneath the surface at no great depth while non-Tuart areas have no limestone beneath the surface.

With regard to the formations Miss Baird writes (pers. comm.) of the Tuart Association: "Trees widely spaced (most in very poor condition), a very much more open formation than the Jarrah-Banksia Association. The dense uniform undergrowth

of mixed shrubs, predominantly *Daviesia* sp., *Hibbertia, Oxylobium,* characteristic of the Jarrah-Banksia, is absent.

"Immediately round the base and under the canopy of big Tuart trees are *Pelargonium drummondi, Trichinium,* and sometimes *Clematis.* Other common shrubs typical of the Tuart Association are *Scaevola holosericea, Jacksonia gracilis,* and *Grevillea vestita.* The undergrowth in general is more herbaceous, much softer, and more mesophytic than in the Jarrah Association."

EFFECT OF BURNING THE AREA

Large areas of Western Australia are burnt each year by fires and Forestry Department practice is to have controlled burns every 3-4 years or as soon as leaf litter and other growth will carry fire. This control measure is to prevent the accumulation of litter which increases the risk of uncontrolled fires during the dry summer. Such fires are a feature of the Park management and with good conditions for the burn, little damage is done to standing timber. All herbs and, depending on the intensity of the fire, a good number of the shrubs are burnt. However it is noticeable that *Jacksonia gracilis,* a recumbent shrub lying on the ground and often many feet in diameter, and which is almost restricted to the Tuart Association, is only scorched around the edges but does not burn to the centre. Other mesophytic plants frequently resist the effect of light burns. On the other hand it is noticeable that the Jarrah-Banksia Association has no shrubs which resist fire as does *Jacksonia gracilis.* Thus when an area is devastated by fire the Tuart Association shows many scattered plants of *Jacksonia* which are unburnt and have acted as refuges while the Jarrah-Banksia area shows nothing surviving except the well grown timber. Further, since *B. bulla* apparently prefers the *Jacksonia* and *Pelargonium* which do not burn readily, this species seems to be favourably situated, not only in having a refuge in which to avoid the fire but also a ready source of leaf litter on which to feed in the ensuing winter. The ground under Jarrah-Banksia Association is black and bare, there are no refuges, and the first soft leaf litter to form will be from *Scaevola* which like other shrubs will regrow from the root stock. In this association and shortly after a burn there is usually a fall of scorched 'leaves' of *Casuarina* sp. which are common in this community. These pale brown needles lie heavily over the ash and charcoal of the fire.

No predators have been recorded as eating *Bothriembryon* in the Park but the Western Magpie *(Gymnorhina dorsalis)* is common and is a ground feeder. K. G. Buller has observed the Squeaker (*Strepera versicolor),* a bird closely related to the magpie, and also a ground feeder, which was feeding on *Bothriembryon balteolus* at the Phillips River. The method of feeding is given in detail by Buller (see this number, p. 70).

CONCLUSIONS

From the observations made on marked animals it is quite apparent that an animal with the observed degree of vagility of *B. bulla* could easily move and mate over the distances in the Park, and thus produce a homogenous population. It is clear that the two forms are selected so that the movement which does take place does not result in a uniform population. Differences in the vegetation which must be related to geological differences are co-extensive with the distribution of the snails, but this does not explain the distribution until it is appreciated how the two associations differ when subjected to burning. The Tuart Association has refuges in *Jacksonia gracilis* while the Jarrah-Banksia Association has no refuges but the ground is soon covered with fallen *Casuarina* needles. Snails in this latter association, feeding at the surface as soon as winter rains come, and long before the soil has an adequate plant cover, are then preyed upon by some ground-frequenting bird which in this locality is likely to be the Western Magpie. As the birds are protected in the Park this postulated predation cannot be checked, but Buller's observations on a closely related species lend support to this contention. The predation must be efficient and highly selective in order to produce the recorded homogeneity in the melanic population, where all animals seen were black-bodied and had shells showing a high degree of cryptic coloration. The colour pattern is quite obviously related to the black soil and brown *Casuarina* litter of the population area.

As the black forms in the typical *bulla* area have quite well developed shells, the thinness of the shell in the melanic population is probably related to the absence of calcium in the heavily leached soil on which it is found.

The behaviour and depth to which snails burrow is possibly a complex interaction between behavioural differences and ease of burrowing in the coarse sand. Whatever the interacting factors, it is certain that the melanic form with its deeper burrow can avoid the scorching of the fires and can thus escape in the same way as the typical *Bothriembryon bulla* which appears to have a ready refuge in *Jacksonia*.

A knowledge of egg laying will obviously give an opportunity of checking on the segregation of the genes for melanism and shell pattern and will also give an indication of the juvenile shells of any area, i.e. before the suggested predation has selected for the appropriate type. Future work in this area will centre on population counts and confirmation of different behaviour patterns in the polymorphs coupled with confirmation of the suggested predation.

SUMMARY

Two species of the genus *Bothriembryon* occur in King's Park, viz. *Bothriembryon indutus* and *B. bulla.* The latter is polymorphic with two forms:— one white-bodied with yellow shell and another black-bodied with striped shell. The melanic polymorph is rare in the Tuart Association where the yellow form is common; but in the Banksia-Jarrah Association only the melanic polymorph is found. *B. indutus* shows little variation in form and occurs only on the cliffs facing the Swan River. Observations on the natural history of *B. bulla* and the melanic form are reported. The distribution of the soils of the Park are given and the two plant associations present are discussed in relation to the edaphic factors. Cover is present in the Tuart Association but is absent in the Jarrah-Banksia Association after fires. It is suggested that the distribution of the typical *B. bulla* (yellow form) and the melanic form, in the Tuart Association and Jarrah-Banksia Association respectively, is due to predation by the Western Magpie *(Gymnorhina dorsalis)* in relation to relative destruction of cover by fire.

The expenses of this research were met by a University Research Grant (Western Australia).

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AMANITAS FROM KING'S PARK, PERTH

By J. GENTILLI, Nedlands.

(Continued from Page 34)

Amanita loricata sp. nov.

The type specimen (Fig. 5) was found at the end of June, a few years ago, some hundred yards from the south-western corner of King's Park. At the end of May 1953 another specimen, partly damaged but clearly recognizable, was found in the north-western section of the Park.

Cap 5-6 cm. in diameter, slightly concave except at the edge, of a uniform biscuit colour, covered with patches of small pointed biscuity warts, and with an outer ring of thick raised angular warts, also biscuit in colour.

Gills strongly ventricose, over 1 cm. broad, attenuated outward, rounded towards the stem, adnexed, crowded, white.

Stem 10-12 cm. long, 20-22 mm. thick, subcylindrical, slightly flattened laterally in one specimen, stuffed, with white flakes above and biscuit fibrillose flakes below, and remnants of a superior evanescent cream-white ring. The foot of the stem (seen in the type specimen only) is glandiform, with a distinct furrow which separates it from the stem proper, around the base of which are several rings of fibrils, remnants of the volva.

Spores elliptical to ovate, hyaline singly, white in mass.

This species has a distinct smell of yeast or rising dough, sweetish to faintly sour.

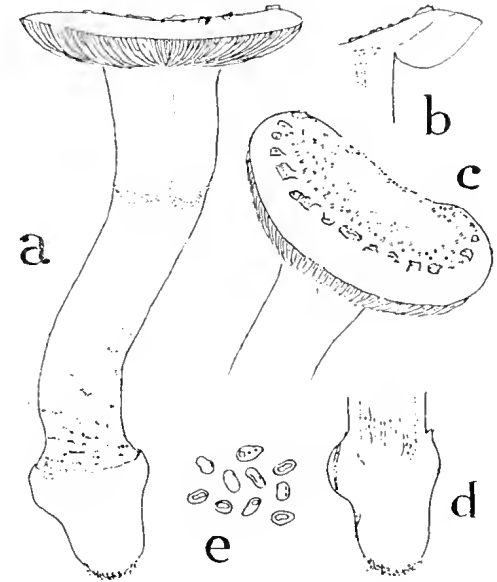

Fig. 5.—*Amanita loricata* sp. nov.

(*a*) Adult specimen. (*b*) Section of cap and upper part of stem. (*c*) Upper view of cap showing arrangement of warts. (*d*) Section of rooting portion of stem showing fibrousness of central part. (*e*) Spores, x 300.

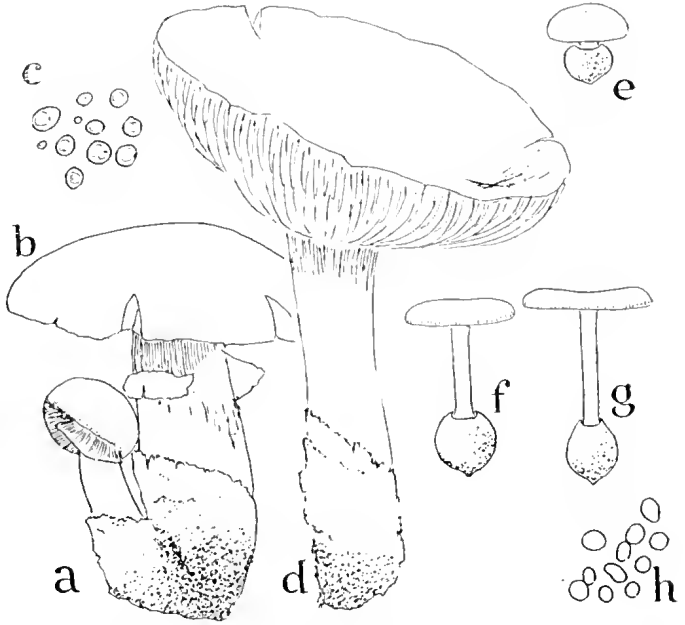

Fig. 6.—*Amanita umbrinella* Gilb. *et* Clel. and *A. pulchella* Cke. *et* Mass.

Left: *A. umbrinella*. (*a*) Very young specimen attached to (*b*) young specimen with torn ring and volva, and marked striations on upper stem. (*c*) Spores, x 300. (*d*) Mature specimen. Right: *A. pulchella*. (*e*) Very young, and (*f*) (*g*) mature specimens. (*h*) Spores, x 300.

Amanita umbrinella Gilbert *et* Cleland

Cooke (1892)* records *A. spissa* as found in woods near Lake Bonney (South Australia, a few miles west of Renmark) and describes its cap as "amber with a greyish tinge", whereas Bresadola (1927) describes it as *"griseo-fuscidulus, brunneo-fuliginosus"* and Maublanc (1946) *"gris-bistre ou gris-souris"*. Should Cooke have written "umber" instead of "amber"?

Cleland (1934) quotes the first description of *A. grisea* Massee *et* Rodway, published in 1901 and based on a Tasmanian specimen; he then describes specimens from South Australia and New South Wales, and discusses their variations. Willis (1950) states that *A. grisea* is "very similar" to *A. spissa*.

The description of *A. spissa* given by Maublanc (1946) applies very well to the specimens described by Cleland, and to our specimens (Fig. 6 a-d), except for the fact that *A. spissa* seems to retain its ring longer, and that its spores are more consistently apiculate. On the other hand *A. spissa*, as shown by Wakefield and Dennis (1950), has a cap of a warmer brown than the specimens collected. These authors however state that the cap is "greyish or umber-brown . . . eventually becoming bare" and their description could apply to our specimens. The spores are mentioned as "broadly elliptical".

Gilbert (1941), after careful study of a large number of original illustrations, descriptions and specimens, comes to the conclusion that: (a) *A. spissa* Fries, named in 1838, is a name to be abandoned because the species is identical with *A. ampla* Krombholz, named in 1831. (b) *A. grisea* as described by Cleland (1934) actually covers two new species, which he names *A. umbrinella* and *A. grisella*, both probably distinct from *A. grisea* Cooke *et* Massee, a Tasmanian species with a cobweb-like veil and persistent volva. (c) *A. umbrinella* Gilbert *et* Cleland has spores which do not react to iodine as starch does. (d) *A. grisella* is usually much more slender than *A. umbrinella* and its spores react like starch to iodine.

Our view is (a) that Cooke's South Australian record of *A. spissa* should be regarded as extremely doubtful, and (b) that our specimens belong to *A. umbrinella*.

Willis (1950) mentions a large ring for the Victorian specimens of *A. grisea*. Our specimens have a large ring *initially* (6 b) but may easily lose it with age (6 d). A general description is as follows:—

Cap 7 to 14 cm. in diameter, nearly hemispherical when young (6a), then plano-convex (6b), later on plane, and finally upturned at the edges at full maturity (6d). The surface is smooth, slightly sticky in wet weather, in some specimens broken by more or less circular patches about 1-2 mm. in diameter, hardly raised above the surface, and usually pale

*See references given on p. 34.

grey. The surface of the cap varies from medium grey-brown, especially when young or wet, to pale coffee colour, or dove grey-brown, grading into whitish towards the edges. The edge of the cap is entire or very faintly striate. The flesh is white, unchangeable, firm, with a pale grey-brownish tinge immediately below the cuticle.

Gills sinuato-adnexed, white at first, later very pale greyish-cream, relatively close, 6-9 mm. deep at the centre, attenuated at both ends, with short ones intercalated.

Stem 8-10 cm. long, 13-20 mm. thick in the middle, 15-20 mm. thick at the upper end, 25-40 mm. thick and truncated at the lower end, which may seldom be bulbous. The stem tends to grow hollow with age, and its flesh is white, unchangeable, very firm. The upper end of the stem always shows crowded striations left by the gills (6b, d).

Ring striate outwards, membranous, ample in young specimens (6a), soon torn (6b) and lost (6d). Its position may be superior, median or even inferior. It begins by adhering upwards, but soon drops and becomes pendulous before disappearing.

Volva present in young specimens (6a, b); it soon breaks off, and in most adult specimens all that is left is a line of fibrils around the base of the stem (6d).

Spores subspherical to very broadly ovoid (6c), rarely apiculate, guttulate, hyaline individually, white in mass turning brown when stained with an iodine reagent (no amyloid reaction).

The species is gregarious, and is found in groups of two or more individuals, usually six or eight, in clearings in the forest. It is hard to tell whether it is a moderately heliophilous species associated with eucalypts, or whether it is associated with the plants which invade the clearings.

This species has also been found in June-July at Reabold Hill, Chittering Brook, Mundaring, Darlington, Lesmurdie, Kelmscott, and Merredin.

Amanita pulchella Cooke *et* Massee

This species was first described by Cooke and Massee in *Grevillea,* vol. XVIII, 1, pl. 176/B, and again in detail by Cleland and Cheel (1914) who also gave a coloured table, by Cleland (1934), and more briefly by Willis (1950). All these authors placed the species in the genus *Amanitopsis,* characterized by the absence of a ring. Singer (1949) does not recognize a genus *Amanitopsis,* and places all the former *Amanitopsis* species under *Amanita.* Our observations actually disclosed that very young specimens of *A. pulchella* have the two veils characteristic of *Amanita,* but the partial veil which covers the gills is very friable and soon disintegrates instead of collapsing to form the typical ring. Thus the species belongs undoubtedly to *Amanita,* but it is suggested here that the nature of the partial veil is distinctive enough to warrant the recognition of a separate section within the genus.

Gilbert (1941) in his monograph of the Amanitaceae retains the genus *Amanitopsis* which he defines as having a cap with striate edge, membranous or sub-membranous volva, spherical or elliptical non-amyloid spores, ring present or absent, sub-membranous cap, and hollow stem *without a bulb.* Even this redefinition of *Amanitopsis* does not cover our specimens of *A. pulchella,* all with a well defined bulb (Fig. 6 e-g). The size and

to some extent the shape of the bulb are often affected by soil texture and depth of rooting, and should not always be relied upon as specific or, worse still, generic characteristics.

The type was collected in Victoria. Cooke (1892) states that the *cap* is "*vermilion*, clad with irregular deciduous *whitish warts*, margin saffron-yellow," but Willis (1950) states that Victorian specimens have "*scarlet to orange* caps, clad with a few *paler*, flattened *warts*." According to Cleland (1934), South Australian specimens have caps "*saffron-yellow to orange*, paling with age, with a few adherent *reddish-orange and white warty* or *patchy remains* of the volva." Our specimens from King's Park area (6 f, g) had caps of a *rich orange-red*, in many instances only *orange-yellow*, with a yellow margin. *No warts* were ever noticed. In a collection from Darlington it was noticed that specimens from red epidioritic soil had orange-coloured caps, whereas specimens from pale granitic soil had yellow caps.

According to Cooke (1892) the *gills* are "white, at length tinged with yellow" whereas Willis (1950) says that the gills are white. Cleland (1934) states that the gills are "white or cream." Our specimens had white gills at first, but a definite yellow tinge appeared fairly soon with age.

The spores vary from globose to broadly elliptical (Fig. 6 h) in the same specimen.

This species has been found in June-July in and near King's Park, and also at Reabold Hill, Chittering Brook, Darlington, Kalamunda, Wungong, Yarloop, and Merredin. It has been recorded in New South Wales, Victoria and South Australia.

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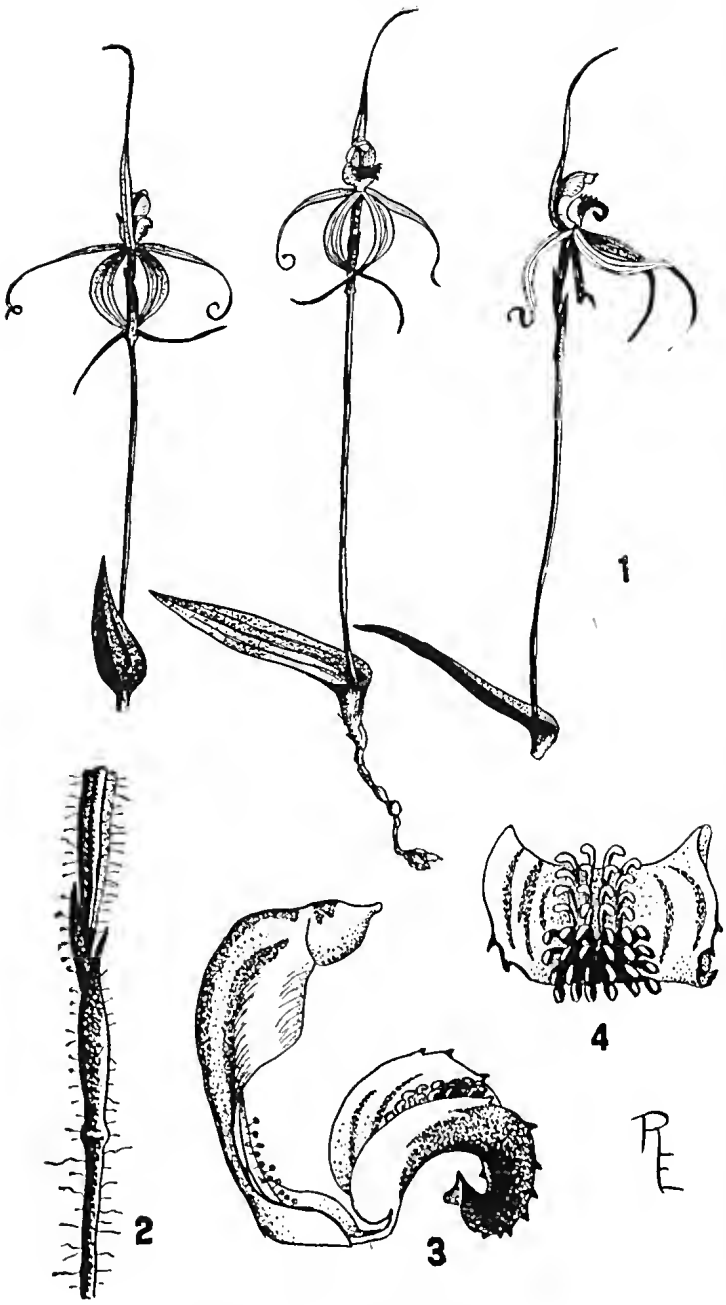
ACKNOWLEDGMENTS

Thanks are expressed to Dr. R. W. G. Dennis, of the Royal Botanic Gardens' Herbarium, Kew, for copies of Fries's original description of *A. preissii* and of Bailey's original pencil sketch showing the type of *A. farinacea*. The writer is especially grateful to Mr. J. H. Willis, of the National Herbarium, South Yarra, for very helpful comments and for details of early records and on Victorian species. Mr. G. G. Smith, of the Botany Department of the University, gave some valuable advice on microscopic work, and Mr. A. R. Main, of the Zoology Department, identified *Hypogastrura*.



Caladenia glossodiphylla sp. nov.

1. Three views of the plant. 2. Braets. 3. Side view of column and labellum. 4. Basal view of labellum.

THE WINTER SPIDER ORCHID, A NEW SPECIES FROM WONGAN HILLS

By H. M. R. RUPP and RICA ERICKSON

Caladenia glossodiphylla sp. nov.

Planta parva, usque ad 7 cm. alta, radice crasso. Folium decumbens, lanceolatum, supra exigue hirtum, infra glabrum et rubrum, 3-5 cm. longum. Bractea amplexicaulis, exigue hirta, c. 1 cm. longa. Caulis graelils, fuscus, hirtus. Flos solitarius, fere 4 cm. longus. Sepala petalaque filiformia, sed sepala lateralia ad bases latiora. Sepalum dorsale angustissimum. 2-fere 3 cm. longum, erectum sed paulum incurvum. Sepala lateralia patentia, **transversa**, saltem 2 cm. longa, ad bases 3 venis longitudinalibus rubris. Petala filiformia, aliquantum torta, c. 16 mm. longa. Labellum oblongum apice acuto, elobatum sed ad basem calcaribus duobus obtusis, breviter ungiculatum, ad basem pallidum, abhinc ad apicem rubrum; margines posteriores integri, margines anteriores dentati. Calli gammati, in 4-6 ordinibus congregati, posteriores pallidi, anteriores rubri, non ad apicem attineti. Columna incurva, supra late alata cum 3 venis fuscis crassis; anthera mucronata; basis columnae glandibus clavatis minutis ornata.

A small plant up to 7 cm. high, with a thick rhizome between the stem and the tubers. Leaf decumbent, lanceolate, resembling that of *Glossodia Brunonis* and *G. major,* except that the latter is not red-coloured on the under surface; sparsely hairy above, glabrous and dark red below, 3-5 cm. long. Stem slender, dark, hairy. Braets about 1 cm. long, the stem bract sheathing the base of the floral bract. Flower solitary about 4 cm. long from tip to tip of the extended segments. Sepals and petals filiform, but the lateral sepals broader towards the base. Dorsal sepal very narrow, 2 to nearly 3 cm. long, erect but slightly in-curved. Lateral sepals spreading, *crossed,* at least 2 cm. long, towards the base with 3 longitudinal red veins. Petals filiform, sometimes twisted, about 16 mm. long. Labellum oblong with an acute apex, not lobed but with a blunt spur on either side at the base, shortly clawed, pale towards the base, thence to the apex deep red; posterior margins entire, anterior margins *dentate.* Calli gammate, in 4-6 crowded rows; the posterior ones pale., the anterior ones red, not reaching the apex of the labellum (extending a little over half-way). Column incurved, broadly winged above with 3 coarse dark veins; anther mucronate; base of column furnished with minute clavate glands.

Habitat: Under thick scrub in red soil on the southern slopes of the Wongan Hills.

Representative locality: Western Australia, Wongan Hills. (Holotype in Perth Herbarium, *leg* Rica Erickson, June 10, 1953).

This species in the group of small spider orchids is distinctive for its unusual leaf, the glandular hairy column and its early flowering season. In other respects it is close to *C. radialis* Rogers, which differs also in the *yellow* calli on the labellum.

THE SOUTH-WEST AUSTRALIAN RACES OF THE SPOTTED SCRUB-WREN, *SERICORNIS MACULATUS*

By ERNST MAYR and ROBERT WOLK, The American Museum of Natural History, New York.

In their *Systematic List of the Birds of Western Australia*, Whittell and Serventy write of this bird (page 77): "This species is in want of revision. At the moment no worthwhile indication of geographical races is possible." This remark encouraged us to try to determine the number of subspecies in South-West-Australia. Nine names are available for what seem to be five good subspecies.

We are particularly grateful to Mr. L. Glauert, Curator of the Western Australian Museum, for sending us 25 specimens from important localities for comparison and to Dr. D. L. Serventy for the loan of 9 additional specimens. It would not have been possible to complete this study without this generous assistance.

Past students of this species have tended to neglect two factors, wear and plumage differences, both of which strongly affect variation. Worn specimens, particularly from the semi-arid portions of the range of the species, may differ quite conspicuously from freshly moulted specimens. Likewise, there are much more pronounced differences between males and females and between adult first year birds and juvenals than is evident from the literature. Since the differences between the various plumages are very much the same for all the subspecies, they have been described in detail only for nominate *maculatus*.

Sericornis maculatus maculatus Gould

Sericornis maculatus Gould, 1847. *Proc. Zool. Soc. London*, p. 2—Albany, South-west Australia.

Sericornis maculata warreni Mathews, 1912, *Novit. Zool.*, 18 (1911), p. 356.—Warren River, Western Australia.

Range. The more humid districts of continental South-west Australia. On the south coast as far east as King George's Sound, on the west coast at least as far north as Perth. Specimens identified from Stirling Range, Albany, King George's Sound, Torbay, West Cape Howe, Wilson's Inlet, Warren River, Augusta, Cape Naturaliste, Vasse, Rockingham, Claremont, Rottnest Island.

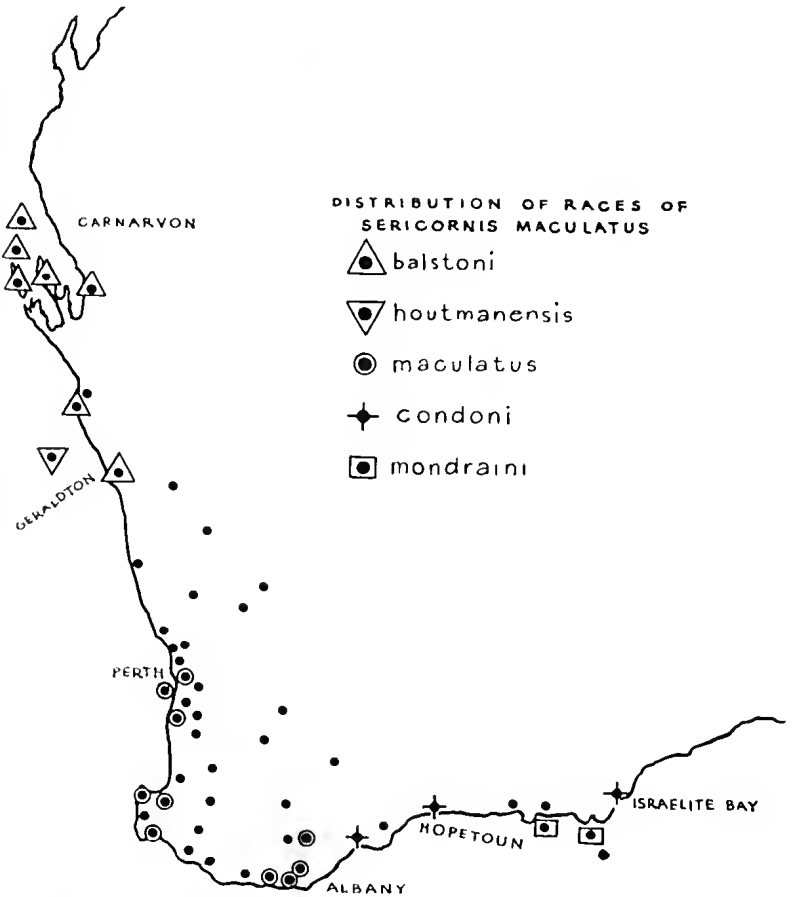
Adult Male. Lores black; white superciliary line immediately above lores from base of bill to a point just behind the eye, bordered above and below by black; also a small white mark directly below the eye. A black line from the gape to the ear-coverts; below it a white malar stripe from the base of the lower mandible to the side of the neck. Chin white, throat and breast white with heavy black shaft streaks or linearly arranged spots; middle of abdomen clear pale yellow, flanks brown. Crown and back dark brown in fresh plumage, lighter, greyer in worn

plumage. Wings brown, greater and median upper wing-coverts and alula blackish, tipped with white. All tail feathers with black sub-terminal band, sometimes indistinct or absent on central pair; white tips on inner webs of three outer tail feathers.

Adult Female. Lores light brown. Streaking or spotting on the throat and breast thinner and not as well defined as in adult male.

1st Year Male. Sub-terminal tail band relatively indistinct. Contrast of black and white on wing coverts less than that of adult male. Lores black.

1st Year Female. Streaking or spotting on the breast does not reach as low an area on the belly as in the adult female. In fact, the markings are practically limited to the upper breast. Lores brown.



Distribution of the Spotted Scrub-wren, *Sericornis maculatus*. The dots, not distinguished by symbols, represent recorded sight observations of the species.

Juvenal. White supereiliary shorter and less distinet than in adult. Brown of baek duller, without grey or olive tints. Under parts white; throat and breast with small light brown spots or streaks; flanks light brown. Some birds are yellowish on the breast and belly. Lores brown. No white on tail.

Measurements (in millimetres)

Adult Male: Wing 50-58 (mean, 53.6), tail 44.5-50 (48.1).
Adult Female: Wing 50.5-56 (52.0), tail 43.5-51.5 (46.2).
1st Year Male: Wing 51.5-56, tail 46.
1st Year Female: Wing 51-55.5, tail 44-52.5.
Juvenal: Wing 50-53, tail 42.5-46.5.

Remarks. Mathews deseribed *warreni* from the Warren River area as differing from *maculatus* in its darker head and greenish olive baek, more pronounced spotting and yellow abdomen. In the material available, there is no significant difference between birds from various localities in humid South-western Australia. The intensity of the yellow on the abdomen and the tone of coloration of the upper parts vary individually. The yellow on the abdomen may be paler near the range of *condoni* but specimens from Albany still have the under parts distinetly yellow.

Sericornis maculatus condoni Mathews

Sericornis maculata condoni Mathews, 1942, *Journ. Roy. Soc., West. Australia,* 27: 78—Hopetoun, Western Australia.

Similar to *maculatus* but without any yellow on the underparts. Upper parts, face, tail and size as in *maculatus.*

Differs from *mondraini* by the whitish throat and breast with smaller blaek spots, by the more brownish hue of the upper parts, and by smaller size.

Range. South-eastern coast of South-west Australia from the Pallinup River to Israelite Bay.

The only available speeimen of this raee from the western point of its range (Magitup, Pallinup River) has the throat and breast more heavily spotted than an average *maculatus;* however, in the type of *condoni* the under parts are supposedly more lightly spotted *(fide* Mathews).

Two speeimens (♂, ♀) from Israelite Bay (D. L. Serventy) are also rather heavily spotted underneath, but the flanks are more greyish fuseous, less brownish. The entire upper parts and likewise the tail are more greyish. These speeimens are exeeedingly simllar to *mcllori,* from South Australia, but perhaps more heavily spotted on the throat. It would not serve any useful purpose to name a population so distinetly intermediate between *condoni* and *mellori.*

Wing, ♂ 54, ♀ 53.5; tail, ♂ 50, ♀ 50.

The range of this raee is separated by a wide gap from the South Australian populations *(mellori* from Eyre Peninsula).

Sericornis maculatus mondraini Mathews

Scricornis maculata mondraini Mathews, 1942, *Journ. Roy. Soc. Wcst Australia* 27: 78. Mondrain Island, Reeherehe Archipelago.

Larger than *maculatus* and without yellow on the under parts. Throat and breast more densely and more extensively spotted than in *maculatus;* breast washed with greyish, not pure white. Sides of breast and flanks grey brown. Rump and upper tail-coverts coloured like the back, not washed with rufous as in *maculatus;* back more greyish. Larger, darker, and more heavily spotted underneath than *balstoni.* Wing, ♂ 60, ♀ 55; tail, ♂ 51.5, ♀ 47.

Two specimens (♂, ♀) from Middle Island, Reeherehe Archipelago (D. L. Serventy, June 20, 1948; July 15, 1947) are quite similar. The under parts are perhaps a little clearer, more whitish and less heavily spotted. The upper parts are more greyish but this may be due to foxing of the older, Mondrain Island, skin (J. T. Tunney, 1906). The Middle Island birds are in fine fresh plumage. Wing, ♂ 57.5, ♀ 55.5; tail, ♂ 53, ♀ 52.5.

Range. The islands of the Recherehe Archipelago. V. N. Serventy *(Australian Geographical Society Reports,* 1 (2) :21) records the bird from Mondrain, Middle and Salisbury Islands, but no specimens have been collected from the last-named island.

Sericornis maculatus balstoni Ogilvie-Grant

Scricornis maculata balstoni Ogilvie-Grant, 1909, *Bull. Brit. Ornith. Club,* 23: 72. Bernier Island, Sharks Bay.

Scricornis maculatus hartogi Carter, 1916, *Bull. Brit. Ornith. Club,* 37: 6. Dirk Hartog Island, Sharks Bay.

Sericornis maculatus geraldtonensis Mellor, 1921, *South Aust. Ornith.,* 6: 43. Geraldton, Western Australia.

Differs from *maculatus* by lacking all trace of yellow underneath and of olive above. Upper parts a colder, paler and greyer brown. Rump and upper tail-coverts coloured more or less like the back; spotting of throat and breast on the average more reduced; flanks greyer. Black sub-terminal tail bar and white tail-tips averaging wider; white tips on wing-coverts also averaging wider.

Wing, ♂ ad. 51-56, ♀ ad. 48-53; tail, ♂ 47-52, ♀ 43-49.5.

Immatures, like those of *maculatus,* with the pattern on the face, tail and under parts reduced.

Range. Western Australia, from Geraldton to Sharks Bay (Wooramel River). Specimens identified from Geraldton, mouth of Murchison River, Sharks Bay, Peron Peninsula, Dirk Hartog Island, Dorre Island, Bernier Island, Wooramel River.

Considerable individual variation is displayed by the material before us. In the type of *hartogi,* for instance, the spotting of the under parts is rather inconspicuous, but in one of the paratypes it is quite heavy. Specimens from Bernier Island (June) are worn to shreds, such from the Wooramel River (April) are

quite fresh. Two birds from Denham, Sharks Bay (July 23, 1944; August 4, 1943) are badly worn. The season of moult is apparently not the same in all parts of the range, nor perhaps in all years. Old specimens, owing to foxing, are much more brownish above than recently collected ones.

Remarks. The available material does not permit any subdivision of *balstoni.* The few specimens in comparable plumage condition suggest that in birds from Geraldton and the mouth of the Murchison River the spotting of the under parts is rather copious, and reaching far up towards the chin, the marks appear to be streaks rather than spots. Specimens from the northern extremity of the range (Wooramel River) appear indistinguishable. Birds from the Peron Peninsula have a tendency toward having the spots rounder and reaching less far up to the chin, birds from Bernier and Dorre Islands again are more like Geraldton birds. There appears to be no consistent difference between all these populations in the colour of the upper parts, of the face, and of the tail tip.

It is significant that *hartogi, geraldtonensis* and *houtmanensis* in their original description were compared only to *maculatus* and not to *balstoni,* with which these names are either synonymous *(hartogi, geraldtonensis),* or to which they are at least most closely related *(houtmanensis).*

Sericornis maculatus houtmanensis Zietz

Sericornis maculatus houtmanensis Zietz, 1921. *South Austr. Ornith.,* 6: 44. Houtman's Abrolhos.

Sericornis maculatus fuscipes Alexander, 1922, *Journ. Linn. Soc. London,* 34: 465. Wallaby Island, Houtman's Abrolhos.

Similar to *balstoni,* but bill and legs darker; spotting on throat and breast and perhaps also black marks in the face of the male much reduced; more white on forehead; less white on tips of tail feathers; no yellow on under parts; rump coloured as the back; general coloration of upper parts not clearly different from that of *balstoni.*

Wing, ♂ 51.5, ♀ 47, 48, 50; tail, ♂ 47, ♀ 45, 45.5, 47.

Range. Abrolhos Islands (East and West Wallaby Islands).

We have seen only four skins which are rather too soiled to permit an accurate description of the coloration, as well as three fresh birds (1 ♂, 2 ♀), collected by D. L. Serventy, December 8, 1945, of which at least the male is not fully adult.

FROM FIELD AND STUDY

Strepera versicolor **feeding on** *Bothriembryon.*—During February, 1952, I was collecting for the Museum in the Ravensthorpe and Hopetoun districts. On one of my field excursions near the Phillips River I disturbed several parties of the Squeaker *(Strepera versicolor),* busily feeding on the ground. Their behaviour attracted my attention. Various individuals would stand with their legs well apart and commence to sweep the debris on

the ground with their beaks, thus exposing whatever food items they were seeking. When the birds flew off at my approaeh I examined the disturbed ground and found several native snails. Some of the snails were alive with the shell eomplete, others had holes in the shells, obviously made by the feeding birds, and in others the shells were fraetured. The shells were brown in eolour and about ¾ in. in length. I colleeted a number of undamaged speeimens, which were later identified by Mr. A. R. Main as *Bothriembryon balteolus*.

Residents in the distriet told me that when there is a "plague" of these snails the Squeakers are about in large numbers.

Major H. M. Whittell *(W.A. Nat.,* vol. 3, 1952, p. 79) has reprodueed field notes by the late S. W. Jaekson, deseribing the feeding by Squeakers on tree-frequenting *Bothriembryon* in the karri forests of the South-west.

—K. G. BULLER, W.A. Museum, Perth.

An Extension of Range of the Western Tiger Snake.—The generally aeeepted distribution range of the Western Tiger Snake *(Notechis scutatus oeeidentalis* Glauert) in this State is the South-west, as far north as the Moore River. I was surprised, therefore, to kill a speeimen of this form in the vieinity of a large dam at Nangetty Station, 16 miles north of Mingenew, on September 19, 1953.

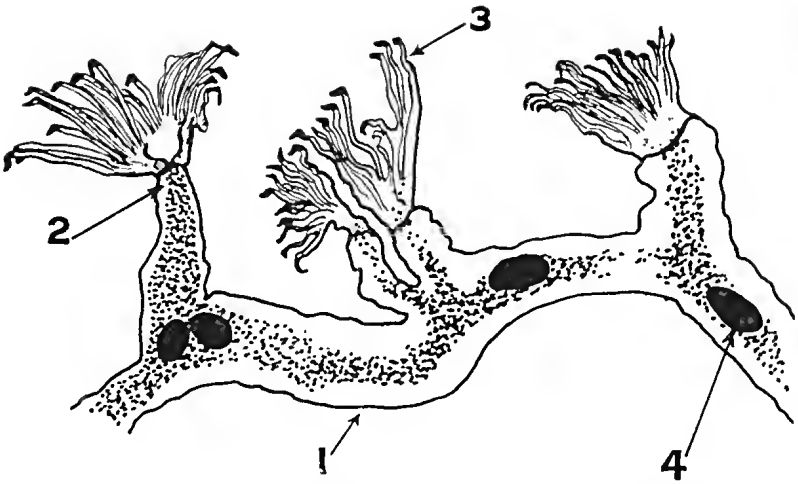
The eolour of the reptile was blue-blaek above and pale beneath. It measured about 4 ft. 6 in. in length and was at first mistaken for a Mulga Snake *(Pseudeehis australis* (Gray)). On being disturbed, however, it showed the characteristie aggressiveness of the Tiger Snake and flattened its neck when rearing to strike.

Unfortunately no faeilities were available for preserving the snake but a eareful examination was made of the sub-eaudal seales, all of whieh were eomplete. This feature separates the Tiger Snake from the Mulga Snake (whieh has the terminal sub-eaudals divided) and from the various forms of the Dugite or Brown Snake *(Demansia nuchalis)* (in whieh the anal and all the sub-eaudals are divided).

—C. F. H. JENKINS, Agrieultural Department, Perth.

Fresh-water Polyzoa from Western Australia.—E. J. Goddard ("Australian fresh-water Polyzoa," *Proc. Linn. Soc. N.S.W.,* vol. 34, 1909, pp. 487-496) listed genera and deseribed new speeies of Polyzoa eolleeted in Australia. Of the speeies listed by him *Plumatella repens* van Beneden had a eosmopolitan distribution. This wide range is presumably aehieved by the aerial dispersal of the drought-resistant statoblasts.

The distribution listed by Goddard was extended by V. V. Hickman and E. O. G. Seott ("The oeeurrenee of the fresh-water



Plumatella repens. Portion of colony, x 20.

1. Creeping cylindrical stolon. 2. Zoid. 3. Tentacles of lophophore. 4. Statoblasts.

Polyzoan, *Plumatella repens* van Beneden, in Tasmania," *Pap. Roy. Soc. Tas., 1932* (1933), pp. 7-9). With this extension the known distribution of *Plumatella repens* covered eastern Australia, from South Australia east and northward. The singular absence of reports from Western Australia was rather surprising and, since the Hamburg Expedition of 1905 (W. Michaelsen and R. Hartmeyer, *Die Fauna Sudwest-Australiens,* 1909-1936, vols. 1-4) had collected in a number of fresh-water localities and not reported Polyzoa, there appeared a prima facie case for believing in a complete absence of Polyzoa from the region. This, in view of the aerial dispersal already discussed, was difficult to believe and could only be effected by the unsuitability of local waters or other factors.

It is the purpose of this note to report that the author, in the company of B. A. Main, and A. K. Lee, in November 1952, searched extensively in Bibra Lake for Polyzoans and B. A. Main had the good fortune to find a well-developed colony of zoids with reproductive bodies on a reed stem in shallow water.

A comparison of the colony and statoblasts with descriptions in the literature revealed the identity of the specimen as *Plumatella repens.*

The accompanying figure showing the branching, adherent tubes of the colony enclosing numerous statoblasts, and zoids with the characteristic lophophore, will facilitate field identification.

No other colonies were located at Bibra Lake but it is unlikely that this animal is limited in distribution in Western Australia and search on shaded, submerged vegetation in suitable fresh waters may yield further data on the distribution of this species.

—A. MAIN, Zoology Department, University, Nedlands.

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SOME BIRD OBSERVATIONS MADE AT THE ABROLHOS ISLANDS

By E. H. M. EALEY*

The following remarks are based on observations made in August 1953, and on information given me by local crayfishermen. During my stay in the Southern Group, of the Abrolhos Islands, I made a trip to an islet of the Mangrove Islands, situated at the northern end of Pelsart Island. Several of these bear local names which appear to vary from time to time. One of these, Fin Island, also called Brad Island, was visited on August 11. The main island, Pelsart, was visited on August 13.

Crested Tern, *Sterna bergii* Lichtenstein

A breeding colony, at the northern end of Fin Island, in which over 150 adults were counted, was inspected. Many birds were absent fishing so that the strength of the colony was estimated at some 200 pairs. Chicks were present but it was impossible to guess at the number because those that were not hidden in the low vegetation would "freeze" to the ground and become indistinguishable among the broken coral. When disturbed the adults would pack and drive their chicks into the closest patches of vegetation, while at the seaward edge of the rookery the chicks usually jumped into the sea, from as high as 4 feet, and swam away, often attended by hovering parents. The chicks appeared to be from a week to a fortnight old.

Five eggs were given me by a local fisherman. He had collected them between July 6 and 10, when each "had a red streak in it", so incubation had evidently begun by that time. This record of early breeding is interesting in view of the fact that Serventy and Whittell *(Birds of Western Australia,* 1951, p. 131) give November as the breeding month at the Abrolhos. The present record indicates a prolonged nesting season in that area, but it still falls within the spring-breeding category of Serventy *(The Emu,* vol. 52, 1952, p. 51) in his review of the nesting seasons of Western Australian sea-birds. No autumn-breeding populations of the species have been noted on the west coast, south of Sharks Bay.

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The eggs were stated to represent the different types that the fisherman had observed in the rookery. They certainly showed a great diversity in pattern. The figures for length and breadth are given in millimetres: 69.0 x 41.5, 59.5 x 42.3, 60.5 x 42.9, 61.5 x 42.0 and 64.0 x 41.2.

Adults continuously brought small fish back to the chicks. When an adult returned with a fish several chicks might stumble towards it but they would be ignored, the parent either seeking out its own chick or standing calling until it came. A pair standing with their chick savagely attacked a strange chick which approached them.

Red-tailed Tropic-bird, *Phaethon rubricaudus* Boddaert

Two dead birds were found between the tourist camp and the loading jetty on Pelsart Island. They were beside a bush under which fishermen had seen this species nesting. Both birds had the flesh torn from the top of the head and the back of the neck; the eyes were missing also. The fishermen claimed that the damage was done by "fish eagles" or Ospreys, although no one had ever seen either attack a Tropic-bird. Mr. J. H. Calaby (C.S.I.R.O. Wildlife Survey Section) considered that the damage was not typical of birds of prey, but he considered it characteristic of rat attack. The following measurements of the birds in millimetres, were made: (a), culmen, 67.5; toe, 59; tarsus, 33; wing, 358; tail, 112, with streamers measuring 438 and 454; (b), culmen, 64.6; toe, 51; tarsus, 31; wing, 340, and tail, 110, with developing streamers 300 and 180. Cephalopod remains were found in the stomachs of both birds.

One of the dead birds contained a fully developed egg in its oviduct. The only other Tropic-bird seen was hovering over the nesting site and may have been the mate of the dead bird containing the egg.

Fishermen claimed that two pairs had been seen nesting in September 1952 and one pair in January 1953. There may have been more as "about a dozen" Tropic-birds had been seen at this time. This claim of the presence of a comparatively large number of Tropic-birds in 1953 is interesting in view of the fact that a fisherman said he had shot 16 of what he described as "fish eagles" between April and June 1952 at Pelsart Island.

Lesser Noddy, *Anous tenuirostris* Temminck

I was unable to visit the breeding site of these birds but, as we left Pelsart Island at sunset, numerous fishing parties each of several hundred Noddies were flying towards the mangroves where they are reputed to nest. This supports the suggestion of Serventy and Whittell *(Birds of Western Australia,* p. 141) that the species is resident at the Abrolhos and not migratory as is the Common Noddy (*Anous stolidus).* No individuals of the Common Noddy nor of the Sooty Tern *(Sterna fuscata)* were seen at the time of my visit.

THE WESTERN AUSTRALIAN SPECIES OF *XYRIS*

By N. A. WAKEFIELD, Noble Park, Victoria.

During the past several years, a survey has been carried out of the Australian representatives of the genus *Xyris**; and, while the aggregate of literature on the subject provides a satisfactory classification of the eastern and northern Australian species, those of temperate Western Australia have not been adequately dealt with.

All *Xyris* species which are known from the temperate part of Western Australia are apparently endemic in the comparatively small 200-mile-long near-coastal belt from about Albany to the Margaret River area†. Three of these species *(X. lanata, X. lacera* and *X. flexifolia)* were named by Robert Brown in *Prodromus Florae Novae Hollandiae:* 256-257 (1810), and Mueller dealt with a further two *(X. laxiflora* and *X. gracillima)* in *Fragmenta Phytographiae Australiae, VIII:* 203 (1874). Of these five species, a very small aggregate of specimens had been collected to provide material for the classification set out by Bentham in *Flora Australiensis, VII:* 76-81 (1878).

Recently, the present writer came across two Western Australian collections of *Xyris,* representing apparently an undescribed species, closely resembling *X. gracillima* but differing in two important details. As the latter was known only from its type collection, there was the possibility that it represented an aberrant form. Examination of the *Xyris* material of the State Herbarium, Perth, revealed a second collection true in all details to the original *X. gracillima,* and also material of two more undescribed species.

In this paper, the 8 known species of the extreme south-west of Western Australia are dealt with in detail; and the three recorded from the north of the State (and two others which probably occur there) are also noted. These last five species are eventually to be included elsewhere in a detailed treatment of the eastern and tropical Australian species, and are mentioned here so that the present paper will cover, as far as knowledge to date goes, all Western Australian members of the genus.

The fact that three species of *Xyris* have each been collected once only in Western Australia indicates the need for further

* The genus has no widely used common name; the vernacular for the group, as given in the Field Naturalists Club of Victoria *Census of Victorian plants* is "Yelloweye", but the name was probably coined by the Plant Names Sub-Committee of the Club.

† A. B. Rendle, in the *Journal of Botany,* 37: 501-504 (1899), cited "Swan River" for several collections, but this would refer to the whole original colony and not to the present specific locality. If the 'Lucky Bay' location for Robert Brown's *X. teretifolia* (Bentham) is correct, then the range of the group is more than doubled, and extends well into the low rainfall area. It is not considered that the 'Champion Bay' specimen of *X. lanata* R. Br. could have come from the Geraldton district.

field work on the genus in that State. It is hoped that this paper will serve as a guide for such investigation.

Bentham (*l.c.* p. 76) may be referred to for the general characters of the genus, or they may be seen in the illustrations with this paper. Entirely different types of capsules indicate natural groups in the Australian species; and the placentation may be consistent within each of these groups, though in many species insufficient specimens are available at corresponding stages of maturity to prove this. The two distinct types of anthers provide a most clear-cut division, and shape and size of this organ relative to the filament is constant within each species. Other stable specific characters are the degree to which the style is cleft, the shape of the petal (often lost however in herbarium specimens), and the nature of the bracts and lateral sepals ("bracteoles"—Bentham).

The following key uses the above features; and no skilled technique is required for the simple dissections to observe them. Vegetative details are avoided as unreliable key features; for, while leaf-blades are consistently present in many species, they may be either present or absent within others, while the cross-section and surface of the scape often vary considerably also. Size of many external characters varies extremely, and the measurements given here in the descriptions of the species are of the maximum sizes noted.

KEY TO THE *XYRIS* SPECIES OF TEMPERATE WESTERN AUSTRALIA

(The accompanying illustrations portray all features used in the key.)

In all these species the apex of the capsule is hard and indehiscent.

A.—Anther-cells distinct; staminodes densely penicillate.
  B.—Apex of capsule smooth; bracts plumose ..... 1. *X. lanata*
  B.—Apex of capsule scabrous; bracts glabrous ... 2. *X. laxiflora*

A.—Anther-cells confluent; staminodes absent or glabrous.
  C.—Bracts distinctly lacerated or toothed.
    D.—Bracts round; style undivided .... 3. *X. lacera*
    D.—Bracts oblong; style 3-fid .... 4. *X. flexfolia*

  C.—Wings of bracts normally entire.
    E.—Style cleft halfway to base.
      F.—Staminodes absent; basal sheaths acute .... 5. *X. royceі*
      F.—Staminodes present; basal sheaths obtuse .... 6. *X. gracillima*
    E.—Style little or not cleft.
      G.—Style entire; anther-lobes sub-equal ... 7. *X. indivisa*
      G.—Style 3-fid; anther-lobes very unequal .... 8. *X. inaequalis*

SUMMARY OF SPECIES

The location of the specimens cited hereunder are abbreviated as follows:

MEL—National Herbarium of Victoria, Melbourne.
NSW—National Herbarium of New South Wales, Sydney.
PERTH—Western Australian State Herbarium, Perth.

I am indebted to the Government Botanists and members of the staffs of these institutions for the opportunity to examine the material concerned.

Duplicates of a number of these specimens and some additional ones are in the British Museum or Kew, England. Some of these are cited by Bentham and most by Rendle. Those which give further locality records are quoted below.

1. *Xyris lanata* R.Br.

Rootstock perennial: leaves few, to 35 cm. long and 1.5 mm. broad, the sheaths with dark keels; scapes terete, to 75 cm. tall and 1.5 mm. in diameter; spikes oblong, about 1.5 cm. long and 1 cm. broad; bracts seriate, dull, the empty ones numerous strap-like concolourous and hirsute at the apex, floral ones oblong pale with dark wings and the upper margins hirsute; lateral sepals narrow, the apex hirsute, the keel denticulate; petals broad; stamens small, anther-cells separated, filament about the same length; staminodes penicillate; ovary with a large hard smooth apex; capsule fragile beneath the hard detachable apical cap.

BOW RIVER—S. W. Jackson, 10/1912 (NSW). ALBANY—W. V. Fitzgerald, Nov. 1907 (NSW); "R.H.", 12/1898 (PERTH); C. A. Gardner, 6 Nov. 1927 (PERTH). KING GEORGES SOUND—Oldfield 575 (MEL); Webb (MEL); Mueller (MEL); J. H. Maiden, Nov. 1909 (NSW). NEAR STIRLING RANGE—J. Forrest, Nov. 1881 (MEL). GRANITE BAR—R. H. Pulleine, 12/1917 (NSW). BETWEEN NANNUP AND NILLUP—R. D. Royce, 24/10/1948 (PERTH). Without locality — E. Pritzel, 11/1901 (NSW); Preiss 2222 (MEL, NSW); J. Drummond 257 (MEL). (Also "CHAMPION BAY, Bower"—Rendle.)

2. *Xyris laxiflora* F. Muell.

"Rootstock annual" (Bentham); leaves flat, to 12 cm. long and 1.5 mm. broad, the outer ones shorter, the sheaths short and broad; scapes terete, flexuose, very slender, to 40 cm. tall, the basal sheath up to 10 cm. long acuminate; spikes oblong, about 1.3 cm. long and 1 cm. broad; bracts scarious, lower ones lanceolate blunt concolourous, upper ones oblong with dark wings and a pale triangular centre; lateral sepals narrow, acute, the keel prominent and shaggy, the wings with scaberulous margins; petals broad, elliptic; anthers small, on long filaments; staminodes penicillate; ovary with enlarged 3-lobed scabrous-pubescent apex.

SYNTYPES—J. Drummond Nos. 202, 355 (MEL). BETWEEN NANNUP AND NILLUP—R. D. Royce 2496, 24 Oct. 1948 (PERTH). "VASSE AND AUGUSTA RD.—Gilbert" (Rendle).

The following six species form a very distinct group having large anthers with the cells confluent at the apex as well as connate for most of their length. Moreover, staminodes are absent in all but one of the species, apparently by reduction, for those of the exception are glabrous. All other Australian species of the genus have the anther-cells separated on a connective and staminodes bearing jointed hairs. These six species are consistent also in having the 3-lobed scabrous-pubescent ovary which however occurs also outside the group in *X. laxiflora*.

3. *Xyris lacera* R.Br. (Syn. *X. teretifolia* R.Br.)

Rootstock robust but apparently annual; leaves few, smooth, elliptical in section, to 30 cm. long and 1.5 mm. broad, the outer ones shorter, the sheaths stout and short; scapes terete, up to 100 cm. tall and 2 mm. in diameter; basal sheath long with short blade; spikes large, about 1.5 cm. in diameter, globular; empty bracts few, narrow, concolourous, irregular at the apex; floral bracts rounded, the basal half brown and shining, the upper half with semicircular pale centre and very lacerated dark wings; lateral sepals spathulate, the apex rounded and bifid with irregular margins, the keel prominent and denticulate; petal lamina round; anthers very large (3 mm. long), oblong, the filament very short and broad, cells connate, the apex rounded and confluent; staminodes absent; style long, undivided; ovary as in *X. laxiflora*.

KING GEORGES SOUND—F. Mueller, Oct. 1867 (MEL). MARBLUP RIVER (Wilsons Inlet)—Oldfield 741 (MEL). LAKE MUIR—F. Mueller, 14/12/1877 (MEL). CHORKERUP—Mueller, 18-20/12/1877 (MEL). TORBAY JUNCTION (Elleker)—Cecil Andrews, 22 Dec. 1902 (PERTH). SCOTT RIVER (South of Nillup, — R. D. Royce 63, 17 Jan. 1945 (PERTH). MARGARET RIVER—A. J. Hall, Jan. 1936 (PERTH). ALBANY—"R.H.", 12/1898 (PERTH). "AUGUSTA—Gilbert" (Rendle). "LUCKY BAY—R. Brown, the type of *X. teretifolia*" (Rendle); "Highly scabrid leaves and peduncles, very stiff terete leaves and smaller spikes" (Bentham).

4. *Xyris flexifolia* R.Br. (Syn. *X. acmula* Steud.)

Rootstock perennial; scapes very slender, twisted, striate, terete, to 40 cm. tall and .5 mm. in diameter, the sheaths to 7 cm. long broad blunt red-brown twisted; "sometimes a second sheath produced into a slender terete blade" (Bentham); spikes narrow-oblong, to 7 mm. long and 3.5 mm. in diameter; bracts narrow-elliptical, the centre pale, the wings dark and lacerated in the upper part; lateral sepals narrow-linear, entire, smooth; petal lamina narrow-elliptical; style cleft at apex into very short arms.

BOW RIVER—S. W. Jackson, 11/1912 (NSW). KING GEORGE'S SOUND—L. Preiss 2221, Duplicate of type of *X. acmula* (MEL, PERTH). BETWEEN PORONGORUP AND WILLYUNG —F. Mueller, Oct. 1867 (MEL).

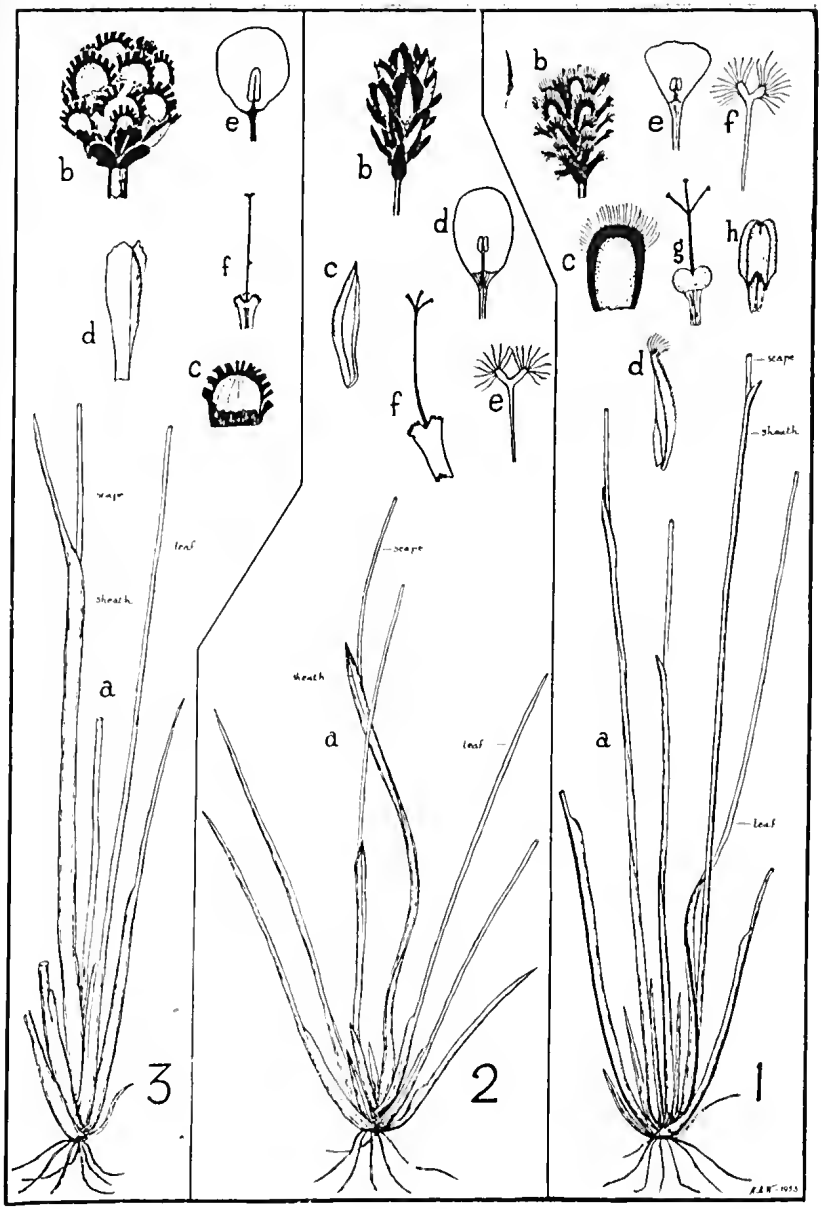


PLATE 1.

Fig. 1.—*X. lanata*—*a*, Rootstock and basal parts (x ½); *b*, spike (nat. size); *c*, braet; *d*, lateral sepal; *e*, petal and stamen; *f*, staminode; *g*, style and ovary; *h*, mature capsule. Fig. 2.—*X. laxiflora*—*a*, Rootstock and basal parts (x ½); *b*, spike (nat. size); *c*, lateral sepal; *d*, petal and stamen; *e*, staminode; *f*, style and ovary. Fig. 3.—*X. lacera*—*a*, Rootstock and basal parts (x ½); *b*, spike (nat. size); *c*, braet; *d*, lateral sepal; *e*, petal and stamen; *f*, style and ovary.

5. *Xyris roycei* sp. nov.

Scapi teretes, graciles, laeves glaberrimique; vagina acuminata. Spica subglobosa, circa 1 cm. longa; bracteae integerrimae, inferiores oblongae scariosae, intermediae (fertiles) latae bicoloratae. Sepala lateralia angusto-oblonga, obtusa, integerrima, carina scabra. Petala lamina lata. Antherae magnae (circa 3 mm. longae), loculis ad apicem confluentibus, filamentum perbreve. Stylus ad medium divisus. Ovarium apice trilobum asperumque.

HOLOTYPE: Plains south of Blackwood River between Nannup and Nillup, R. D. Royce 2938, 24 Oct. 1948 (PERTH, duplicate at MEL).

Scapes to 90 cm. tall and 1.5 mm. in diameter, basal sheath about 20 cm. long spirally twisted and tapered to an acuminate point; spikes to about 1 cm. in diameter; bracts rounded, pale with dark entire wings, lower ones narrow, spreading and concolourous; lateral sepals oblong, bifid, scabrous-keeled; petals broad; anthers large (about 3 mm. long); style cleft halfway to the base.

BETWEEN NANNUP AND NILLUP—There is only the one collection of this species, which is named in honour of the discoverer of this and other significant material of the Western Australian species of *Xyris*.

6. *Xyris gracillima* F. Muell.

Rootstock perennial; scapes "3 to 4 ft. tall" (Royce), terete, to about 1 mm. in diameter; sheaths loose, blunt, to over 10 cm. long, "a second sheath sometimes produced into a long filiform blade" (Bentham); spikes globular, up to 7 mm. diameter; bracts rounded, entire, with dark wings; lateral sepals oblong, entire, smooth, bifid; petals broad; staminodes dilated, glabrous; style cleft more than halfway to base.

NILLUP, on the Brockman Highway—R. D. Royce 3019, 30 Oct. 1948 (PERTH). Without locality—Drummond 199, the type (MEL).

7. *Xyris indivisa* sp. nov.

Scapi teretes, graciles, basi vgaina obtusa. Spica globosa, circa 8 mm. lata; bracteae imbricatae, alis integerrimis, intermediae (fertiles) bicoloratae. Sepala lateralia angusto-oblonga, integerrima, obtusa. Petala lamina lata. Antherae magnae, loculis ad apicem confluentibus, filamentum perbreve. Staminodia nulla. Stylus indivisus. Ovarium apice trilobum asperumque.

Ex affinitate *X. gracillima* sed stylo indiviso et staminodiis nullis.

HOLOTYPE: Karri Forest, swampy banks of the Shannon River, F. Mueller, 12/12/1877 (MEL., duplicate at PERTH).

Rootstock perennial; scapes to 80 cm. tall and 1.5 mm. in diameter; sheath loose, obtuse, a second sheath sometimes produced into a long filiform leafblade; spikes globular, up to 8 mm. in diameter; bracts rounded, entire, pale with dark wings; lateral

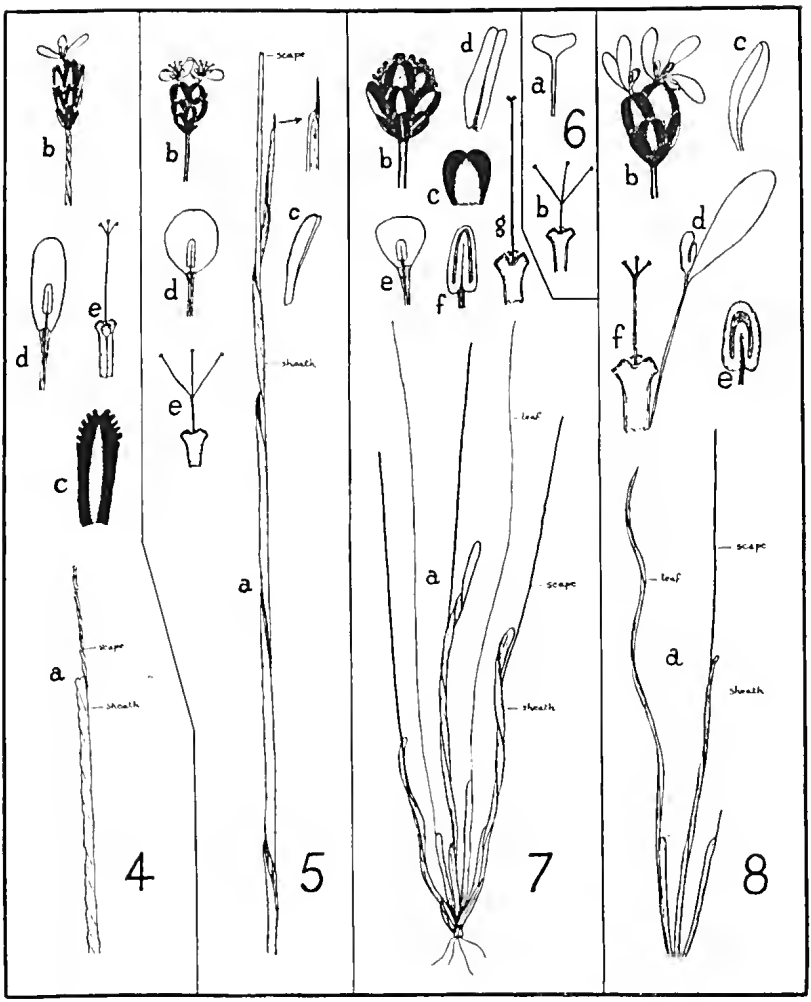


PLATE 2.

Fig. 4—*X. flexifolia*—*a*, Basal part of eulm and sheath (x $\frac{1}{2}$); *b*, spike (nat. size); *c*, braet; *d*, petal and stamen; *e*, style and ovary. (Details from Preiss 2221). Fig 5.—*X. roycei*—*a*, Basal part of eulm and sheath (x $\frac{1}{2}$); *b*, spike (x $\frac{1}{2}$); *c*, lateral sepal; *d*, petal and anther; *e*, style and ovary. (Details from type specimen). Fig. 6.—*X. gracillima*—*a*, Staminode; *b*, style and ovary. (Details from type specimen). Fig. 7.—*X. indivisa*—*a*, Rootstock and basal parts (x $\frac{1}{2}$); *b*, spike (slightly enlarged); *c*, bract; *d*, lateral sepal; *e*, petal and anther; *f*, stamen (outer view); *g*, style and ovary. (Details from Bow River specimen). Fig. 8.—*X. inaequalis*—*a*, Some basal parts (x $\frac{1}{2}$); *b*, spike (x 2); *c*, lateral sepal; *d*, petal and anther; *e*, anther (outer view); *f*, style and ovary. (Details from type specimen).

sepals oblong, smooth, the apex bifid; petals broad; anthers large; no staminodes; style undivided.

SHANNON RIVER—This type material has no leafblade. BOW RIVER—S. W. Jaekson, 11/1912 (NSW).

8. *Xyris inaequalis* sp. nov.

Folia angusta, complanata. Scapi teretes, graeiles; vagina obtusa. Spica globosa, cirea 4 mm. lata; braeteae imbricatae, alis intgerrimis, intermediae (fertiles) bicoloratae. Sepala lateralia lata, integerrima, obtusa, carina denticulata, alis inaequilateralibus. Petala lamina angusta. Antherae parvae (circa 1 mm. longae), loculis ad apicem confluentibus atque quum apertis lobis valde inaequalibus. Stylus ad partem quintum trifidus. Ovarium ad apieem trilobum asperumque.

HOLOTYPE: Bramley, Margaret River Distriet, R. D. Royee 1407, 8 Nov. 1946 (PERTH, duplicate at MEL).

Rootstoek perennial; leaf-sheaths blunt, with blades (to 20 em. long, 1 mm. broad, flattened) in younger plants only; scapes to 65 em. tall, under 1 mm. in diameter, the largest ones slightly flattened, basal sheath blunt up to 25 em. long; spikes up to 5 mm. long and 4 mm. in diameter; main bracts entire, round smooth, pale with dark wings, lowest ones concolourous; lateral sepals dilated with unequal entire wings, the dorsum denticulate; petals narrow; anthers short (about 1 mm. long), opening unequally with a very short outer lobe; style cleft at apex only.

BRAMLEY—The holotype material is a small specimen with leafblades, and some collected at the same time (Isotype) is taller and lacks the leafblades. OSMINGTON, Margaret River District —R. D. Royce 2808, 14 Oet. 1948 (PERTH, duplieate at MEL). The latter material is very tall and lacks leafblades.

TROPICAL SPECIES

The tropical Western Australian species all have the capsule fragile and dehiscing along its entire length; the anther-cells are distinct, and there are eiliate staminodes present.

Xyris complanata R. Br. (Syn. *X. elongata* Rudge) is a stout perennial with the scapes and leaves normally very mueh flattened and with acute edges. It is however a polymorphie species with a number of synonyms, and ranges aeross tropieal Australia, south-easterly to near Sydney, and northerly into the larger islands. In eastern Australia the seapes are sometimes narrower and scabrous (Syn. *X. scabra* R. Br.) or terete and smooth (Syn. *X. laevis* R. Br.); but the verrucose bracts with out-turned wings and the usually elongated spikes readily distinguish the species. It has been reeorded from eleven loealities in the north of Western Australia.

X. indica Linn. (Syn. *X. paludosa* R. Br.) and *X. pauciflora* Willd. (Syn. *X. denticulata* R. Br.) are known from Western Australia only from a single eolleetion (of both together), made by W. V. Fitzgerald at Isdell River in May 1905. *X. indica* is a

coarser plant with leaves up to 6 mm. broad and transversely marked, and the scapes are rounded in section with 5 or 6 longitudinal channels; while *X. pauciflora* is more slender, with leaves up to 1.5 mm. broad, and scapes terete and striated. Both species range across tropical Australia and into south-east Asia.

It is most probable that two other much smaller annual species are native also in tropical areas of Western Australia, for they have been recorded in the Northern Territory and Queensland. *X. pusilla* R. Br. has broad short spreading leaves and the scapes are two-angled beneath the spike; and *X. oligantha* Steud. has erect narrow reddish leaves and the scapes 4-angled. Each is only a few inches in height.

WESTERN AUSTRALIAN PEARL SHELLS

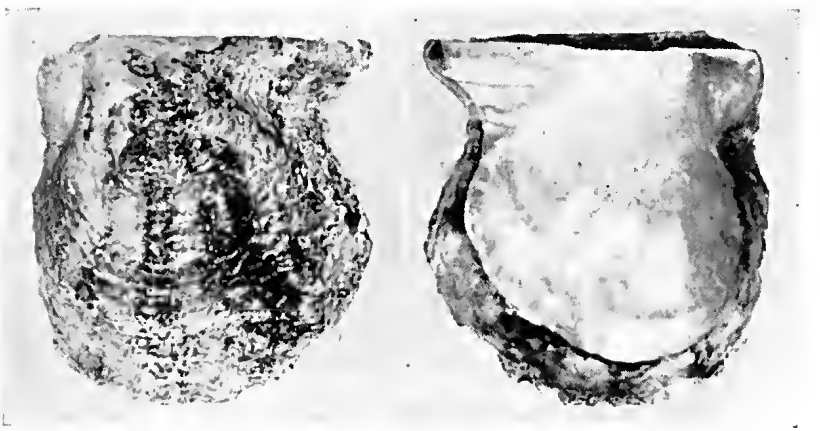
By BERNARD C. COTTON, The South Australian Museum, Adelaide.

The Pearl Shells belong to the family Pteriidae and there are four genera: *Austropteria,* with a long wing developed along the hinge; *Magnavicula,* with a shorter wing; *Pinctada,* without a wing, and *Electroma*, small and delicate, without a wing. The first genus, *Austropteria*, has not been recorded from Western Australia.

In Hedley's "A Preliminary Index of the Mollusca of Western Australia" *(Journ. Roy, Soc. W.A.*, vol 1, 1916), a dozen species appear under this family name.

Malleus malleus Linne, 1758. Coral Hammer. This is the coral reef species. *Malleus albus* Lamarck, 1819, the White Hammer, should be added as this is the Northern and North-western mainland species.

Malleus regulus Forskal, 1775. Bean Hammer. The species comes from the Philippines and belongs to the genus *Parimalleus*



Sharks Bay Pearl Shell, from Albany, natural size.

in which the shells are elongate but the hinge line is not produced laterally and the hinge is toothless. Brazier, 1884, records it from Cossack under the name *Malleus vulsellatus* Lamarck. These two species belong to the family *Vulsellidae*.

Pteria macroptera Lamarck, 1819. Black Band Wing Pearl Shell. This belongs to the genus *Magnavicula*.

Pinctada zebra Reeve, 1857. Zebra Wing Shell. This species came from Moreton Bay, Queensland, but the Western Australian species may be *Avicula physoides* Lamarck, 1819, *Anim. S. Vert.*, VI, p. 149. Described from North Australia another possible name is *Avicula virens* Lamarck, 1819, described on p. 150 of the same publication, from North-western Australia.

These three specific names are listed as *Pinctada*, but *zebra*, *physoides*, and *virens* belong to the genus *Electroma*.

More than a dozen true pearl shells of the genus *Pinctada*, genotype *P. margaritifera* Linne, 1758, have been recorded from Australia. Most of them occur in the north but one species, *P. perviridis* Reeve, 1851, the Southern Pearl Shell, lives in New South Wales. Western Australian species appear in Hedley's Index under the following names.

Pinctada margaritifera Linne, 1758. Black Lip Pearl Shell of the Indo-Pacific. This is closely related to the smaller Australian Black Lip, *P. nigromarginata* Saville Kent, 1893, described from Thursday Island, Torres Straits. These two are distinguished one from the other by pearl traders and again from the more valuable commercial *P. maxima* Jameson. *P. margaritifera* has been listed by various authors from South Australia, Western Australia and Victoria, all of which records are probably erroneous.

P. maxima Jameson, 1901. Golden Lip or Silver Lip. Described from Moresby Island, British New Guinea and plentiful in Torres Straits, occurs in North-western Australia.

Pinctada sugillata Reeve, 1857. Sugillate Pearl Shell. Described from Cape Hillsborough, North Australia. Synonyms are *P. fimbriata* Reeve, 1857, and *P. reevcana* Dunker.

Pinctada vulgaris Schumacher, 1817. Probably a West Indian species difficult to determine.

Pinctada carchariarum Jameson, 1901. Shark's Bay Pearl Shell. This species was once collected at Shark's Bay for pearls, but is now used only for manufacture into small buttons. We have dead or subfossil specimens from the Abrolhos and it is in quantity as a subfossil in raised beaches at Murat Bay, South Australia. I took living specimens of what appears to be this species at Leighton and Mrs. E. R. Stubbs found it at Albany early in April, 1953, washed up on the ocean beach after a heavy blow. Western Australian naturalists should search for this pearl shell and compare South-western and North-western specimens as the true *P. carchariarum* appears to be somewhat larger and thicker than the southern shell.

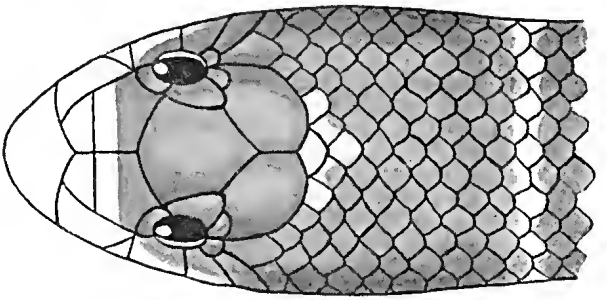
HERPETOLOGICAL MISCELLANEA*

By L. GLAUERT, W.A. Museum, Perth.

III.—A NEW BURROWING SNAKE FROM NORTH-WESTERN AUSTRALIA

Rhynchoelaps approximans sp. nov.

Snout prominent, shovel-shaped, the edges sharp. Rostral broader than deep, its upper portion forming a right-angle posteriorly, entering some distance between the internasals; slightly longer than its distance from the frontal. Internasals broader than long slightly shorter than the prefrontals which are also wider than long. Frontal almost as wide as long, as long as its distance from the tip of the snout, nearly as long and nearly as wide as the parietals. Nearly three times as wide as the slender supraoculars. Nasals semi-divided. Six upper labials; the third and fourth entering the eye; one preocular; two postoculars; temporals one plus one. Three lower labials in contact with the anterior chinshield which is larger but scarcely longer than the posterior.



Rhynchoelaps approximans sp. nov. x 5.

Scales in seventeen rows; 174 ventrals; 26 divided subcaudals; anal divided.

Remarks: Close to *R. campbelli* Kinghorn, 1929 but differing in the shape of the rostral as seen from above, the internasals shorter than the prefrontals; the broader parietals and the number of upper labials, 6 instead of 5, and in the absence of the intercalated shield which may be an abnormality in *R. campbelli.*

Colour: Clove-brown with 80 narrow cross bands less than a scale wide extending from the nape to the tip of the tail; head and nape darker. Snout pale, this colour extending backward half across the prefrontals, upper lip and entire under surface whitish.

Locality: A single specimen collected on Mucean Station (Lat. 23°30'S., Long. 120°E.) by Mr. D. W. H. Shilling, June, 1953.

Holotype: In the Western Australian Museum, R10768..

I am indebted to Miss O. Seymour for the illustration.

*Nos. I and II of this series appeared in this journal, vol. 3, no. 7, p. 166.

OBSERVATIONS ON THE LIFE HISTORY OF THE MOTH *ANTHELA XANTHARCA* (MEYRICK)

By MRS. M. B. MILLS, Merredin

On May 6, 1951, while opening up a bag shelter of *Ochrogaster contraria* (Walker), I found a caterpillar which was new to me. It had entered the bag shelter and was living with the bag shelter caterpillars.

Later that week a small number of the new caterpillars were collected on jam trees *(Acacia acuminata)*. Observations showed that they are usually found in wood borers' holes, under dry bark or in cracks in the trees.

A description of the caterpillar is as follows: Head, dark brown. Body, thickly covered with short bristling hairs cinnamon brown in colour along the back with slender grey lateral bands. Grey hairs extending along each side of the body to underparts. Small white dots extending down the body and along each side. Long bristling hairs sparsely scattered about the body.

Specimens were forwarded for indentification to the Division of Entomology, C.S.I.R.O., Canberra. Mr. I. F. B. Common replied as follows: "The species with the smooth cocoon is almost certainly *Anthela xantharca* (Meyrick), the original type specimen having been collected by E. Guest at Koolunga, South Australia."

By May 17 five caterpillars were collected on jam trees and placed in a box with wire mesh at the top. During daytime the caterpillars rested on the side of the box or were hidden in a piece of paper at the bottom of the box. In the evening, usually about 7.30 p.m. they would begin to move about in search of food. Fresh jam phyllodes were provided for them. The caterpillars appeared to be contented and thrived in captivity.

Later, during May, five more specimens were collected on jam trees, under bark and in wood-borers' holes. Very fine silken threads leading up the tree indicated the presence of the caterpillars.

By June 6 all of the caterpillars were thriving and had moulted. Two more specimens were collected, one of which was found moving along the ground near the wall of the house, and the other, a larger one, was just under the door.

Next evening, on June 7, a large caterpillar had made a cocoon of a light brown colour and cylindrical shape rather pointed at one end, and this end being attached to the bottom of the box with short silken threads. The other caterpillars continued to feed at evenings, and at intervals cast skins were found in the box. On July 20 another cocoon was made and had been attached by silken threads to the side of the box.

During the days that followed, the caterpillars continued to feed, and cast skins. Some of them were now quite large — over two inches in length.

On a very cold morning in August, a large caterpillar was found moving along the ground and it was collected and placed in the box. On August 27 another cocoon was found attached to a corner of the box, close beside a previously made one. Two other cocoons had also been made alongside the first one. One of them, which was not quite finished, was atttached by short silken threads to a jam twig. The cocoon was silvery white in colour and silken in general appearance. The caterpillar could be seen inside the cocoon weaving silken threads about its body. The other cocoon on the side of the box was whitish, but had a paper-like appearance. All of the finished cocoons were darker in colour, one being a dull tan-brown. All cocoons were fastened to some object when made and were firm and papery or like thin card when completely finished. Next morning the silken cocoon was finished and was now darker in colour and papery in appearance like the previous ones.

On August 29, at 7.30 p.m., after a warm, pleasant day, two more cocoons were being made. One caterpillar had just begun and was curled into a half circle in fine silken webbing. The first silken threads which were very fine and shining had been woven and secured to the box. For a short time, while fresh phyllodes were being put into the box, the caterpillar in the cocoon remained motionless. Other caterpillars in the box were busily feeding on phyllodes or resting on the sides of the box.

The caterpillar which was in the other partly-made cocoon remained motionless when disturbed but shortly afterwards began to work on its cocoon again. Both ends of the cocoon appeared somewhat pointed, and there was a round, not quite covered hole, at one end. The caterpillar was curled into a half circle in the cocoon, it using its mouth and forelegs in making the cocoon, weaving to and fro across it from the inside, in a movement like the letter "S". The underpart of the caterpillar being upwards, it would weave from end to end of the cocoon slowly, the head swinging to and fro. This cocoon had been attached to a jam twig.

That evening, other caterpillars in the box appeared to be restless, moving about and travelling around the box, attempting to escape when the lid was removed. However, at 10 p.m. they had settled down and were resting in various places in the box. At that hour, the two caterpillars were still working in their cocoons.

Next morning, the more advanced cocoon seemed almost finished, and had shifted slightly from its former position. The cocoon was now papery and light brownish in colour. The open end had been closed up. The other caterpillar was resting in its partly-made cocoon, and as the chilly morning became warmer it began to work on the cocoon again. Other caterpillars in the box, with the exception of one which had started to make a cocoon, were still resting in the same places as they were the previous evening. Silken threads were attached in straight lines to the box, then others were woven across into a pattern like a net.

That evening the cocoons of the two earlier caterpillars were finished and when held up to the light the caterpillars could be seen in silhouette, and both were motionless. Tiny light brown ants prey on the cocoons if care is not taken. One cocoon had a tiny pin-sized hole in it, made by the ants, through which they entered and destroyed the pupa.

By September 21 all of the remaining caterpillars had made their cocoons. At times when the cocoons were handled the caterpillars within began a rapid whirring sound. When placed in the box again the caterpillars became quiet.

In the late afternoon of March 10, 1952, a cool, cloudy day, a perfect moth was found clinging to the wire mesh inside the box. It was large and grey with other distinguishing marks. As it clung to the wire its wings were resting vertically. Later, its wings were in a horizontal position, and at dusk the resting moth became active and began to flutter rapidly about in the box. It continued in this manner for almost an hour, then rested again.

On March 13, at noon, a larger and different grey moth was clinging to the wire inside the box. One wing was crumpled, and did not straighten out later, but remained abnormal.. Besides being larger than the first one, this moth had a very stout body, and was differently marked. It was a female.

At dusk a third moth, a male, emerged from its cocoon. During the bright moonlight evening the moths fluttered about in the box. By March 23 eight moths had emerged from their cocoons. Three females and five males.

The description of the adult moths is as follows:

Female: length across expanded wings approximately 3 inches. Upper wings, finely haired, grey with darker grey wavy markings, border of light silver grey wavy markings; two white spots, one large and one small, on each wing. Under pair of wings, grey, with a border of silver grey wavy markings; Length of body, $1\frac{1}{8}$ inch; body, stout and hairy, head part covered in bristling light grey, dark grey and brown hairs; rest of the body, from half way down covered with bristling orange hairs; underpart of body, head and thorax hairy, pale orange-grown and grey with dark, almost black bands. Down the centre of the abdomen, a lighter marking of pale orange-brown with some grey hairs.

Male: length across expanded wings, approximately $2\frac{1}{4}$ inches. Upper wings finely haired, grey, with darker grey wavk markings, two white spots, one large and one small on each wing. Under pair of wings, where joined to the body, light grey and lemon yellow, the yellow colour fading out half way along the wings where a wavy narrow band of grey and a grey spot terminate the delicate yellow colour, from there on the wings are grey. Length of body, 1 inch, slender, hairy, brown with white and light grey hairs. Half way down the body, the brown hairs end, the latter part is covered with orange hairs with some white hairs

at the posterior end. Underpart of body, head and thorax, deep brown, other half of body pure white.

The first hatched female laid over one hundred fawn-coloured eggs, while in captivity.

Searches for cocoons in the wild were rather unsuccessful. On rare occasions, one or two cocoons were found attached by silken threads at one end to old stumps, under bark, or on dry trees. Usually they were a few feet up from the ground. Most of the cocoons had small holes in them, no doubt made by small ants or other predators, or parasites.

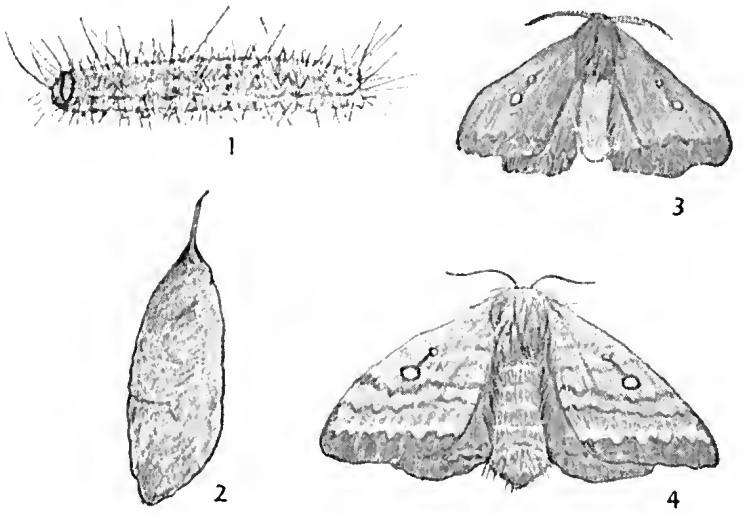
On May 17, 1952, a further series of observations was begun on this species of caterpillar.

The following winter months were very dry and there seemed to be a scarcity of caterpillars. In May, a solitary individual about an inch in length was collected on a jam tree, and fresh phyllodes were fed to it daily. The little caterpillar seemed contented in captivity and usually climbed the jam branch to feed at 7.15 p.m., or a few minutes later. After feeding it rested on the side of the box. Another caterpillar was collected on a jam tree on June 23.

In August, a fine, large specimen was found under bark on a jam tree. Then later that month a fourth one was collected. All were contented and prospered in captivity.

By September 21, all of the caterpillars had made cocoons, with a short period between each. The cocoons were cylindrical and papery and, as before, attached by silken threads to the floor or sides of the box.

During September, when the box containing the cocoons was



Anthela xantharcha, two-thirds natural size.
1—Caterpillar. 2—Cocoon. 3—Male moth. 4—Female moth.
—M. B. Mills del

shifted to a new position, one caterpillar in its cocoon began a whirring, clicking noise. This appears to be made when the caterpillar, feeling disturbed, begins either to turn rapidly around, or from side to side in the cocoon.

On the night of March 16, 1953, after a thunder storm, two female moths emerged from their cocoons. Next evening, one of the moths laid her eggs, which were attached with a sticky substance to the wire mesh on the box. Moths also emerged from the two remaining cocoons.

A search about trees and other likely places did not reveal any more of that season's cocoons. Perhaps the dry season may have been the reason for the scarcity of the caterpillars and their cocoons.

During the morning of March 30, hairy caterpillars about ¼ inch in length hatched from the moth's eggs. Fresh jam phyllodes were fed to the young caterpillars which soon moved up the jam branch to feed on the phyllodes. After feeding, they rested on the box top and sides. The little caterpillars were voracious feeders and soon began to grow. The caterpillars were kept in captivity until May 18 when the box, with the lid off, was place at a jam tree in natural surroundings. The caterpillars would leave the box at evening, usually about 7.30 p.m. and ascend the jam tree to feed on the phyllodes. Many of the caterpillars returned to the box after feeding and they continued life in this way during the following months.

On October 7 about fifty very large caterpillars, all about 3 inches in length, were resting in the box. A small number of cocoons had been made in a group at the bottom of the box and two cocoons had been made on a wheat sack which was used for covering the box. A large amount of "dirt" and cast skins had accumulated in the box. Only two caterpillars were found resting outside on a piece of board. The winter rains had been exceptionally heavy, but it apparently had not affected the caterpillars.

At the end of October only a small number of caterpillars remained in the box. By November 17 there were no caterpillars in the box, but a large number of cocoons were in a group at the bottom of it.

FROM FIELD AND STUDY

Name of a Jockey Beetle—a Correction.—In my article on the jockey beetle in the *W.A. Naturalist,* vol. 2, no. 6, p. 132, I referred to it as *Chlamydopsis duboulayi.* The correct name for the species discussed and figured is, however, *Chlamydopsis loculosa* Lea. The error was brought about by comparing my material with a mis-named specimen in the collection of the W.A. Museum.

—R. P. McMILLAN, Cannington.

Spotted Harrier at Busselton.—In his review of the bird irruptions in 1952 D. L. Serventy stated that the Spotted Harrier *(Circus assimilis)* had not hitherto been recorded in the South-

west area *(W.A. Naturalist,* vol. 3, 1953, p. 189). I find, however, in my records a reference to an individual of the species which was shot at Busselton in 1934. On January 11, of that year, Mr. Roy Macgregor gave me a specimen whose dimensions I noted as follows: length, 21½ in.; wing, 22½ in.; tarsus, 2 in.; the legs were white; nails, horn; bill, horn; iris, dark blue; and facial disc dark grey. The bird was not sexed.

A large number of Straw-necked Ibis were present on the Broadwater at the time.

—H. M. WHITTELL, Bridgetown.

Incipient Song in Juvenile or Female Blue Wrens.—On September 6, 1953, on the Muchea-Gingin road in the vicinity of Lake Catambo, a group of about 8 Blue Wrens *(Malurus splendens)* was under observation for about half an hour as they fed in a gum and wattle thicket. The birds used a monosyllabic "flock" note, a short "*tip*" as they moved about. There was only one fully plumaged male in attendance and this was quite silent but on several occasions one of the juveniles or females was heard and seen to utter a short snatch of song. The birds frequently came within 8 feet as they fed. It was impossible to tell whether the songs all came from the same individual or whether they were juveniles or females; none had any blue on the wings though all had blue on the tail and chestnut beaks and eye patches.

—JOHN WARHAM, Leederville.

Occurrence of Red-eared Firetail and Red-winged Wren in the Darling Ranges.—When collecting for the W.A. Museum along the Albany Highway on February 28, 1954, I examined a dry creek bed near the 53-mile peg (from Perth). The precise locality was about one mile along an old timber track leading off from the Highway to the west, on the Perth side of the 53-mile peg. The country is mostly wandoo forest with a few scattered jarrah trees and the usual sclerophyllous ground flora. The Red-winged Wrens *(Malurus elegans)* were feeding in the thickets near the creek bank. The Red-eared Firetail *(Zonaeginthus oculatus)* were found in the same area, and in the company of the Red-winged Wrens. I saw 5 finches and there were large parties of Wrens, there being at least 15 birds in one group, including 3 fully-plumaged males. Nearby was a company of the Banded Wren *(Malurus splendens)*. Specimens of the finch and the Red-winged Wren were collected for the Museum.

—K. G. BULLER, W.A. Museum.

Sunbathing of Senegal Turtledove.—On September 12, 1953, in a garden at Leederville an adult Senegal Turtledove *(Streptopelia senegalensis)* was noticed squatting on a gravel path at right angles to the strong sun. The tail was fully fanned and the left wing, that on the sunny side, half extended with the primaries separated a little. This attitude was held for several

minutes and then the left wing was raised vertically and fully extended. The sun could now beat on the bird's left flank and underwing. The other wing remained folded to the body. This posture was again retained for more than a minute before some disturbance sent the bird off. Sunbathing appears to be a regular habit among many birds, particularly with juveniles and it has been suggested that the separation of the feathers is to allow the sun to reach the naked skin and by irradiation to assist in the production of Vitamin D. (see *British Birds*, xl, pp. 172-174, and xli, pp. 304-305 for discussion and photographs of this habit for various European species). Vertical elevation of the wing to enable the sun to reach the flanks does not appear to have been recorded though it is probably a common practice.

—JOHN WARHAM, Leederville.

Wood Sandpipers at Lake Mungal.—In view of a recent review by K. A. Hindwood and A. R. McGill (*Emu*, vol. 53, pp. 1-13) of the Australian occurrences of the Wood Sandpiper (*Tringa glareola*), the presence of a pair of these birds at Lake Mungal, approximately 50 miles north of Perth, may be worth recording. The Sandpipers were first noted on December 5 and 6, 1953 and again, presumably the same pair, during a second visit on December 12 and 13, 1953. The birds were quite approachable and excellent views were obtained with x 6 binoculars and x 25 telescope. The characteristic features were the wholly white rump, noted both during flight and while the birds were preening, grey breasts, prominent white eyestripe, mottled backs and rather long legs. They were noticeably greyer than a Common Sandpiper (*T. hypoleucos*) feeding nearby, nor did they move their tails up and down as persistently as does this latter species. In these Wood Sandpipers tail wagging and head bobbing seemed to be indicative of slight uneasiness. On both occasions the birds were feeding on the same patch of mud where they also rested, bathed, and preened. When a hawk flew over flying high the Wood Sandpipers crouched low in the water with their bellies awash and the same flight-intention movement took place when they saw me emerge cautiously from cover.

—JOHN WARHAM, Leederville.

Protective Freezing by the White-fronted Chat.—The distraction display known as the "broken wing trick" is well known in the White-fronted Chat (*Epthianura albifrons*). This note reports another reaction to an enemy during the breeding season which may not be so well known.

On August 28, 1953, at a salt lake a few miles north of Kalannie, a pair of the above species were observed carrying food into a small samphire bush. After the female had entered the shrub on one occasion, I approached rather incautiously but the bird did not leave. She was observed from a distance of about two feet perched near the nest which contained four small

young. The bird remained perfectly motionless, with her head cocked to one side, watching me intently with her right eye for the several minutes I watched her. She was carrying a grasshopper nymph in her bill. The young were apparently not aware of the parent bird's presence for they made no acknowledgement of it.

As the bird was fully conscious during the time it was under observation and followed with her eye slight movements that I made, it is apparent that the behaviour observed was a case of protective freezing and not one of paralysis from fear. It is possible and even likely that this freezing reaction would have been followed by the "broken wing trick" had I moved closer or attempted to touch the bird.

—D. L. McINTOSH, Perth.

White-naped Honeyeater at University Grounds.—On October 1, 1953, an unusual call attracted my attention to a honeyeater at the University grounds, Nedlands. At the time a Red-tipped Pardalote's nest was being inspected, and from the jarrah canopy came a "clicking" sound, somewhat like the call of an agitated New Holland Honeyeater. A clear view was had of the birds which proved to be the White-naped Honeyeater *(Melithreptus lunatus)*. The black head, with a white band around the back of it, was noted. On calling it up to about six feet, by kissing the back of my hand, it was noticed that a small patch above the eye was conspicuously pure white. Apart from this colour, the bird tallied exactly with the description in Serventy and Whittell's *Handbook*.

In habit this bird differed from other honeyeaters in the University grounds. It was seen in a jarrah tree, hopping around the outer branches, in the manner of a Pardalote, stopping now and then to feed. The common local honeyeaters, the Brown and the New Holland, only use this tree as a resting place in flight.

—ERIC LINDGREN, Nedlands.

[The late O. H. Lipfert recorded the White-naped Honeyeater at Crawley during the 'nineties of the last century, it being abundant there and nesting freely *(The Emu,* vol 37, 1937, p. 133). Since those early observations the species has not been reported in the area until Mr. Lindgren's record.—Ed.]

Birds Dew Bathing.—The following records of apparent dew bathing may prove of interest. (a) Wooroloo. June 5, 1951. At about 0900 hrs. a Red Wattle-bird, *Anthochaera carunculata,* was observed making a considerable flutter among the extremities of branches, i.e. twigs too weak to support its weight. In all it visited several different branches in three different trees, the last a lemon-scented gum *(Eucalyptus citriodora)* where, after fluttering in one mass of leaves, the bird perched and preened, more or less confirming the impression that the bird had been bathing in the moisture that lay thick upon the leaves. The trees visited

were not in blossom (E.H.S.). (b) Wooroloo, July 13, 1952. At about 1000 hrs. a cock Golden Whistler, *Pachycephala pectoralis*, was observed dew bathing in the topmost boughs of a densely foliaged *Persoonia elliptica* in jarrah forest. The night had been cold and the morning was fine and clear. Much moisture remained on the leaves. About thirty inches from the whistler, in a similar situation in the same tree, a cock Spinebill, *Acanthorhynchus superciliosus*, was behaving, apparently, in much the same way. (E.H.S.).

(c) Crawley, July 16, 1952. A Red Wattle-bird was seen fluttering with wings spread and feathers ruffled in a number of parts of the thick foliage of a Moreton Bay fig *(Ficus macrophylla)*, at the University. This continued for several minutes. The sun was shining, but the foliage was damp from rain which had fallen an hour before. Similar behaviour had been noted in a Red Wattle-bird at Wooroloo early in May, but in this case the tree used was a jarrah *(Euc. marginata)*. (L.E.S.). (d) Crawley, July 21, 1952. A Western Magpie, *Gymnorhina dorsalis*, was seen leaf bathing in a low dense mass of buffalo grass *(Stenotaphrum glabrum)*, *Hardenbergia*, and other low creepers in King's Park. The method of bathing was as described in the foregoing note, but in this case went on indefinitely, i.e. for over five minutes the approximate total length of my observation. (L.E.S.).

—ERIC H. and LINDSAY E. SEDGWICK, Wooroloo.

Observations on Feeding of Dusky Wood-Swallows.—On February 22, 1954, Mr. K. G. Buller made a hurried trip to Bannister in order to collect specimens of the Dusky Wood-Swallow *(Artamus cyanopterus)* seen in the area a short while previously. He located approximately a dozen birds of which he collected two mature females, one immature female showing the characteristic plumage, and one mature male.

On the following day I did a routine check of the stomach contents, and found two particularly interesting features. The first was that all specimens of the Dusky Wood-Swallow contained numbers of Jumper Ants *(Promyrmecia swalei* Craw.) comprising all forms, winged males and females, and workers. The stomachs also contained other insects, but *Promyrmecia* predominated.

In specimen no. 2, a female *A. cyanopterus* was a small portion of a jewel beetle, possibly *Curis* sp., which is not represented in the Museum collection. Specimen no. 3 was an immature female. This bird was not hawking, but was shot resting in company with an adult female. Its stomach contained material similar to that of the adults, but in a much more mutilated condition, together with the remainder of the *Curis* individual seen in no. 2. I assume that this immature female was still being fed by the parents. Mr. Buller's observations support this.

About half a mile distant from where he collected these birds, Mr. Buller saw 5 Black-faced Wood-Swallows *(A. cinereus)*, of

which he collected one. Its stomach contents were: 5 males or drones of the domestic bee, 1 elytron of *Paropsis*, 1 head of a Hylaeid bee, and mashed insect material. The area where the Dusky Wood-Swallow was collected was a wandoo flat, with a little marri, both species flowering, as well as some scrub. Apparently there was a marriage flight of the *Promyrmecia* at the time. The other Hymenoptera and Coleoptera were hawked by the Wood-Swallows in the vicinity of the flowering wandoo and marri. In the second case the Black-faced Wood-Swallow apparently hawked in a different area where drones of the domestic bee were plentiful.

—ATHOL M. DOUGLAS, W.A. Museum.

Diving of Musk Duck, *Biziura lobata*.—On October 4, 1953, a Gould League party visited the Victoria Reservoir, near Maddington. As usual, waterfowl were scarce and only one duck, a male Musk Duck, was seen. This was diving in deep water, so a group undertook to time a number of successive dives.

Times recorded were as follows:

Dive	Duration in seconds.	Time on surface in seconds.
1	60	Not recorded
2	65	.. ..
3	62	.. ..
4	58	20
5	45	Not recorded
6	50	18
7	55	20
8	60	Not recorded
9	57	18
10	62	17
11	60	Not recorded
12	57	18
13	62	20
14	50	27
15	55	20
16	57	16
17	50	17
18	42	24
19	55	Observations concluded.

It will be observed that the duration of the dives was remarkably consistent, ranging from 42 seconds to 65 seconds and averaging 55.9 seconds. Surface times were much shorter ranging from 16 seconds to 24 seconds and averaging 19.6 seconds.

Mr. D. Reid, who has seen the Reservoir empty, estimated the depth of water at the point where the bird was diving — about 100 yards behind the centre of the retaining wall — to be about 40 feet.

The bird was watched by Mr. D. Reid through binoculars while Mr. E. Garrett, using a watch with sweep second hand, recorded the duration of the dives and the writer recorded the observations and, where possible, obtained surface times.

The times given above are much greater than those recorded in Serventy and Whittell's *Birds of Western Australia* — of a

bird diving in the waters of Lake Cooloongup which averaged 11 to 12 seconds under water and 5 to 6 seconds on the surface. The Lake Cooloongup records were made on a bird "in the shallows close inshore" (vide the observer's field notes). The depth of the water was not estimated but it probably would not have exceeded six feet.

—ERIC H. SEDGWICK, Wooroloo.

Birds Recently Established in the Central Wheatbelt.—During the early part of 1954 I spent two months in the Dangin district. This area lies in the Central Wheatbelt, 100 miles east of Perth, and midway between Brookton and Kellerberrin. Amongst the birds observed there, several species were of particular interest in that they were only recently established in the area.

The Kookaburra *(Dacelo gigas)* was a conspicuous, though perhaps not abundant, species. I observed it at several points up to seven miles west of Dangin. A group of eight birds were established near my camp-site; at another point I once recorded two individuals; and at a third point a chorus of calls indicated the presence of another small group of Kookaburras. One was also noted at Brookton on January 1, 1954. Serventy and Whittell, in *Birds of W.A.*, regard the species as being a "casual visitor east of Northam to Kellerberrin". At Dangin, however, the Kookaburra has become at least temporarily resident. Local opinion indicates that they have only recently arrived in the district. One farmer stated that he had never seen the bird in the district prior to December 1953, and another that he first observed them early in 1953, since when their numbers have increased considerably.

Increases in the numbers of Maned Geese *(Chenonetta jubata)* have recently been noticed in numerous areas in the South-West. A farmer at Jacob's Well (8 miles west of Dangin) informed me that a pair of the geese arrived on his property in 1952. In 1953 they were joined by about a dozen more, and have since increased till the flock totalled about 60 individuals. Although this flock was the only one I encountered, various duck shooters informed me that they had observed similar increases elsewhere in the district, and especially at Lake Mears, to the south of Dangin, where the species is now reputed to be exceedingly abundant.

While visiting the district in 1951, I recorded the appearance of the Senegal Turtle-dove *(Streptopelia senegalensis)* at Dangin townsite *(W.A. Naturalist,* vol. 2, p. 195.) My recent visit revealed that the colony has declined; there are now none resident on the townsite and I only observed two individuals during the whole of my period of observation. These were on the outskirts of the town, near some abandoned buildings. Four miles to the east of Dangin, however, in the large town of Quairading, the species was both common and conspicuous, and birds are reported to have occurred there for at least five years .

—L. E. SEDGWICK, St, George's College, Crawley.

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ON A RARE XANTHID CRAB FROM WESTERN AUSTRALIA

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In July 1953 Mr. L. Glauert of the Western Australian Museum brought to the British Museum for determination a dry and rather broken speeimen of a Xanthid Crab, that had been eaptured off Laneelin Island between 30 and 40 fathoms in March 1953. The speeimen proved to be a large senile male of a speeies hitherto known as *Acanthodes armatus* de Haan that was long thought to be restrieted to Japanese waters until speeimens were obtained in the Great Australian Bight, off Euela, by the *Endeavour,* 1909-14 (Rathbun, 1923, p. 128).

The monotypie genus *Acanthodes* was established by de Haan in 1833 (diagnosis on p. 20 and Pl. iv) although the deseription of the speeies *A. armatus* did not appear until 1835. However, it appears to be preoeeupied by *Acanthodes* Agassiz 1833, an important genus of fossil fishes, although this has been overlooked by most careinologists; Gistel (1848, p. viii) proposed that it should be replaeed by *Hypothalassia.* Hilgendorf (1897), who was unaware of Gistel's name, proposed that *Acanthocarcinus* should be used — a name that has been overlooked till now and therefore does not appear in Neave's *Nomenclator Zoologicus* (1939-50).

This speeies, whieh must now be referred to as *Hypothalassia armata* (de Haan), appears to be rare for during the past 148 years fewer than 20 speeimens have been reeorded (the exaet number eannot be given as some authors do not say how many they had). No eomplete deseription has been published but this was probably thought unneeessary in view of the exeellenee of the figures in several papers, and the ease with whieh the speeies ean be reeognised.

Genus *HYPOTHALASSIA* Gistel, 1848

Acanthodes de HAAN, 1833-35, p. 20 and 52 (nee *Acanthodes* Agassiz).

Acanthorcarcinus HILGENDORF in WELTNER, 1897, p. 280.

Fig. 1 Photograph of male from off Lancelin Island, in dorsal aspect, x approx. 2/5.

Hypothalassia armata (de Haan)

Cancer (Acanthodes) armatus de HAAN, 1833-35, pp. 20 and 52, pl. iv. 1 ♀

Acanthodes armatus, DOFLEIN, 1902, p. 661, pl. ii. 1 large ♂.

" " , PARISI, 1916, p. 187, 1 large ♂.

" " , BALSS, 1922, p. 116. 2 ♀♀.

" " , RATHBUN, 1923, p. 128, pl. xxxi and xxxii, fig. 1. 2 ♂♂ and 1 ♀, all young.

" " , URITA, 1926, p. 16. At least 3 specimens.

" " , SAKAI, 1934, p. 306. Probably no new record, but the 3 mentioned by Urita.

" " , SAKAI, 1939, pp. 516 and 719, pl. lxiii (coloured). 2 ♀♀.

" " , WELTNER, 1897, p. 243 — as host of epizooic *Poecilasma kaempferi* Darwin. At least 1 specimen.

OCCURRENCE. Off Laneelin Island. Western Australia, 30 to 40 fathoms. 1 large ♂. Other specimens in the Western Australian Museum are: 1 ♂ No. 8890, trawled in 24 to 40 fathoms off Rottnest, 1914, and 1 ♀ No. 47.1950, trawled in the Western Bight.

RECORDED DISTRIBUTION. Japan: Sagami Bay, Simoda, Kagosima Bay, Saisyu-to. Australia: Off Euela, Great Australian Bight.

DESCRIPTION. The *carapace* is hexagonal in outline, although the front and anterolateral borders together form an are of a circle, moderately convex from back to front and almost flat transversely. The front is approximately one-fourth of the carapace width (excluding the spines); a U-shaped sinus separates the two lobes each of which is armed with 3 spines, one near the small supraorbital spine and two near the sinus; behind these, each frontal lobe has 2 or 3 short spines. The orbit is equal in width to the frontal lobe and is as deep as wide; the upper margin bears 4 small spines, including the supraorbital spine and the outer orbital or first anterolateral spine, and shows traces of two suture lines; the lower margin has 4 spinules in addition to the infraorbital spine. The antenna stands in the wide orbital hiatus but the main segment of the pedunele (2 + 3) does not reach the front. The anterolateral margin, behind the orbital spine, bears 4 principal spines the first of which is the smallest, and a subsidiary spine is present immediately behind each of the other spines. This particular specimen is not symmetrical as regards the two sides of the body; on the left side the first anterolateral spine is obsolete (replaced by a few spinules), the second is small and conical, the third is bifid, with a subsidiary spine behind it; only the last spine and the subsidiary one immediately behind it are as on the right side. As the specimen is senile, the spines on front and anterolateral margins are relatively much smaller and less curved than in de Haan's holotype (carapace 84 x 98 mm. or, if the spines are included in the width, 110 mm.) and the spines on the epibranchial, hepatic and gastric regions are much

redueed or obsolete. The posterolateral margins, which are equal to the posterior, and longer than the anterolateral, border are slightly eonvergent and straight. Near the posterior margin and subparallel to it is a row of spinules, and some spinules are present on the branehial region.

Fig. 2. Photograph of de Haan's figure of the female holotype (reduced).

The specimen is too damaged to show the details of the thoracic sternum. The *abdomen,* which is detached, is too curved to permit of a drawing being made. It differs from that of the young male figured by Rathbun (1923, p. 128, text-fig. 3) in being relatively wider; all seven somites are free (as in the young) but the terminal one is more definitely triangular (length approx. two-thirds the basal width), the sixth somite is nearly twice as wide as high; there are a number of sharp granulations on each of the first two, and traces of granulations on the pleurites of the third, somites.

The *chelipeds* are very unequal and much more massive than in the female or in the young. While the merus in each retains the series of graded curved spines on its upper margin, the long curved spines on the carpus and the palm of the chela are very much more reduced in the case of the smaller, or left, cheliped and entirely wanting in the large one (only the inner spine of the carpus being indicated by a blunt protuberance). The enormous enlargement of the chelipeds and the great reduction in the spiny armour of the crab is a feature of the senile male.

The *walking legs* are very similar to those of the female holotype, although the curved spines are relatively shorter. The merus of pereiopod II is three times as long as wide; its dorsal margin bears a graded series of 13 spinules and curved spines, the ventral surface has a series of 8 short straight spines along the posterior margin and an interrupted series of spinules along the anterior one. The carpus has three longitudinal series of spines on the upper surface while the propodus has spines or spinules on all surfaces. The long dactylus is cylindrical and, apart from the dark terminal claw, is heavily clothed with short setae. The lengths of the principal segments are given below. Pereiopod V is similar but rather shorter.

Doflein (1902) referred the genus to the subfamily Menippinae of Ortmann and the male copulatory *pleopods* certainly confirm this for pleopod 2 is longer than pleopod 1 and has a darker lash-like terminal portion.

MEASUREMENTS in mm.:

Carapace—length x breadth		108 x 125 (131 with spines)
Smaller cheliped:	l. x b. of merus	45 x 39
	l. of carpus	48
	l. x b. of palm	47 x 40
Larger cheliped:	l. of carpus	57
	l. of chela	140
	l. x b. of palm	70 x 64
Pereiopod II:	l. x b. of merus	62 x 20.5
	l. of carpus	41
	l. of propodus	31
	l. of dactylus	54

REMARKS. This specimen is very similar to, and almost as large as, the old male figured by Doflein (1902, pl. ii); the chelipeds, however, are even smoother with no trace of spinules on the carpus of the larger one. The number and arrangement of the anterolateral spines also differ somewhat, but a comparison

of all the illustrations shows that there is some variation in this respect.

Although so few specimens are known, they vary in size from 19 to 150 mm. (carapace width). In the smallest individual there are long hairs on the carapace and pereiopods and Rathbun describes it as *Pilumnus*-like. As the animal increases in size the hairs become fewer and soon disappear from the body and the chelipeds, though some persist on the walking legs. With age too the spines become relatively shorter, notably on the front half of the carapace. In the young the chelipeds are only slightly unequal, but with age the difference between them becomes more apparent. It is only in the very old male that the chelipeds undergo allometric growth, becoming much enlarged and very unequal. Sakai (1939, pl. lxiii) figures a female of almost the same size as the specimen I have described (*c.l.* x *c.b.* = 100 x 124

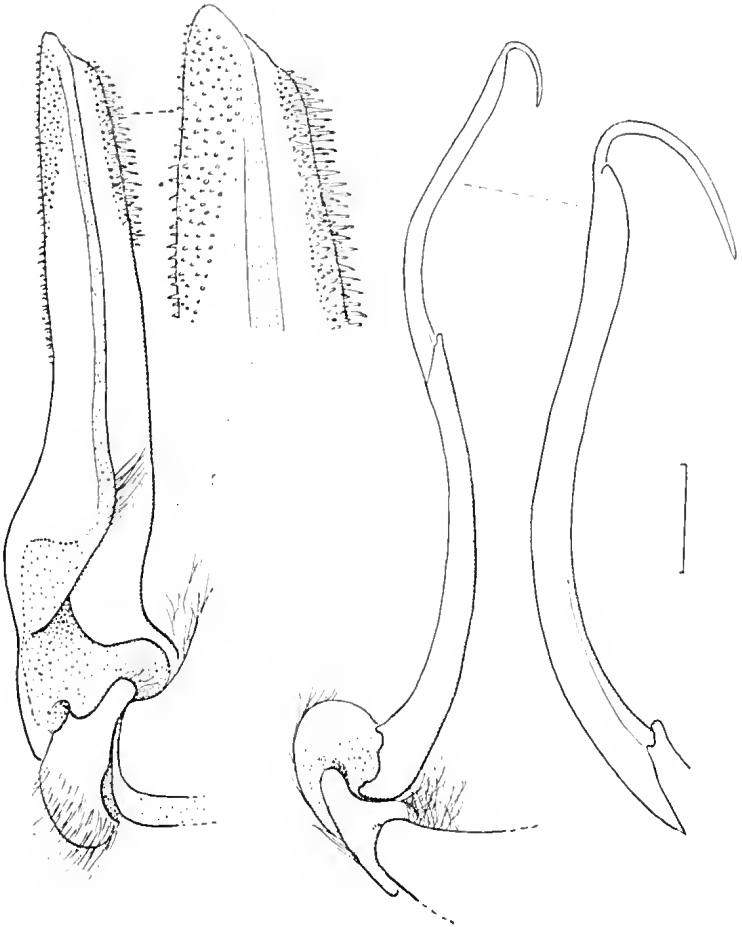

Fig. 3. Pleopods 1 and 2 of male specimen from off Laneelin Island, with distal portion of each more highly magnified. The scale on right = 5 mm. and indicates the lower magnification.

mm.), in which the chelipeds are relatively much smaller and moderately spiny. The length of the larger chela in this female is not quite two-thirds of, whereas in the male it exceeds, the maximum width of the carapace (see measurements given above).

A number of tiny Cirripedes belonging to a species of *Poecilasma* were adhering to the specimen. Weltner (1897, p. 243) has recorded *Poecilasma kaempferi* Darwin from this host.

HABITAT. According to Sakai (1939, p. 516) this species is usually found in rocky places in 50 to 100 metres — i.e. down to 55 fathoms. Rathbun (1923, p. 128), however, gives the depth at which the immature specimens were captured as 80 to 90 fathoms.

ACKNOWLEDGMENTS. The Trustees of the British Museum are indebted to Mr. L. Glauert of the Western Australian Museum for the gift of this large specimen; hitherto the genus *Hypothalassia* was not represented in the B.M. Collection. I am also grateful to Dr. L. B. Holthuis of the Leiden Museum for calling my attention to the obscure reference to Hilgendorf's generic name *Acanthocarcinus*.

ADDITIONAL NOTE. After the above description had been sent to Australia my assistant, Mr. R. W. Ingle, successfully repaired the specimen which is complete except for some distal segments of the last two walking legs on the right side. The accompanying photograph shows the almost smooth, very unequal, pincers characteristic of the senile male (Fig. 1).

In addition, a reduced copy of de Haan's original figure of the female holotype (*c.l.* = 84 mm.; *e.w.* between bases of the posterior spines = 98 mm.) is included to show the very spiny, slightly unequal, pincers which are more typical of the species (Fig. 2).

The male pleopods were removed and relaxed in a 0.1% solution of tribasic sodium phosphate (Na_3PO_4) in distilled water to which a little glycerine was added, and I am now able to include camera lucida sketches of these (Fig. 3). Pleopod 1 is stout, almost straight, beset with spinules and spines near the apex, as illustrated. Pleopod 2 is very long and slender and, when the two pleopods are interlocked, its apex would project a considerable distance beyond that of pleopod 1. The proximal part of the shaft of pleopod 2 is whitish whereas the distal lash is light brown in colour and transformed apically into a slender recurved sickle or hook.

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JOHN GILBERT'S NOTEBOOK ON MARSUPIALS

BY MAJOR H. M. WHITTELL, O.B.E., BRIDGETOWN*

In the library of the Queensland Museum, Brisbane, there is a copy of Volume XXIV of Jardine's *Naturalist's Library* (Mammalia. Marsupialia, or Pouched Animals, by G. R. Waterhouse, August 1841), which, though in the original covers, has had the pages referring to Australian marsupials mounted and interleaved. It commences with page 117 of Waterhouse's text, continues to page 165, the pages covering the kangaroos are missing, and the book commences again at page 249 and continues to the end (page 323). Pages 262 and 263, concerning the Spotted Phalanger, are not included. This little book was Gilbert's notebook on marsupials and he has entered in his own handwriting further notes on the species he collected. The observations end with a brief item on the one Monotreme in our fauna, the Echidna.

An announcement of the existence of this notebook together with a preliminary description have already been made (Whittell, 1951). In that paper it is stated that the missing pages 262 and 263 concern an American marsupial. This is not the case as they refer to the Spotted Phalanger (Cuscus) *(Phalanger maculatus* (Geoffroy)) of the New Guinea region which, subsequent to Gilbert's death, was discovered on Cape York Peninsula by John Macgillivray. Of considerable interest is the fact that the notebook contains two pen-and-ink sketches of marsupials "which are possibly the work of Gilbert. If that be so, it is the first intimation we have that Gilbert was able to produce artistic and accurate drawings." As recorded by Whittell (1951) there was found with Gilbert's notebook a ms. index to a notebook on kangaroos but unfortunately the volume itself was not forthcoming.

*After Major Whittell's death the manuscript of this article was completed for publication by Mr. J. H. Calaby, Wildlife Survey Section, C.S.I.R.O., Perth.

Referenee to Gould's *Mammals of Australia* (1845-1863) shows that most of Gilbert's notes, but not all, are published there, ehiefly in the text to the plates, but a few are ineluded in the *Introduction* whieh was also issued in a limited oetavo edition in 1863. However, they are generally eondensed and always re-written in a more elegant style. Quite often the notes are not acknowledged as having eome from Gilbert. In view of these considerations and the fact that some of the notes as quoted by Gould have been used by authors of general works on Australian marsupials from as soon as they were published (Waterhouse, 1846) until the present day (Troughton, 1954), it is believed that their publication in full would serve a useful purpose and reflect a little more credit, however belated, on one of the most important diseoverers in Australian natural history.

This notebook eontains notes on all non-macropodid marsupials oeeurring in South-western Australia with the notable exeeption of the Quenda (*Isoodon obesulus* (Shaw, 1797)). Gould, however, published notes on this speeies sent to him by Gilbert, and there are specimens eollected in South-western Australia by Gilbert in the British Museum (Thomas, 1888). Gilbert eollected the type speeimens of almost half of the speeies or subspecies of reeent marsupials known to occur in South-western Australia (see Glauert, 1950 for list). Only one reeent marsupial has been discovered in South-western Australia sinee Gilbert's day, *Sminthopsis granulipes*, Troughton, the type of whieh was collected at King George's Sound in 1869 but was overlooked and remained undescribed until 1932, no doubt because of its close resemblance to *S. crassicaudata* (Gould).

In some eases the native names given in Gilbert's notebook differ slightly from those published by Gould.

The following are the ms. notes in Gilbert's handwriting. They are listed under the modern names of the speeies to whieh they refer (with better known synonyms, in certain instanees, within brackets). Gilbert's text, with any headings he used, is printed in small, 6pt. type.

CHUDITCH, *Dasyurus geoffroyi*, Gould, 1841.

Dasyurus Geoffroyi

Bur-iad-da Perth
Bur-ra-jit York and Toodyay
Ngoor-ja-na Vasse
Dju-tyche K.G.S.
Native Cat of the Colonists of Western Australia

This speeies is very generally dispersed over the whole eolony of Western Australia. It has also been seen at South Australia and New South Wales from both of whieh places Mr. Gould collected it. It lives in hollow stumps, hollow trees or in holes in the rocks from which they issue at night in quest of food eonsisting for the most part of birds and the smaller quadrupeds, it is said to oeeasionally feed on insects a gentleman informed me he found its stomach completely filled with the White Ant. It is a very destruetive speeies in the farmyard attacking indiseriminately Ducks, Geese, Turkeys or Fowls.

No. 21 of my colleetion.

WAMBENGER, *Phascogale tapoatafa* (Meyer, 1793) (= *P. penicillata* (Shaw, 1800))

Bul-loo-wa York
Bal-ba-ga Perth
Bal-la-wa-ra north of Perth
Bal-lard K.G.S.

Squirrel of the colonists of Western Australia.

This is a nocturnal feeder, its principal food being Coleoptera which it collects from the upper branches of the different species of acaela, but it occasionally feeds on small birds, and at one season of the year, several species of Fungi, particularly a large kind of Garracus. It breeds in hollows of decayed trees.

Hab: Western Australia, South Australia, and New South Wales.

No. 12 of my collection.

RED-TAILED WAMBENGER. *Phascogale calura* Gould, 1844.[1]

Phascogale

Keng-goor Aborigines of the Williams River

This new species, easily distinguished from the foregoing P. penicillata, by its smaller size, and the reddish colour of the fur on the basal half of the tail. I only obtained one specimen of [it]; and for which I was indebted to a domestic cat. I understand that it occasionally makes its way into the stores.

This is either the same or a very near ally to the Flat-tailed Mouse of the Sydney Museum Catalogue[2], a species brought from the banks of the River Darling by Major Mitchell.

No. 36 of my collection.

MARDO, *Antechinus flavipes leucogaster* (Gray, 1841)[3]

The White-bellied Pouched Mouse
Antechinus leucogaster

Mar-do Aborigines of Moore's River
Man-durt Aborigines of Perth
Tum-mart Aborigines of King George's Sound

Head and shoulders grey, behind rather browner, with scattered longer black-tipped hairs; chin and beneath pure white, feet brownish grey. Body and head 4; tail 2½ inches. The above description was taken from a single specimen which I have reason to suppose was not a fair specimen of the species, the male being very much larger, and always nearly a third larger than the female.

This species is found in nearly every part of the Colony of Western Australia. My first specimen was a female, and it had eight young ones

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[1] Gilbert's single specimen, a male, from "Williams River", is the type.

[2] This is presumably the animal subsequently (1856) described by Gould as *Phascogale lanigera,* from a specimen collected by Mitchell. The type specimen must have been badly prepared. Gould's plate shows a pair of animals on a tree branch and in the text he says, "In form it is precisely similar to the *Phascogale calura* but in size and colouring it is very different . . ." Krefft (1867) who also had a skin collected at the same time by Mitchell and who had seen the animal alive showed that it was completely terrestrial and had long thin legs adapted to a saltatory mode of progression. He erected for it the new genus *Antechinomys.*

The catalogue referred to is the *Catalogue of Specimens of Natural History and Miscellaneous Curiosities deposited in the Australian Museum,* (1837), compiled by George Bennett.

[3] The type of the subspecies, an unsexed adult, was collected by Gilbert at "Canning R., W.A." on April 9, 1839 (Thomas, 1888).

attached to as many mammae in a semipouch similar to the Myrmecobius. The young ones were three quarters of an inch in length, quite naked, and blind; the posterior parts were most disproportionately small as compared with the anterior. The semipouch is formed by a fold of the skin of the abdomen downwards from which are numerous long hairs, which effectually cover up the young, the latter as soon as they are covered with hair, leave the semipouch, and remain in a nest formed of fine grasses, but as to the positive situation of this nest, I am not satisfied, not having myself taken it, the natives have frequently brought it to me, some have asserted that it makes a nest on the ground resembling the Bettongia Ogilbyii, while others assert as strongly the nest is always formed in the upper grasses of the Xantherrhea.

It is an exceedingly active little animal and when started in the bush generally makes for the first hollow log, in the absence of which it will readily take to a standing tree, up which it runs with the utmost facility, in fits and starts.

Specimens from different localities differ a good deal particularly in size, those from Perth are the largest.

Hab: Western Australia.

No. 3 of my collection.

DIBBLER, *Antechinus apicalis* (Gray, 1842)

Antechinus

Marn-dern	Aborigines of Moore's River
Wy-a-lung	Aborigines of Perth
Dib-bier	Aborigines of King George's Sound

This species is universally dispersed over the whole of Western Australia; it is easily distinguished from all others of the Genus by the long hairs on the sides of the basal portion of the tail, which gradually shorten towards the extremity giving the tail a pointed appearance. It appears to vary a good deal in habits, in different localities. At Moore's River the natives describe it as making a nest beneath the overhanging grasses of the Xanthorrhea. While at Perth its nest is taken either from the dead stump or from among the upper grasses of the same Plant, while at the Sound the natives constantly pointed out a nest of short pieces of sticks and grasses on the ground very much resembling the common Perameles excepting that there was in general a larger and higher heap than is generally brought together by the latter. On examining the stomach it was found to contain insects generally, but more particularly small Coleoptera. While at the Sound I obtained a female with seven young attached in the same manner as observed in A. leucogaster. These young were little more than half an inch in length, the hinder parts remarkably small, as compared with the anterior extremities. The young are very tenacious of life in the above instance the young lived attached to the dead mother nearly two days before they were removed when they were rather forcibly detached, I put them in spirits, and it was nearly two hours after immersion before they ceased moving.

Hab: Western Australia.

No. 2 of my collection.

FAT-TAILED DUNNART, *Sminthopsis crassicaudata crassicaudata* (Gould, 1844)[4]

The Thick-tailed Pouch Mouse

Antechinus

Of this singular and pretty species I could gain no information of its habits, it was brought into the house by a domestic cat.

The most striking and singular character in this species, is the extraordinary form of the tail, the size of which in the dried skin is nearly a third less than nature, from its peculiar form it was quite impossible to skin it without making an incision nearly its full length, the middle or largest part was a lump of white oily fat.

[4] Gilbert's single specimen, a male, is the type.

I take this to be a very rare animal or at least a very rare local species, for no person to whom I have shown the only specimen I ever obtained at all recognises the species, not even any of the natives could remember to have seen it.

Stomach contained insects generally, irides black, full and prominent; before skinned it measured:—

Length from nose to extremity of tail	5-5/8 inches
Length of tail	1-13/16 inches
Length of face from nose to ear	7/8 inches
Length of ear	¾ inches

Hab: Williams River, Western Australia.
No. 35 of my collection.

[Opposite the above species is a pretty pen and ink sketch of the animal.]

DUNNART, *Sminthopsis murina fuliginosa* (Gould, 1852).

Antechinus [5]
Dtam-in Aborigines of Perth

This is an inhabitant of the dead stumps of Xanthorrhoea, making no nest, but merely scraping together a few of the soft fibrous parts, and forming a floor or seat. It is rarely seen or met with in small families as in the nearly allied species from King George's Sound. Stomach contained small coleoptera. I only know of two habitats for this species, viz. the grass lands of the Toodyay Valley and in the thick groves of Xanthorrhoea surrounding the swamps and lakes around Perth.

Hab: Western Australia.
No. 1 of my collection.

Before skinning the measurements were:—

Length from nose to extreme tip of tail	7 inches
Length of tail	3-3/8 inches

Antechinus [6]
Twoor-dong Aborigines of King George's Sound

This species so much resembles that found at Perth that I first considered them as identical, until I obtained a large series by hunting them out of their nests myself. It not only differs in its mode of making a nest and other habits, but is very much darker, having the cheeks paler, while the under side is not so pure a white. Its favourite haunt is in newly burnt spots particularly around swamps or adjacent to moist lands; among the clumps of the burnt stumps of grass or small scrub it burrows out the earth, which is filled up with very small pieces of short twigs or coarse grass, formed into a round heap, a few inches above the ground, and often with the top on a level with the ground like the Perameles, on the top are several entrance holes, which do not appear to lead to a common centre or nest but turn and twist about among the grass roots independently of each other, the size of this little mound of grass and sticks varies from 6 to 10 inches in diameter, and from 10 to 15 inches in depth, about half the depth of the structure, are several small galleries or burrows, running out from the sides among the surrounding roots, into one or other of these the animal conceals itself when disturbed by the removal of the nest.

[5,6] These two items refer to the same species. Gilbert's supposed distinction between the "Dtam-in" and the "Twoor-dong" was upheld by Gould who identified the "Dtam-in" with the species *albipes* (now recognised as a subspecies) described by G. R. Waterhouse in 1842 from a specimen from "Port Adelaide, South Australia," and described the "Twoor-dong" as a new species *fuliginosus* in 1852. The type is a male collected by Gilbert at "R. Avon, W.A." (Thomas, 1888). It is interesting that Gilbert apparently did not connect his specimens with *murina* which is described and figured in Waterhouse's book. Gray's list of 1841 showed *murina* as occurring in the Perth area (see Glauert, 1950).

Until the natives pointed out this singular architecture as belonging to this little animal I had passed by hundreds of them supposing they were Ant-hills, to which they bear so close a resemblance that you do not detect the difference in casually passing them. From four to seven are generally found together in one nest.

In confinement it is an exceedingly active little creature, the general contour of its body is very short and ball like; the eyes are black and prominent; the lower lip shows rather conspicuously and is of a light straw yellow colour: in one old female I could make out six mammae. It utters the singular half hissing cry, so characteristic of the marsupials. It is a very nocturnal feeder. Stomach contained insects generally.

Hab: King George's Sound.

No. 37 of my collection.

NUMBAT, *Myrmecobius fasciatus* Waterhouse, 1836.

Noom-bat Aborigines of York and Toodyay

Wai-hoo Aborigines of King George's Sound

Ant-eater of the Colonists

This beautiful little animal may be said to be tolerably abundant and equally distributed over the whole of the White-Gum forest land, it is never seen west of the Darling range on the west coast, or south of Mount Barker on the south coast, when seen running on the ground, it has very much the general appearance of a squirrel, its progressive motion being in short successive leaps, with its tail a little raised — every now and then stopping, and sitting up on its hind feet; with the body quite erect, with its brush tail tolerably well up the back, in this way it moves on till meeting with a hollow stump, it does not immediately enter, but again erects itself at its full height as if to reassure itself of the certainty of approaching danger, this last is so constant a habit, that I never saw one enter a hollow log without.

It is by chasing them in this way into hollow stumps they are mostly captured. It is so harmless that on handling it even the minute after it is caught, it does not attempt to bite or scratch, in fact it very soon becomes tame, while it is in the hollow, and when it finds no means of escape, it gives forth a kind of half smothered prolonged grunt, produced apparently in a great measure, by hard breathing from the nose. I have heard from several settlers, who have kept the noombat in confinement, several weeks together, that it lived principally on bran, and which say they it appeared to eat with relish. I have never found anything in the stomach but white ants, from which circumstances I had considered this as forming their exclusive food in a state of nature. Its long tongue is admirably adapted for collecting these insects from the small fissures and entrance holes of the ant-hill. When they cannot obtain Ants in this way, their strong fore-claws enable them to break down the sides of the Ant-hill, thus in passing through a gum forest where the White-ant abounds, scarcely an ant-hill will be seen that is not hollowed out more or less. The male seems to be most particularly shy, or else there is a great preponderance of females over males, for I have generally remarked where you kill one of the latter, you get at least 6 of the former; one circumstance in particular would seem to strengthen this conjecture, I once took a nest of four half-grown ones, the whole of which were females. The Noombat breeds in holes or short burrows, generally choosing a grassy spot at the edge of a White-Gum forest. The young are at first naked and attached to the mammae in the semipouch precisely as in Antechinus until they are about 2 inches long when they are covered with hair, leave the pouch, and are then found huddled together in a warm nest like the genus Mus. I have never seen it run up a growing tree, although I have frequently heard it said that it does so, especially the male when closely pursued by a dog. By the natives the Noombat is considered the quickest sighted animal in the country.

Mr. Waterhouse is in error in supposing he had discovered the remains of a pouch, for the Noombat has no more than a slight fold of the skin is [sic] described in Antechinus; in fact the description of the latter, in reference to this, will equally apply to both.

The greatest number of young I have seen together attached to a female Noombat is seven, but I believe they occasionally have as many as nine or ten.[7]

No. 10 of my collection.

DALGITE, *Macrotis (= Thalacomys) lagotis* (Reid, 1837).

Dol-goitch Aborigines of Western Australia

This is a burrowing animal, living in pairs, and choosing spots where there is a loose soil; its burrows are in general several feet in depth, and often of very great extent, and its powerful claws enable it to burrow with astonishing rapidity, which renders it anything but easy to capture; it often occurs that while the native is digging along its burrow, the animal becomes alarmed, and commences burrowing upwards from the extremity of its long burrow and thus makes its way out, generally unperceived by the man while employed digging. The Dolgoitch in a state of nature seems to be almost exclusively an insect feeder, and one of its most favourite morsels apparently is the larva of a species of Cerambyx, found in the roots of the Jam-wood (Acacia) this grub too is eaten with great avidity by the Natives, who never fail to cut it out from an exposed root where the Dolgoitch has been unsuccessful.

The P[erameles] lagotis is tolerably abundant over the whole of the grass district of the interior where it is exclusively confined.

The flesh is extremely delicate, and when boiled greatly resembles that of the common rabbit.

No. 29 of my collection.

MARL, *Perameles myosura* Wagner, 1841.[8]

Perameles

Mal-a Aborigines of Western Australia
Nyem-mel Aborigines of King George's Sound

This species so nearly resembles the P. fusciventer[9] in general habits and manners that the one description almost equally applies to both, if anything the Mala perhaps gives the preference to more thickly scrubbed parts; a thicket of seedling casuarina is a favourite resort; the Mala differs from all others of the genus with which I am acquainted in the exceeding tenderness of the skin, it is so very thin, that the weight of its own leg, if suffered to hang down for a few moments is sufficient to separate it from the body; it is without exception the most difficult to skin of any Australian mammal I have yet operated upon. As far as I can learn this species is confined to the interior.

Hab: Western Australia.

No. 42 of my collection.

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[7] Several authors have pointed out that the female of *Myrmecobius* has but four mammae, and therefore Gilbert's observation of seven attached young was an impossibility. Krefft (1868) appears to have been the first to publish this fact. In the course of his remarks, he says: ". . . one observer, and a good one, states that he has actually seen seven young on the nipples."

[8] A male specimen of this species collected at "York, W.A." by Gilbert is the type of *P. arenaria* Gould, 1844. However Gould synonymised *arenaria* with *myosura* after reading Wagner's description.

[9] This is *Isoodon obesulus*, the South-western Australian animals being sometimes separated as a weak race, *I. o. fusciventer* (Gray, 1841). According to Glauert (1950) Gilbert collected the type of *fusciventer* at King George's Sound.

PIG-FOOTED BANDICOOT, *Chaeropus ecaudatus occidentalis* (Gould, 1845).[10]

Chaeropus castanotis Gray's Brit. Mus. Cat.

Bur-da Aborigines of the Walyemara district, W.A.
Wot-da Aborigines of the York district, W.A.

This curious new form since Major Mitchell's discovery of it on the Murray has since been found at South Australia and in Western Australia. The first seen was described as being tailless, but this character there can be no doubt now, was accidental, for both specimens from South and Western Australia, have tolerably lengthened tails. The Chaeropus is doubtless nearly allied to the Perameles and like it has a very tender skin and would be as likely to lose its tail, as I have frequently seen in the different species of Perameles. The description of Major Mitchell's original specimen was erroneously described, as regards the character of the hind feet. On examining the specimen deposited in the Sydney Museum I found it agreed in every particular with those I obtained in Western Australia and that sent from South Australia by Captain Grey.

The measurements of those I obtained were:—

Length from tip of nose to end of imperfect tail	12½ inches
Length of tail	3½ inches
Length of face from tip of nose to ear	2¾ inches
Length of ears	1¾ inches

The two and only specimens I obtained were brought in by a party who formed an expedition to the Walyemara district about 45 miles north-east of the Townsite of Northam a district of country abounding in swamps and thickets, the first was hunted by the dogs from a small patch of grass and took refuge in a hollow log, from which it was captured. During my last expedition to the interior my native guide frequently hunted them out of their nests, but in general the brush was so thick, it was quite impossible to either get a shot at them or offer a chance for the dogs to hunt them. It makes a nest of dried leaves, pieces of stick, dried grass, &c., the inside being lined with very soft fibrous grass, &c., with the exception of using a different material it makes a nest precisely like the Perameles, like the latter too on leaving its nest leaves no opening. These dense thickets doubtless form its western boundary, for none according to the natives are ever seen beyond them, and the animal before these two were brought in was quite unknown to the oldest settlers in the colony.

No. 33 of my collection.

POSSUM or KUMARL, *Trichosurus vulpecula* (Kerr, 1792).

Phalangista vulpina

Goo-mal Aborigines of Western Australia

Inhabits the hollows of standing trees, or hollow logs lying on the ground, only feeding at night on the tender shoots of the upper branches of the different species of Gums (Eucalyptus). In Western Australia I found this species varied very much in the colour of its fur, the young at first are often nearly black, but its most usual colour is an uniform light grey; very old males are often met with of a reddish brown colour, some have the tail tipped with black others with white; having obtained and seen a great number taken from different situations and seasons I have no hesitation in considering them as all belonging to one species. It is most abundant in the extensive Gum forests of the interior, but is very generally distributed over the whole colony of Western Australia.

No. 15 of my collection.

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[10] The type of the subspecies, a female, was collected by Gilbert at "Boorda, Kirltana, W.A." in October 1843 (Thomas, 1888).

Mo-gnurk and Mo-mo-lyne [11] Aborigines of Port Essington

This is the only species I observed inhabiting the Coburg Peninsula; it is not very abundant and from seeing a few specimens I could not learn if they are subject to the same changes on the north coast as observed on the south.

No. 8 of my collection.

WESTERN RINGTAIL, *Pseudocheirus occidentalis* Thomas, 1888.[12]

Hepoona Cookli
Ngo-ra Aborigines of Perth
Ngorh Aborigines of King George's Sound

This species in Western Australia does not confine itself to standing trees, or to the ball like nest often seen among the smaller upper branches but is occasionally met with in holes in the ground or hollows of dead logs; like the P. vulpina it varies very much in colour, from a light grey to nearly an uniform brown. In one instance I took a nest of two young ones about half grown presenting these two extremes of colouring.

Although this is very generally distributed over the whole colony it is most abundant in the beds of the rivers or other moist places.

No. 40 of my collection.

MUNDARDA, *Cercartetus concinnus* (Gould, 1845).[13]

Bell's Dromicia
Dromicia gliriformis Gray's Brit. Mus. Cat.
Man-dur-da Aborigines of Perth, W.A.

This little opossum is tolerably abundant in most parts of the colony on the west coast, inhabiting the smaller trees particularly the Casuarina.

I kept one alive for nine months, and it became very tame. It generally slept during the day and became exceedingly active at night. It was particularly fond of catching flies. Besides the above Habitat it is found in New South Wales and South Australia.

No. 26 of my collection.

HONEY MOUSE or NOOLBENGER, *Tarsipes spenserae* Gray, 1842.

The Tarsipes
Tarsipes Spencerae Gray's Brit. Mus. Cat.
Ice-pin Aborigines of Perth
Nool-boon-goor Aborigines of King George's Sound

This little creature inhabits the smaller trees from the blossom of which, like the Meliphagidae, it is constantly extracting honey and minute

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[11] This is presumably the same species as the previous. Under this species Gould states, "According to Mr. Waterhouse, it is also found in Northern Australia; but I observe that specimens from that country are larger than those obtained in the countries above mentioned [the southern mainland states] and a doubt exists in my mind as to their identity." The northern Australian animals were not separated subspecifically until 1897 when they were named *T. v. arnhemensis* by Collett.

[12] Gould was somewhat puzzled as to the relationships of his specimens of Ringtails from various parts of Australia, and also to which form the name *cookii* Desmarest should apply. Subsequent workers have shown it to refer to the Tasmanian form. The Western Ringtail was not differentiated from the south-eastern Australian forms until it was described as a new species by Thomas in 1888. The type is a female collected by Gilbert at "King George's Sound" on February 27, 1840.

[13] Gilbert did not differentiate this species from its representative *(nanus)* of south-eastern Australia. Two males collected by Gilbert at "Swan R., W.A." are the co-types of *concinnus* (Thomas 1888).

insects. I do not think it is abundant in any part of the colony, or else it is difficult to find, for notwithstanding I offered high rewards to the natives they never brought me in more than four specimens one of these a female kept alive several months, in a few days after captivity it became quite tame, would suffer itself to be handled without attempting to escape. It would occasionally show itself for a few minutes during the day, but its general habit was to feed during the night when it became very active; one of its most constant habits was, sitting in a corner of its cage, intently watching the movement of a fly, until, attracted by the sugar, it was fairly within the precincts of the wires, when with one bound exceedingly rapid the fly was seized, the Tarsipes with its prey between its fore-feet sitting very erect, after tearing off all the rejected parts, viz. the wings, head, and legs, would devour the body with avidity. I obtained a living specimen which I put in the same cage, the latter soon commenced worrying its companion, which in a few days after died.

The Tarsipes uses its tail precisely as seen in the Nepoona; but its most conspicuous character is its long prehensile tongue; it was very fond of licking its food if very sweet from the finger, in this way I have often seen the tongue well displayed, at times I have often seen it distended (sic) a full inch beyond the nose, the general form is very flattened, tapering to a very delicate point, on each side near the tip the edge is slightly serrated. The eyes are not large, black, and very prominent, in the living animal the eyes so swell out that there appears but a very small portion of the head separating them, the ears are in general carried quite erect. When sleeping it rolls itself into a ball, resting on the lower part of the back, with its long nose bent down between its fore-feet, with the tail brought up over all with the extremity lying down the back.

No. 28 of my collection.

[Opposite covering nearly the whole page is a pen and ink drawing of the animal. Well executed.]

ECHIDNA, *Tachyglossus aculeatus* (Shaw, 1792).[11]

Dun-ung-er-de Aborigines of Toodyay, W.A.
Nyoong-aru Aborigines of York, W.A.

This animal I have discovered inhabits the west coast, as well as the east. In Western Australia it appears confined to Rocky gullys.

No. 45 of my collection.

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[11] Gould gives the name "Dun-ung-er-de" as of the aborigines of "Toodyay and Guildford Districts." He states "Mr. Gilbert obtained a single example in Western Australia, which had been taken on a farm situate on the upper part of the eastern branch of the River Avon; he subsequently learnt from the natives that it had been seen in the Toodyay District and in the vicinity of Guildford."

In letters to Gould written just prior to leaving Perth for Sydney and after arriving at Sydney, after his first visit to Western Australia (published by Whittell, 1942), Gilbert specifically stated that the Echidna was not known to occur in Western Australia.

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KEY TO THE FROGS OF SOUTH-WESTERN AUSTRALIA

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INTRODUCTION

The most recent paper dealing with Western Australian frogs is Parker's (1940) treatment of the Australian Leptodactylidae. The same author, in a brief paper (Parker, 1938) discussed some of the local Hylidae, and Loveridge (1935) included Western Australian species of both families in his list of Australian frogs at Harvard.

The above papers, based on preserved specimens, are strictly taxonomic; they depend solely on the technique of comparative morphology in establishing species and thus are largely outside the scope of techniques available to field workers. We are at present engaged, in the Zoology Department, in a long term investigation of the systematics and biology of local frogs and it is apparent that new species will need to be erected.

Parker's paper is out of print and until our larger study revising genera is ready for the press this key to the species listed by Parker is issued as an aid to identification in the field. The accompanying illustrations are copied from photographs of live animals and have been selected as portraying the characteristic attitude of the various species when viewed dorsally. The drawings are not to scale but dimensions are given under each species description.

It is always preferable to give detailed distributions by listing localities at which specimens have been collected but such a procedure would make this paper too long for its purpose. So as a compromise only the generalised range of the species is given.

The geographic limits of South-western Australia, for the purpose of this paper, are taken as Western Australia south of the Tropic of Capricorn.

KEY

1. Toes and fingers with sticky terminal pads or discs (Hylidae) 2
   Above absent 5

2. Colour on dorsal surface uniform i.e. no pattern 3
   Conspicuous pattern, usually green and gold 4

3. Silver grey to pale brown dorsally and having bright red spots on posterior of thigh ..... *Hyla adelaidensis*
Reddish brown dorsally, lacks red spots on thighs (as far south as Murchison River) ..... *Hyla rubella*

4. Large species, brilliant pattern of green and gold dorsally, lacks black on ventral surface and thighs ..... *Hyla aurea*
As above but having prominent black and yellow marks on thighs and groin ..... *Hyla cyclorhynchus*

5. 'Typical' frogs 6
Not as above, having very small head and extremely short limbs. Looks like a Turtle and lives always beneath soil surface ..... *Myobatrachus gouldii*

6. Large species having a "shovel," see Fig. 1, on the heel of foot, all capable of burrowing 7
Small to very small species, without "shovel" on foot. Aquatic or cryptozoic 10

7. Dorsum rough or warty with a pattern of warts or blotches 8
Dorsum rough, if pattern present then not distinct, usually mottled, never having red on any part of body 9

8. Yellow mid-dorsal line, leg with prominent swollen gland, red in groin and on thigh ..... *Lymnodynastes dorsalis*
Yellow dorsal line and two lateral yellow lines, one from above tympanum to flank and the other running parallel to mid-dorsal line ..... *Helioporus wilsmorei*
Dorsum warty to almost smooth, with very variable pattern of brown to golden blotches, flanks often bright yellow, some specimens with a red dorsal stripe. Leg never with swollen gland or red markings. ..... *Helioporus pelobatoides*
Helioporus centralis

9. Purple brown dorsally, flanks with small golden yellow spots. Burrowing forms in clayey soils. ♂ with spines on 'thumb' in breeding season ... *Helioporus australiacus*
Brown to grey dorsally and having large cream or white spots on dorsum and flanks. Burrows in sandy areas, east of Darling Scarp. ♂ having spines on thumb in breeding season ..... *Helioporus albopunctatus*
Brown to mottled grey above sometimes with yellow blotch on snout and yellow smudge above each shoulder (especially in juveniles). Burrows in sand on coastal region and in sandy valleys in Darling Range ..... *Helioporus eyrei*

10. Frogs with webbed toes. Reddish brown dorsally, having flat red-brown warts from behind eyes and along flanks ending with two large orange-red blotches each side of urostyle ..... *Glauertia russelli*
Feet not webbed 11

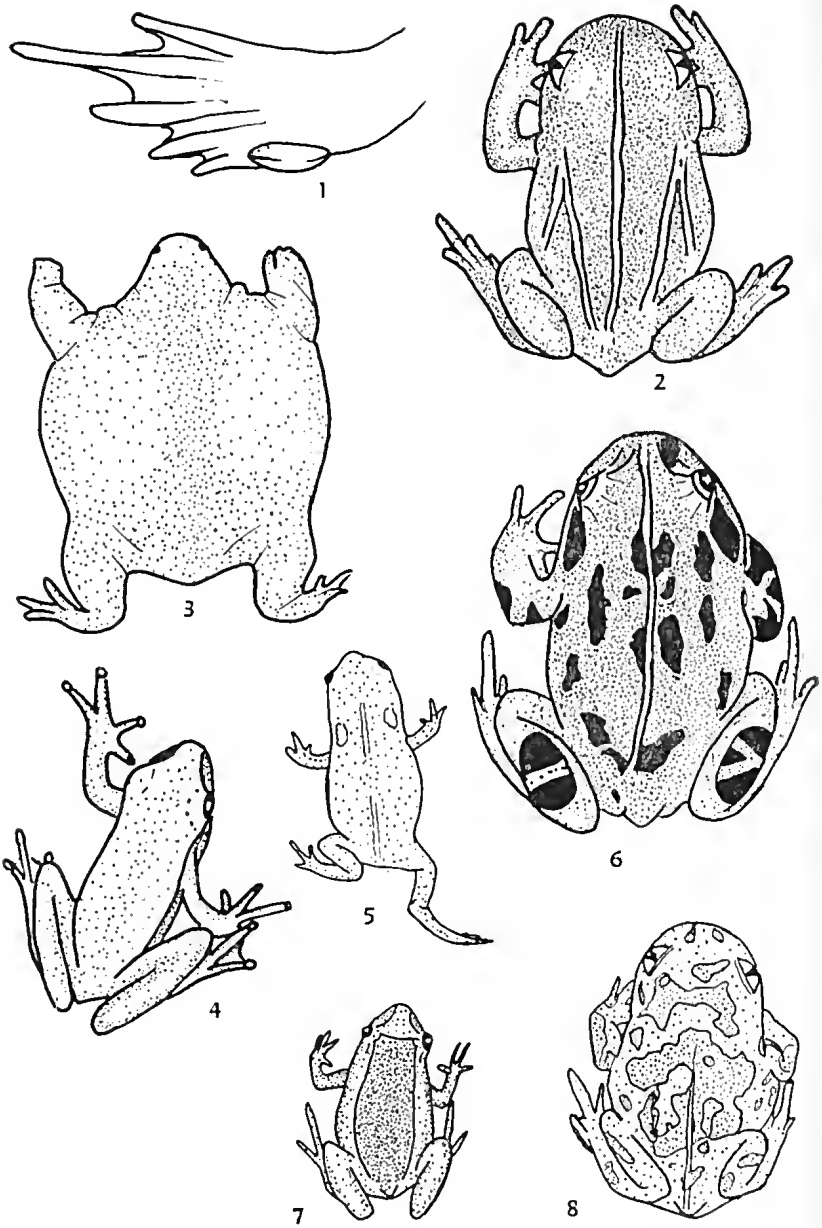

PLATE 1

Fig. 1—Foot with 'shovel'.
Fig. 2—*Helioporus wilsmorei.*
Fig. 3—*Myobatrachus gouldii.*
Fig. 4—*Hyla adelaidensis.*
Fig. 5—*Metacrinia nichollsi.*
Fig. 6—*Limnodynastes dorsalis dorsalis.*
Fig. 7—*Crinia leai.*
Fig. 8—*Helioporus centralis.*

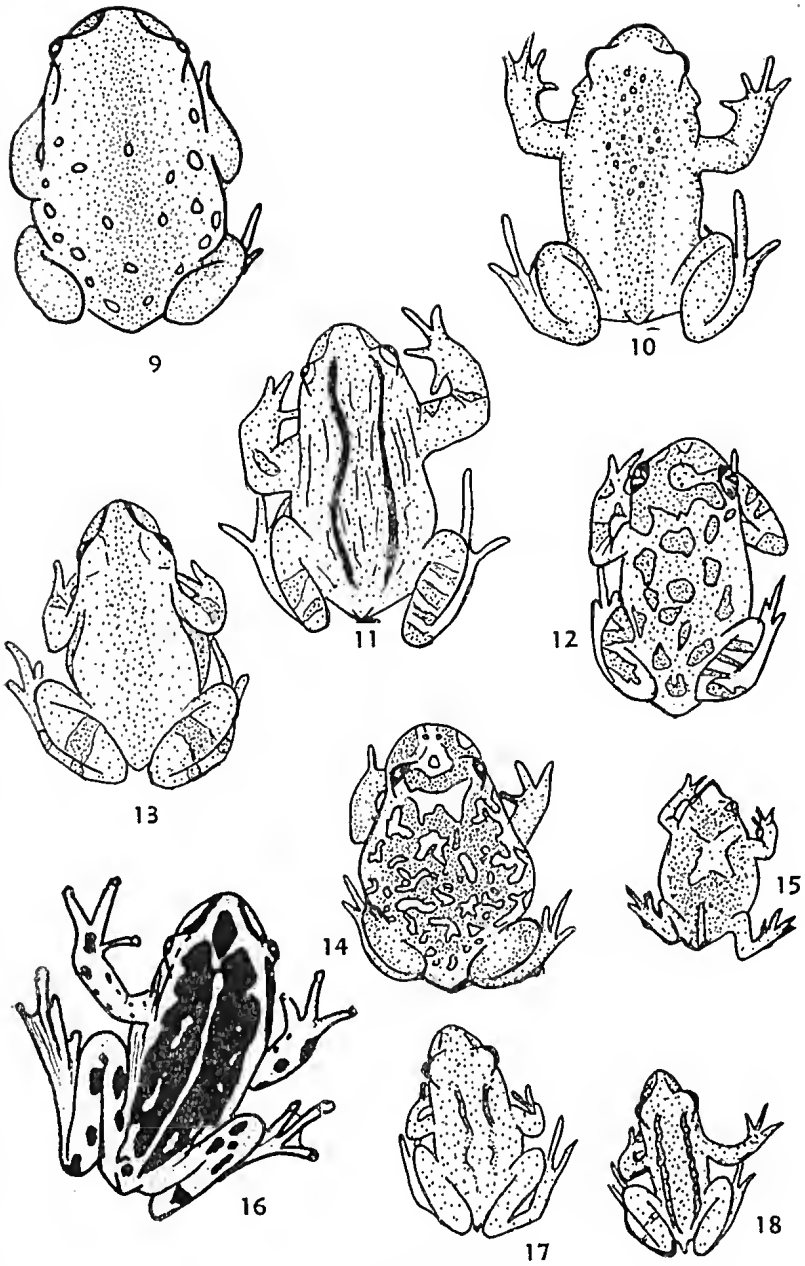

PLATE 2

Fig. 9—*Helioporus albopunctatus.*
Fig. 10—*Crinia rosea.*
Fig. 11—*Crinia georgiana.*
Fig. 12—*Helioporus pelobatoides.*
Fig. 13—*Crinia signifera.*
Fig. 14—*Helioporus eyrei.*
Fig. 15—*Pseudophryne guentheri.*
Fig. 16—*Hyla aurea.*
Figs. 17 & 18—*Crinia glauerti,* showing variation.

11. No ear drum, reddish brown to grey dorsally. Sometimes with 'X' above shoulders always with light or reddish streak above urostyle. Walks on tip-toe, rarely hops ..... *Pseudophryne guentheri*
P. occidentalis

Having ear drum (sometimes indistinct) 12

12. Ventral surface blue with prominent yellow or orange blotches. Walks ..... *Metacrinia nichollsi*
Not as above 13

13. Ventral surface pink or red ..... *Crinia rosea*
Not as above 14

14. Groin and thigh flamed in bright red, hands without pigment, eyelid yellow or golden. Dorsum may be smooth, red, grey or black, ridged or warty ..... *Crinia georgiana*
Not as above 15

15. Dorsum smooth and without warts or ridges, dark triangular interorbital mark sometimes extending whole length of back. Dorsum and flank often with small scattered blue-white spots. Legs very long (longer than body) ..... *Crinia leai*

Dorsum smooth to rough and warty, grey to biscuit brown, hands dark and pigmented. Call; Crk, Crk, Crk ..... *Crinia signifera*

Dorsum rough and warty to dark and smooth with longitudinal ridges and yellow and red streak on each flank. Call, prolonged rattle. The smallest of the Crinias ..... *Crinia glauerti*

Genus *HYLA* Laurenti

Hyla adelaidensis Gray

Type Locality: "Western Australia."

Range: The wetter parts of the South-west in the area of winter rainfall and following the coast near the limits of range. Collected as far east as Pine Hill (between Balladonia and Israelite Bay).

Description: Fig. 4. A long slender frog, length about 60 mm., usually pale fawn or brown dorsally having a much darker stripe commencing at the eye and running along each flank. The red spots on the thigh are characteristic and remain constant irrespective of dorsal colour.

Habitat: Reed-grown margins of swamps and lakes. Calls from water or soil level up to as high as three feet while hanging on the reeds.

Hyla rubella Gray

Type Locality: Port Essington, N.T.

Range: From about the Murchison River inland and northward to include the whole of northern Western Australia.

Description: A small stout frog, about 30 mm. long, reddish brown or dull grey-brown dorsally. Broader and shorter than *adelaidensis* and lacks spots on thigh.

Habitat: Found wherever there is relatively permanent fresh water; in the event of drought the animals survive for some time beneath debris.

Hyla aurea Lesson

Hyla aurea raniformis (Keferstein)

Type Locality: "Australia."

Range: The coastal and wetter parts of the South-west in the same general situations as *H. adelaidensis*. Somewhere east of Cheyne Beach and west of Jarramongup this species is replaced by *H. cyclorhynchus*.

Description: Fig. 16. When full grown a large stout frog, up to 80 mm. long, capable of marked colour changes, in sunlight generally green and gold, in darkness or cold may be dull brown. Lacks the black and sulphur markings in groin and thigh which is characteristic of *cyclorhynchus*. Generally has mid-dorsal stripe.

Habitat: Swamps and lakes, also along vegetated margins of streams. In undisturbed situations can be frequently found up paper bark trees and swamp gums. In disturbed conditions such as boggy pastures, drains and creeks through pastures it becomes a frog of the grass.

Hyla cyclorhynchus Boulenger

Type Locality: "Western Australia."

Range: As already mentioned under *H. aurea* this form extends along the southern coast, and has been taken as far east as Pine Hill.

Description: As large as *H. aurea* and appears to differ from this species mainly in the black and sulphur markings in groin and on thigh. Dorsally has a pattern of green blotches, and lacks the mid-dorsal stripe usually found in *aurea*.

Habitat: Swamps and permanent waters. At Hopetoun it is commonly found in rain water tanks.

Genus *MYOBATRACHUS* Schlegel

Myobatrachus gouldii (Gray)

Type Locality: "Western Australia."

Range: From about Geraldton in the north to Stirling Ranges in the South-east.

Description: Fig. 3. A stout leaden grey frog having a very small head and extremely short limbs. Body up to 45 mm. long.

Habitat: This appears to be a truly subterranean frog and it is only by accident that it is found. Some specimens have been dug up, others disclosed when rolling rotten logs. The animal appears to eat termites.

Genus *LIMNODYNASTES* Fitzinger

Limnodynastes dorsalis (Gray)

L. dorsalis dorsalis (Gray)

Type Locality: "Western Australia."

Range: Throughout the South-west in the area of winter rainfall from about Northampton in the north to Pine Hill in the South-east.

Description: Fig. 6. Mature specimens may be up to 75 mm. long. The dorsal stripe to which the specific name is an allusion is invariably present. The red in the groin is constant and with the large gland on the leg of mature animals is always diagnostic.

Habitat: Swamps with permanent water and along swampy stream banks. Throughout the Western wheatbelt it is common in dams and water catchments.

Genus *HELIOPORUS* Gray

Helioporus wilsmorei Parker

Type Locality: Wurarga, W.A.

Range: North and east of a line drawn from the coast north of Geraldton through Morawa to Lakeside, i.e. the dryer and interior part of the State.

Description: Fig. 2. A large stout chocolate brown frog up to 60 mm. long having bright yellow or golden stripes dorsally as follows: commencing over the shoulder on each side one stripe running along the back, beginning at the same spot a second stripe occurs. These run backward and downward to each flank. Feet with digging shovel (see Fig. 1). Male in breeding season with a pad on thumb.

Helioporus pelobatoides Werner

Type Locality: Beverley and Broomehill, W.A.

Range: From Caversham through Wubin and southward to the Stirling Ranges. In the north the species merges into the range of *centralis*.

Description: Fig. 12. A variable frog as indicated in the key. Smaller than *H. centralis* up to 45 mm. long, but small *centralis* are only separable from *pelobatoides* by geography. Male in breeding state having a roughened back and dark rough pad on the thumb and first finger of the hand.

Habitat: A burrowing species not met with in the summer but common when the first rains occur.

Helioporus centralis Parker

Type Locality: 100 miles east of Lake Eyre.

Range: Murchison River, Morawa, Yalgoo, Bunjil via Caron, and northward and eastward of these localities.

Description: Fig. 8. Variable as *pelobatoides* but a little larger, up to 55 mm. long. Male at breeding having black roughened pad on thumb and first finger.

Habitat: Not known; is a burrower and appears great distances from water.

Helioporus australiacus (Shaw)

Type Locality: "New Holland." (= County of Cumberland, N.S.W.).

Range: The Darling Scarp and occasionally the clay zone to the west, to the east of the Scarp in areas of laterites and clays as far east as a line joining Baker's Hill and Kojonup. Bindoon is near the northern limit of the range.

Description: A very large frog, up to 80 mm. long. Chocolate-brown dorsally and having the flanks profusely spotted with bright yellow. Male in breeding season with one or two large spines on the thumb. In shape very like *albopunctatus*.

Habitat: Frequents clayey soils where it occupies shallow burrows beneath logs or rocks.

Helioporus albopunctatus Gray

Type Locality: "Western Australia."

Range: From about Geraldton in the north then southward through the sands of the eastern part of the Darling Range and Wheatbelt to Jarramongup in the south.

Description: Fig. 9. A large frog, much larger than *eyrei*, up to 70 mm. long, leaden grey dorsally and spotted with large cream spots. Head high and rounded, ♂ with spine on thumb.

Habitat: Creeks and swamps in the region discussed under range, digs irregular horizontal or vertical burrows in the sand. Eggs laid in the burrow.

Helioporus eyrei (Gray)

Type Locality: "On the banks of the river Murray" (W.A.).

Range: The coastal plain on the west and south coast in area of winter rainfall wherever it is sandy. Specimens have been obtained from as far east as Esperance and the species also occurs on Rottnest.

Description: Fig. 14. Smaller than either *albopunctatus* or *australiacus* up to 60 mm. long, leaden grey dorsally variously mottled in dirty white or light grey. Head flatter and snout more pointed than *albopunctata*.

Habitat: Swampy areas where the soil is sandy, they are sometimes found in the sandy valleys on the western side of the Darling Range. Eggs laid in a burrow in the sand.

Genus *GLAUERTIA* Loveridge

Glauertia russelli Loveridge

Type Locality: Creek flowing into the Gascoyne River near Landor Station.

Range: Known only from the type locality and from Weeli Wolli (Marillana Station) in the Hamersley Range.

Description: A stout frog up to 30 mm. long. Olive brown with orange-red blotches on shoulder and similar blotches extending irregularly along flanks. A pair of the same colour on each side of the anus.

Habitat: Reed-grown border of permanent water where the frog occurs beneath fallen stems of reeds.

Genus *PSEUDOPHRYNE* Fitzinger

Pseudophryne guentheri Boulenger

Type Localities: "Swan River, N.W. Australia, Australia."

Range: A very widespread and common frog from the Chapman River in the north through the wetter part of the Wheatbelt to the far south coast.

Description: Fig. 15. A small flattened frog up to 30 mm. long with very variable markings, the constant character being a red streak above the coccyx. The dorsum may be grey or brown, warty or smooth, with a mottled pattern which sometimes looks like an X above the shoulders. Belly marked in black and white.

Habitat: A cryptozoic frog. Occurring in damp situations beneath rocks and litter or under fallen timber or dead grass.

Pseudophryne occidentalis Parker

Type Locality: Bruce Rock.

Range: Inland from that of *P. guentheri.*

Description: Generally very similar in size and appearance to *P. guentheri* but lacking warty skin. Chocolate brown dorsally with orange stripe over coccyx, an arrow-shaped orange mark between eyes and along snout and upper part of fore and hind limbs orange. Belly boldly marked in black and white.

Habitat: Beneath fallen reeds and debris adjacent to permanent water.

Genus *METACRINIA* Parker

Metacrinia nichollsi (Harrison)

Type Locality: Pemberton.

Range: In the wet Karri forest from Manjimup to Pemberton, Augusta and Nornalup.

Description: Fig. 5. A small frog up to 25 mm. long with very blunt snout, usually very dark brown or almost black dorsally though some specimens may be rust-coloured dorsally. Ventrally blue with yellow or orange blotches usually at the base of each limb.

Habitat: Early specimens found appeared to be associated with sergeant ants *(Myrmecia* sp.*)* but specimens have been found in rotten logs of peppermint *(Agonis* sp.*),* beneath rotting logs of *Banksia* and crawling in deep wet forest litter.

Genus *CRINIA* Tschudi

Crinia rosea Harrison

Type Locality: Pemberton.

Range: The valley of the Warren River about Pemberton.

Description: Fig: 10. A small stout frog up to 25 mm. long having dorsal markings somewhat like *C. leai* but clearly distinguished by the rose pink under surface. Male at breeding with almost black throat.

Habitat: In tunnels beneath the moist vegetation along the fast-flowing tributaries of the Warren River.

Crinia georgiana Tschudi

Type Locality: King George's Sound.

Range: This species is recorded in the literature from as far north as Carnarvon but local collecting indicates that the species only extends north to the Brockman River thence the range covers the western part of the Darling Range southward to the south coast and then east along the coast.

Description: Fig. 11. A frog up to 40 mm. long with an extremely variable dorsal pattern varying from rough warty and grey to smooth and red-brown. The invariable characters are already mentioned in the key viz. the golden eyelid, unpigmented hands and red in the groin. Male in breeding dress with very dark throat.

Habitat: A forest frog, found in the wet Jarrah and Karri forests where surface water, apart from streams or swamps, abundant in winter.

Crinia leai Fletcher

Type Locality: Bridgetown and Pipe Clay Creek, Jarrahdale.

Range: That of *C. georgiana* except it does not extend along the south coast beyond Albany.

Description: Fig. 7. A light brown to dark brown frog up to 25 mm. long, having a broad black dorsal stripe which commences between the eyes and extends over whole dorsum. Frequently this stripe is eroded and the margins irregular. Many animals are profusely spotted dorsally with minute blue-white spots. Occasionally animals may have large irregular yellow blotches dorsally.

Habitat: This is a frog which favours cool shaded swampy places. In the north of its range it frequents deep naturally vegetated and shady streams, while in the south it is found in nearly every swamp and along every stream.

Crinia signifera Girard

C. signifera signifera Girard

Type Locality: New Holland.

Range: Including that of *georgiana* and *glauerti* but extending much further to the east, where it is common at most temporary waters and water holes where natural vegetation is still found.

Description: Fig. 13. May be almost the same size as *georgiana* but lacks the red in the groin, the golden eyelid, and has pigmented hands. Throat of male dark brown. Can readily be confused with *glauerti,* which is however probably a valid species.

Habitat: In swamps and along streams where it may occur with *C. leai* or in swamps and marshes with *glauerti*.. In the Wheatbelt it is common at most temporary waters and waterholes where the natural vegetation is still found.

Crinia glauerti Loveridge

Type Locality: Mundaring Weir.

Range: Throughout the South-west.

Description: Figs. 17 and 18. This is the smallest crinia found in Western Australia, up to 20 mm. long, apart from its small size, it is extremely variable in colour and dorsal pattern. It lacks colour in the groin and the characteristic cyclid of *georgiana* and is usually too rough dorsally to be confused with *C. leai*. It may be confused with small or juvenile *C. signifera*. Throat of male dark.

Habitat: Swamps and marshy stream banks throughout the area of winter rainfall. This frog adapts very well to disturbance of natural conditions and is common in marshy pastures.

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FROM FIELD AND STUDY

Tawny-crowned Honeyeater in Forest Country.—During February, March and early April, 1954, a large invasion of Tawny-crowned Honeyeaters *(Gliciphila melanops)* occurred in the Bailup-Wooroloo district. The birds were feeding in the tops of high marri *(Eucalyptus calophylla)* in flower. They were very active at dawn but not so noisy as they usually are in the sandplain country. They were rather shy but with some trouble a specimen was procured and positive identification established. This specimen, collected on March 7, was a bird of the year, having a small ovary and the skull incompletely ossified.

This occurrence links up the Wheatbelt habitat and that of the coastal sandplain. —I. C. CARNABY, Bailup.

Aggressive Behaviour by Black-faced Wood-Swallows.—Several papers and notes have appeared recently concerning communal nesting among Australian birds so that the following incident relating to a group of Black-faced Wood-Swallows *(Artamus cinereus)* may be worth recording.

Near Mooliabeenie on January 1, 1954, my attention was drawn to a nest of this species when the fully grown young "exploded" from a banksia bush as I passed by. On reaching down and picking up one of the nestlings no less than six adult Wood-Swallows began intimidatory dives "Stuka" fashion and kept up their attacks until I left the area. The whole community appeared to react to the danger to one of their number as if they themselves were directly concerned though a casual search later failed to reveal any other nests in the neighbourhood.

—JOHN WARHAM, Leederville.

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HERPETOLOGICAL MISCELLANEA

By L. GLAUERT, W.A. Museum, Perth.

IV.—A NEW SWAMP TORTOISE FROM THE SWAN RIVER DISTRICT

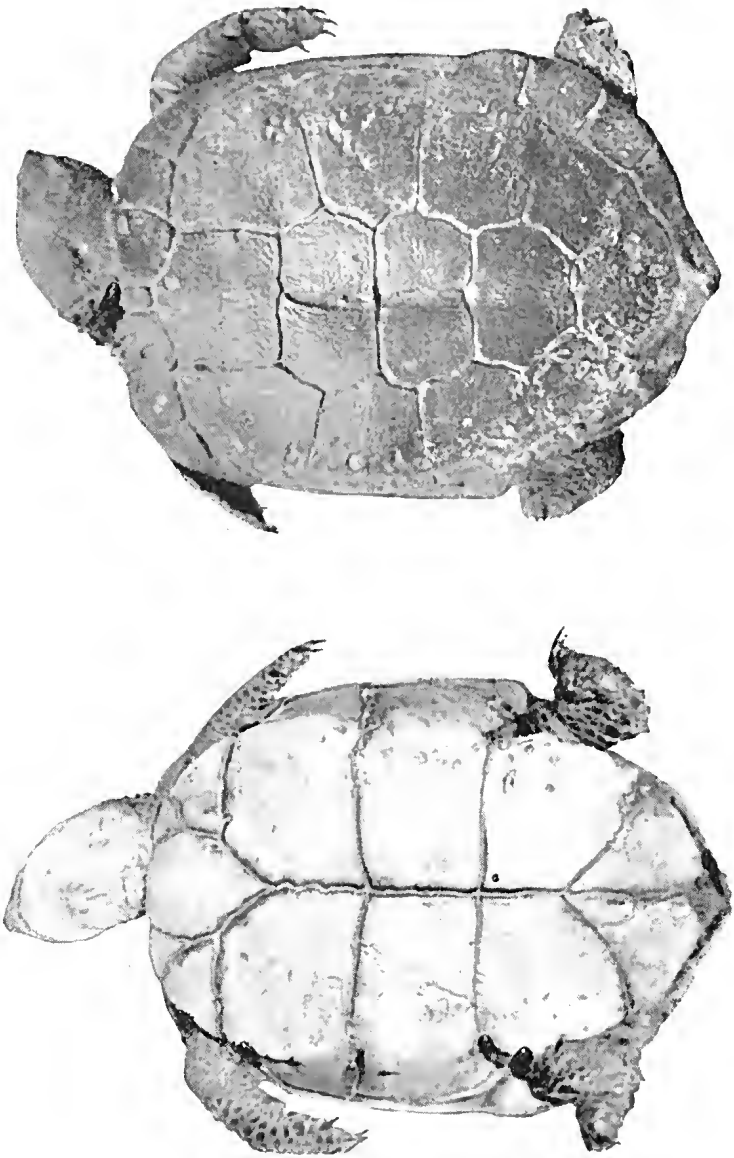
Up to 1953 only one species of fresh-water tortoise was definitely known to occur in South-western Australia, the Long-necked Tortoise, *Chelodina oblonga*. When, therefore, at the Wild Life Show of the Western Australian Naturalists' Club in September 1953 Mr. R. Boyd exhibited a locally taken specimen of a shorter-necked tortoise considerable interest was aroused. Close examination revealed that this tortoise was not referable to any known species and efforts were made to procure additional material. A second specimen was finally obtained in the same locality.

The new species is an ally of a common tortoise in south-eastern and northern Australia and it is rather remarkable that so large a creature should have been overlooked for so many years. Its discovery should encourage the search for still other representatives of eastern States faunas that might linger in the South-west, and the recent similar finds of Bassian fish species, such as *Galaxias truttaceus* and *G. pusilla*, suggest that some of these forms might survive in refuges of very limited area.

The species is characterised as follows:

Emydura inspectata sp. nov.

Specimen R 11092: Carapace slightly depressed, broadly oval (133 x 103 mm.), slightly narrower in front (96) with a distinct sulcus; nuchal very small (9 x 5) entirely free below; fifth, sixth, seventh and eighth marginals with distinct flange, fourth to seventh narrowest. First vertebral largest, as wide as long, obtusely pointed in front; second and third much wider than long, shorter than the adjacent costals; fourth and fifth slightly wider than long, longer than the second and third. Plastron (124 x 95½, measured to the edge of the bridge) flat, large, almost as wide as the carapace, semicircular in front, narrower behind with a broad straight-sided anal notch; bridge rounded, one-third the



Emydura inspectata sp. nov. Upper and lower views of specimen R11092; about three-fifths natural size.

length of the plastron, measured along the middle line. Intergular very large (29.5 x 25.5) widely in contact with the pectorals; gulars very small, widely separated; humerals triangular, slightly narrower than the intergular; pectorals slightly shorter than the femorals, suture between the latter shorter than that between the anals, latter forming a broad, shallow notch behind. Head broad and flat (54 x 27), rugulose above, snout projecting, interorbital space twice the width of the symphysis, the latter equal to the vertical diameter of the orbit. Neck above and laterally with pronounced conical tubercles, temporal region, chin and throat reticulate. Two small barbels. Fore-limbs with three series of transverse lamellae and a flap of three or four enlarged scales. Tail very short, hardly projecting. Colour of carapace bone-brown; head above dark-olive, sides of face, lower lip, chin and throat, marguerite yellow; a few dark markings on the throat; fore-limbs olive-black, hind-limbs darker; plastron buffy-olive, over the sutures of the bones buff.

Specimen R 11093: This smaller, younger individual, with the carapace measuring 98 x 83 mm. and the plastron 88 x 76 mm., shows all the characteristics described above though the bridge is angular not rounded. The coloration of the carapace is a brighter brown and the plastron has the plates edged with brownish black as is usual in the young of *Emydura*. As in the larger specimen the yellow streak along the sides of the face so characteristic of the other species, is lacking.

This new species differs from *E. macquaria*, occurring from the Kimberley District to Victoria and South Australia, in the shape of the carapace, the greater width of the plastron, the unusually large intergular and in the fact that the nuchal is entirely free below. These features also separate it from other species known to occur in northern Australia and Indonesia.

The type, R 11092, was collected in July, 1953, at Warbrook, about 24 miles north of Perth, by Mr. A. Gates, who found it crossing the road in sub-swampy country between the railway line and the Great Northern Highway. It was kept in captivity for nine months by Mr. R. Boyd and then presented by him to the W.A. Museum. The second specimen, R 11093, was also found by Mr. Gates in the same general locality and in similar circumstances in April, 1954.

I am indebted to Mr. J. C. Battersby for sending me drawings of the carapace and plastron of the type of *Emydura australis* (Gray) in the British Museum of Natural History, and to Messrs. H. M. Hale, Director of the South Australian Museum, and C. W. Brazenor, Assistant Director of the National Museum of Victoria for permission to examine and compare specimens in their Museums. Also to Mr. H. Butler for the photographs illustrating this communication.

THE RECENT INCREASE OF THE RARER NATIVE MAMMALS

I — INTRODUCTION

Reports from various sources indicate that several species of native mammals, long regarded as having become scarce, or even rare, are now entering a cycle of relatively greater abundance (cf. S. R. White on the Fat-tailed Dunnart, *W.A. Nat.*, vol. 3, 1951, p. 1). It is desirable to document this phenomenon as well as possible and the present series of reviews, from various districts in the South-west where competent observers are located, is intended as a first contribution in this field.

It will be noted from the several reports that the situation is not precisely the same everywhere, and, in fact, some observers have not found the fluctuations in certain species in their districts which appear to be evident elsewhere.

The increase in number of some species of the rarer marsupials has figured prominently in the quarterly reports of several of the Honorary Fauna Wardens who were first appointed last year under the terms of the Fauna Protection Act 1950. Two sets of reports have now been received (for the quarters ended, respectively, December 31, 1953, and March 31, 1954) and through the courtesy of the Chief Warden of Fauna (Mr. A. J. Fraser) a summary of the relevant data may be included in this section. The observers, though not trained naturalists, are practical men familiar with the situation in the bush over recent years, and their unsolicited opinions on the species they discuss have considerable value. The data are presented hereunder:

Numbat.—Most reference books suggest that this creature is a rarity and threatened with extinction. However, it has probably always been present in some numbers in the wandoo belt but latterly it has become more noticeable, indicating a strengthening of the population to a point where it may even be called a "common" animal in some localities. Honorary Wardens' reports are as follows: Drakesbrook ("I have seen only two in ten years"); Cuballing ("a small number of Numbats seen"); Narrogin ("I am very pleased to report that *Myrmecobius fasciatus* has been seen around here several times during the last few weeks"); Katanning ("a small colony of Numbats in the West Woodanilling area was reported to me several months ago"); Manjimup.

Possum.—The reduction in numbers of the Possum has been almost catastrophic. The last open season for commercial hunting was in 1941 (between September 15 and October 31, when royalty was paid on approximately 50,000 skins). Apart from that short season the species had been protected since 1932. Over large areas the animals seemed to have completely vanished. The recent reports indicate increases or re-appearances in the following districts: Mt. Marshall; Drakesbrook (in the Darling Range area); Beverley ("increasing in the Avon Valley and some farms west;

have noticed quite a number killed on roads between Northam and Narrogin; ten years ago would hardly see any traces of Possums"); Narrogin ("this species is definitely showing an improvement"); Cuballing ("have increased in numbers on western side of railway"); Wickepin ("a few have been seen lately, but it is the first for some years"); Kulin; Upper Blackwood; Manjimup.

Quokka.—Two reports of the re-appearance of the Quokka are reported: from Yarloop (in the Darling Range, "Quokka seems to live here in the swamps, seen occasionally, but plenty of signs in all swamps"), and Manjimup ("Some months back observed a dead Quokka near Broke Inlet turn-off, the first seen or heard about for ten years"). S. R. White (*W.A. Nat.*, vol. 3, 1952, pp. 101-103) has discussed the status and decline of the Quokka in the South-west over recent years.

Brush-Wallaby.—Though not rare in the usually accepted sense, this wallaby had over recent years declined noticeably in numbers (cf. Bruce Shipway *W.A. Nat.*, vol. 1, 1947, p. 19). Several Wardens now report that this tendency has been reversed. Districts reporting an increase are: Geraldton ("there are a few Brush Kangaroos on the sandplain; I have not seen them for years until the last twelve months"); Gingin ("seem to be increasing"); Drakesbrook ("becoming plentiful in the timber areas east of Waroona"); Beverley ("slightly increased"); Cuballing ("quite numerous on the western side"); Narrogin; Katanning ("fairly numerous in a number of patches of bush west and south of Woodanilling; several residents consider they are increasing"); Cranbrook ("a few appearing after being absent for years"); West Arthur ("a few about, these seem to be on the increase"); Bridgetown ("for years I thought the Brush had either died out or been killed out by foxes, but I have seen quite a number of late between Bridgetown and Augusta"); Albany; Kulin ("many years ago Brush were very plentiful on the sandplain in the Kulin area but from 1938 onward they decreased; in 1950 they once again started to increase"); Esperance ("increasing").

—D. L. SERVENTY

II — RECORDS FROM THE W.A. MUSEUM

The present status of our marsupial fauna is not easily ascertained, firstly because so many forms are crepuscular or nocturnal, and secondly because the arrival of material at the Museum is governed by so many factors. The finders may consider the specimen so common that it is not worthwhile to send it to the Museum, means of transport may not be available or the finder may not be in any way interested. Further, propaganda in the press or over the air may increase interest for a season and this is bound to decline sooner or later.

For instance, twenty years ago large numbers of small marsupials reached the Museum, far in excess of those received either earlier or later.

The clearing of the land also plays an important part in bringing the animals under the notice of the clearers or the settlers in adjacent areas to which the animals have fled because of the destruction of their habitat.

In the following account comparisons have been made between the material received at the W.A. Museum during three-year periods, successively ten years apart. These are 1922-24, 1932-34, 1942-44 and 1952-54 (to September 1954).

The Mardo is now very rare, or even extinct, as no specimen has reached the Museum since 1939. The Dibbler is not represented in the Museum's collection of small marsupials, the three specimens mentioned by Shortridge (*Proc. Zool. Soc. London,* 1909, p. 840) proving to be the Mardo.

The Wambenger is more than holding its own in the South-west, the 10 specimens recorded during 1952-54 show that it is to be found in many parts from Kalamunda in the north to Capel, Yornup and Margaret River in the south. In the 1942-44 period 5 were received; in 1932-34 there were no less than 12, and in 1922-24 only two. The Red-tailed Wambenger still exists in the southern Wheat Belt. Three specimens were collected (in the Kulin-Pingrup area) in 1952-54; two were recorded during 1942-44; one only in 1932-34, and none in 1922-24.

The Dunnart appears to be declining, one specimen (from Albany) reached the Museum in 1952-54; there were 12 in 1942-44; 12 in 1932-34, and 17 in 1922-24. The Fat-tailed Dunnart was far less in evidence in 1952-54 as only one specimen was received. On the other hand there were 10 in 1942-44; 14 in 1932-34, and four in 1922-24. This may not be a true picture of this useful little animal's status as official propaganda has been conducted on its behalf. The much rarer Granule-footed Dunnart has not appeared at the Museum since 1939, when specimens were received from Kulin and Marvel Loch.

It may be added that in the Museum's collection are two specimens of the Jerboa-Marsupial, a male and a female caught near Lake Grace in 1936 and 1939. They probably represent the species *Antechinomys lanigera* in Western Australia. The animal appears to be extremely rare.

The largest local Dasyurid, the Chuditch, still exists in various districts. Two specimens (from Carmel and Pingelly) reached the Museum during the 1952-54 period; one arrived in 1942-44; there were 11 in 1932-34, and two in 1922-24. From reports received the animal is today far more abundant than the low figures of Museum receipts would indicate.

No specimen of the Numbat was registered in 1952-54, though several living individuals had been offered and declined with the suggestion that the little animals should be liberated. In 1942-44 five were received; in 1932-34 there were six, and in 1922-24, two. There is satisfactory evidence that this animal is far from extinct, though rare or absent in many of its former haunts, probably because of the spread of agriculture and the clearing of the land.

Of the Peramelids the Quenda is the only species giving information. The specimens received indicate its presence at Gosnells and various places in the Darling Range near Perth. It appears to range as far south as Albany and inland to Kukerin and Nyabing. During the 1952-54 period 14 specimens were received; one in 1942-44; 10 in 1932-34, and one in 1922-24. In this case a gradual recovery seems to be indicated.

The Marl has not been recorded for 40 years. It was already scarce in the early years of the century when the able collector, Shortridge, obtained but a single specimen (from Woyaline Well, east of Brookton). The Dalgite seems to have died out. There are no reports of its presence anywhere within recent years. Probably the fox and rabbit fumigation are mainly responsible for the decline. In the 1922-24 period 7 specimens reached the Museum.

The Honey Mouse (or Noolbenger) has recently been collected in many parts of the South-west from Serpentine to Albany and inland to Pingrup and Kukerin. During the 1952-54 period 15 specimens were sent to the Museum compared with 3 in 1942-44; 24 in 1932-34, and 4 in 1922-24.

The Mundarda, represented by 8 specimens during the period 1952-54, has a wide range in the South-west. Specimens show that it also exists as far inland as Nyabing and to Ravensthorpe in the south-east. In the years 1942-44 the tally was 19; in the 1932-34 period 21 were received, and in 1922-24 the number was 17.

The Possum, though not yet plentiful, still exists in the Metropolitan area and in many parts of the South-west. The Western Ring-tail has also been seen in a few localities in the lower South-west lately.

The small Macropods appear to have died out though there are persistent rumours that Bettongias have been seen here and there.

The Rock Wallaby manages to exist on some of the granite hills of southern Western Australia where the soaks at the base provide the animals' staple food. The closely related Hackett's Rock Wallaby is not in danger of extinction on the islands of the Archipelago of the Recherche, which have been gazetted a fauna reserve for its special protection.

The Quokka is still plentiful on Rottnest Island where it enjoys a certain amount of protection, on some islands off the south coast, and, it is said, in some swampy country of the lower South-west. The valleys of the Darling Range, in which the Quokka was once so abundant, have long been deserted by this interesting species. The Tammar is to be found on East Wallaby Island, of the Abrolhos Group; on Garden Island, and probably in some isolated area of the South-west mainland. It is some years since its skins appeared on the skin market. The Brush, which was becoming very scarce, is reported to be slightly more plentiful in certain portions of its range, in spite of the activities of "sportsmen."

The exact position of the three larger kangaroos, the Grey Kangaroo, the Red Kangaroo and the Euro (or Biggada) is difficult to evaluate. These animals increase slowly, having but one young at a time. However, there is definite evidence that they have increased during the last few years in certain areas. This may be more apparent than real when the status of the species is concerned, for the unusually dry conditions in many parts of the interior have driven the animals to seek refuge elsewhere where conditions are more favourable.

—L. GLAUERT

III — BAILUP (DARLING RANGE)

This brief note refers to the occurrence of some native mammals observed on my property of about 5,000 acres at Bailup, on the Toodyay Road, some 30 miles east of Perth. The area was under observation since 1945.

A permanent inhabitant is the Brush-Wallaby, which may be noticed in pairs, sometimes accompanied by a half or three-quarter-grown young. The animals can be flushed during the day, or if observation is required, can be watched in the early evening or morning as they feed and chase each other about. They haunt particular territories, which they seldom leave. If one is killed the remaining animal acquires a new mate very soon. A very rough estimate of the population of the property is at least 30 pairs. Prior to 1945 I had been absent from the Darling Range country since 1927, when I was located at Parkerville. In my opinion there has been no significant change in the status of Brush-Wallaby as between the two periods.

The Grey Kangaroo is seen in twos, threes and family parties. It would be a mere guess to attempt a census as the animals move about a good deal. I have seen as many as 20 in one morning, and sometimes one may walk all day and see none. Hunters, from the Perth metropolitan area mostly, take a heavy toll at weekends.

I have met with no indications of Possums. There are many signs of Echidnas and in 1953 one individual was seen. A species of small Bat is fairly common; when a large tree was cut down I counted no less than 23 small bats as they issued one at a time from a hollow spout and flew off.

—I. C. CARNABY

IV — PIESSE BROOK-BICKLEY DISTRICT (DARLING RANGE)

Recent observations indicate that there has been a decrease in numbers in the Black-gloved or Western Brush-Wallaby and an increase in numbers in the Western Forester or Grey Kangaroo in this district over the last few years. Over the same period there appears to have been a steep increase in the population of the Brush-tailed Phascogale or Wambenger. Apart from one of the Rat-Kangaroos *(Bettongia)*, which was said to have been abundant in

the district in the early days of settlement but is now no longer seen, and of the Quokka which vanished from its gully haunts in these hills 30 years ago, others of our better known small animals appear to be holding their own at a fairly even population level.

The Echidna or Spiny Ant-eater is met with about as frequently, or infrequently, as it was in former years. Like the majority of our small native animals it is largely a night feeder and consequently it is not often encountered though it may be comparatively plentiful. Now and then it will be seen in the open during daylight, particularly on grey days, but it is more likely to be brought to notice by the activities of a dog at night. It appears to wander farther afield and to be more often met with in the month of June than at other times. Possibly its wanderings in that month are in search of a mate.

Records of it in recent years include one of June 2, 1950, when a dog had found one at about nine o'clock at night and attracted our attention by its excited barking. The little animal had succeeded in burrowing down amongst some stones, and continued to shift some earth with powerful movements of its fore limbs, but could not get far down for the rock. We tried to turn it out but, curving itself up into a spiny ball, it clung down with unbelievable strength and we failed to shift it. The dog had broken a few of its spines.

On June 13, 1951, the children of Piesse Brook School found one out in the open on the hillside above the school building during the day.

The most recent record I have is of June 11, 1954, when two dogs found one at dusk in the forest country east of Piesse Brook and had broken some of its spines, one of them, not as bush-wise as the other, receiving some nasty wounds in the face in the process when Mr. G. F. Parton came up with them. The Ant-eater had curved itself up into something of a ball and was clinging to the ground in typical manner. These notes point to about the frequency with which the animal comes under notice in the immediate neighbourhood.

The Phascogale or Wambenger has obviously experienced a period of comparative abundance in recent years, as formerly I had no record whatever of it occurring in the district. On December 3, 1949, Mr. Clements described to my wife an animal his cat had brought in the previous night, his detailed description leaving no doubt whatever that it was a Wambenger. He stated that the animal was quite new to him. Mr. Clement's home is in Hackett's Gully, about a mile east of Piesse Brook. This was the first report I had of the animal having been seen in the district.

A second report came when Mr. and Mrs. G. F. Parton encountered one when driving home along a bush track to the east of Piesse Brook at 1 a.m. on June 10, 1951. The animal ran across the track and leapt to the trunk of a banksia, going to the highest point of a broken limb but at once coming down again. It returned to the track and, apparently in no way disconcerted by the glare

of the headlights of the truck, cast about as though trying to pick up a scent trail and then concentrated on one spot at the side of the track. Mr. Parton got out of the truck to watch the animal more closely, but unfortunately his dog raced round and the Wambenger leapt to the bole of a jarrah and ran up out of sight.

Mr. Parton again saw one of the animals when returning home on foot by a different track towards dusk on the evening of March 20, 1952. It had apparently been on the ground and his attention was attracted by the noise it made in climbing a tree. It went up some distance and then crouched in a fork amongst some foliage, but he drove it higher. He said its action in climbing was quite smooth.

On April 6 of the same year he again encountered a Wambenger near this spot. On this occasion he was driving home at about 10 p.m. and once more the animal was startled from the ground. It at once ran up a small jarrah and when he shook the tree it made a whacking noise as though it was angrily beating its tail against a limb. Presently it ran out and leapt down from the limb it was on to the leafy part of a lower branch, from where it easily moved into a casuarina. He then lost trace of it. Possibly it leapt to the ground and went off.

Other reports came in. The head teacher at Piesse Brook School, Mr. C. Rose, found one of the animals dead on the road between the school and Kalamunda in 1952, and later the same year he saw another one when driving past the school at night, the animal on this occasion running from the road and leaping to the trunk of a tree. Mr. J. Rose also encountered one when driving at night less than a mile from the school. In the spring of 1953 my daughter Gretchen saw one that a cat brought in to Illawarra Orchard at Karragullen. From these reports it was clear that the Wambenger had become comparatively numerous in recent years.

The Western Native Cat or Chuditch continues to exist in the district in considerable numbers, coming to notice from time to time when it raids someone's fowl-roost or, more rarely, when one is killed on the roads. Mr. and Mrs. G. F. Parton had an interesting encounter with one in August, 1951 (*W.A. Nat.*, vol. 3, 1952, p. 93). In July, 1953, one paid a visit to my fowl-run on three successive nights, killing a fowl on each of its first two visits but being trapped and killed itself when it returned to the run the third time. It was a male in good condition and lacked a white tip to its tail. Its visit to the fowl-run on the third occasion was after 11 p.m. as the traps were empty when examined at that time. On each of its previous visits it had sucked the blood of its victim and had chewed off the head and discarded it, though it had eaten a portion of the breast. The Native Cat's raids on domestic fowls appear to occur rather more often on wild wet nights than at other times.

One of the few animals that appears to have suffered no notable reduction in numbers as a result of the varied hazards brought about by settlement is the Quenda or Southern Short-nosed Bandicoot. It seems remarkable that this little animal has been able to

survive in undiminished numbers where others, such as the Rat Kangaroos and small Wallabies have met with disaster. About the outskirts of the habitations and throughout the forest country the pits dug by the Quenda in its search for insects and their larvae are extremely numerous. In some instances I have found where they have dug down to a species of fungus but have not been able to ascertain if this is what they were really after. The most remarkable concentration of Quenda diggings I have seen was found by my daughters in the autumn of 1952 when a party of us were out on the hills. This was in a comparatively bare area about two chains long by half a chain wide where twelve inches or more of gritty soil had found lodgment on a shelf of granite high on one of the hillsides. In it there were literally hundreds of fresh pits dug by these animals and in each case we found that the pit had been dug to unearth the cemented pupa cells of some insect, most of which had been broken up and the inmates devoured. Later some of the undamaged cells were sent to the Curator of the W.A. Museum, Mr. L. Glauert, and to him I owe thanks for the information that they were the pupa cells of a saw-fly. Insects of previous generations had used the same highly suitable spot in which to pupate for in many cases we found that the more recent cells had been built on the top of older ones. Actually the number of saw-fly grubs that had found their way to this particular small area to pupate was more remarkable than the number of pits dug by the Quenda to obtain the larvae. One marvels where all the insects came from.

My wife and I again visited this spot on June 11, 1954, but though it was obvious that many more pits had been dug since our earlier visit, very few were fresh. The area had been rendered rather unsuitable to the insects by the uprooting it had received.

On several different occasions Mr. G. F. Parton has drawn my attention to nests that we concluded were the work of these animals. One of these was a mounded structure built of sticks and leaves and other herbage and was situated in a tall thicket of *Bossiaea* in a low-lying area, but two others of similar composition were in hollows or excavations under the boards of low-growing blackboys and the flat tops of these were level with the ground.

The Quenda is sometimes seen in the daytime, but mostly only in a fleeting glimpse as it shoots across an open space or a bush track in front of one. Generally speaking it confines its activities to the hours of darkness.

The dainty little Mundarda or South-western Pigmy Possum I have seen only three times in 40 years' residence in the district, and not at all recently. However, it is so likely to escape observation that it could be present in considerable numbers and still be overlooked.

The Brush-tailed Possum has not been plentiful in the forest country hereabouts for as long as I can remember, though in the early days of settlement it was said to be abundant. Judging by its occasional appearance in fruit sheds and such places, but more particularly by its scratches and an occasional well-worn runway on forest trees, it is still present in moderate numbers.

The marked reduction in numbers noted in the Brush-Wallaby is not readily explained, as hunting and shooting, at any rate in the immediate district, appears to have been carried on to a less extent in recent years than it was formerly, a fact that might well account for the local increase in the Grey Kangaroo. Disease in some form is always a possibility and it is rather of interest that one of these wallabies was found dead in my orchard on May 2, 1949. The animal had suffered no apparent violence though it bled a little from the nostrils when moved. It was a doe and had a naked six-inch-long joey alive in the pouch. The Brush is inclined to be a solitary animal, but whereas one would start up three or four individuals in a mile walk through the bush a few years ago, at the present time the animal is only occasionally seen.

The Western or Sooty Water-Rat is still quite plentiful along local brooks, even in thickly settled areas. I have occasionally seen a Water-Rat out on a brook bank in daylight, but like many another this animal usually waits until the deepening of dusk before it ventures out from its retreats. The young Water-Rats appear to be born in the autumn, for one usually sees their tiny tracks in the mud silts along the water courses soon after the first heavy rains.

On July 9, 1949, Mr. J. McWhirter brought me one of these animals that a dog had killed some nights before. It was dark grey above with some blackish hairs, but was rather noticeably lighter below. Length from nose to tail tip was 22 inches, the head and body being about 12 inches. Barely an inch at the tip of the tail was white.

—W. H. LOARING

V — DRYANDRA FORESTRY STATION

Whether the district around the Forestry Department's mallet plantation at Dryandra is peculiarly favoured for the survival of native animals, or whether they are better known there than elsewhere because of the presence of interested observers, it is a fact that this is the best place near Perth for the study of several species of native mammals. At least eight species are known to occur there at the present time, and on recent visits I have seen seven of them. The local habitat is preserved and for many years there has been an absence of devastating fires through a policy of controlled burning in the cooler weather and continued vigilance. Furthermore, the local fauna is protected and the foresters are *ex officio* wardens.

Dryandra lies about five miles north-east of Congelin railway siding, 15 miles north-west of Narrogin, and 90 miles south-east of Perth. It is in the wandoo belt and may be described as being at the eastern edge of the Darling Range forest country.

Mr. G. E. Brockway, Regional Superintendent of the Forests Department, drew our attention to the interest of the district and piloted members of the Fauna Protection Advisory Committee through on October 30, 1953. That afternoon we saw four Numbats on the road from our vehicle. The first, at 5.45 p.m., dashed across into a fallen hollow wandoo log and three others were seen at 6

p.m. frisking around on the track ahead of us. With their tails elevated they looked remarkably like squirrels, the bristling hairs giving the tail a curiously feathered appearance. We were able to watch them for some moments before they darted into a hollow wandoo log and Mr. A. Douglas, of the Museum staff, approached them so closely that he could easily have caught one by hand. There is no doubt that, because of its bright colours, striking pattern and alert bearing, this must be one of the most attractive marsupials to watch in the field.

Through the kindness of Mr. Brockway I was able to visit the station again on March 22-23, 1954, with Professor G. A. Bartholomew, Jr., of the University of California. We saw two more Numbats and Professor Bartholomew was able to handle one which we extricated from a hollow wandoo log.

At the fire observation hut, on Tower Hill, the lookout man, Mr. Frank Price, has the company on summer evenings of a few Tammars and a number of Woilies, locally called Boody Rats. These appear around his campfire from about sunset and remain for an hour or so, feeding on scraps of bread, etc. They do not come around in the mornings. He counted 17 of them on one occasion. On the evening we watched them we were impressed with their extraordinary tameness. They hopped around like miniature kangaroos, coming close to us for the pieces of bread scattered about. They were not disturbed at all by conversation and appeared similarly heedless of the light of electric torches. Occasionally they would give a sharp little grunt, at which others in their vicinity would jump away in alarm. Some of the little animals came to drink at a small puddle from the waste water from the hut. That night we went "spotlighting" for mammals through the mallet plantations with Mr. John Currie, District Forester in charge of the station. We saw a Brush-Wallaby, one Woilie and several rabbits.

Mr. Currie informed us that Quendas (locally called "wild pigs") occurred in the area, and Mrs. Currie gave us a native mouse (*Pseudomys* sp.) caught in a pollard bin.

A few days later, on March 28, I revisited the area with my wife and Mr. J. H. Calaby. Though looked for, we did not see any Numbats on this occasion. In the evening we watched the Woilies at Tower Hill. They first appeared at 6.30 p.m. and remained until 7.45 p.m. (sunset locally was at 6.19 p.m.). About a dozen of them came around the camp-fire; some had heavily-laden pouches. With them, but remaining rather in the background, were two Tammars, and one large Brush-tailed Possum. All three species showed a fiery-red eye-shine, like a glowing ember, when the torch was flashed into their eyes. On the run home, in the Congelin area, another Possum and a Woilie were seen and two small mammals, grey and mouse-sized, crossed the road. During the day three Great Grey Kangaroos were encountered. Kangaroo faeces were plentiful and there were many Possum faeces under some of the wandoos, which carried Possum scratches.

—D. L. SERVENTY

VI — NYABING-PINGRUP

Several writers have referred to fluctuations in our bird populations when after periods of scarcity there followed, not the feared extinction, but a wave of plenty. That such a wave is on us now in respect to some native mammals is suggested by local records.

Even large animals like the Great Grey Kangaroo have figured in the increase. In this district the early settlers (1900 onwards) reported the sighting of a Kangaroo as an event; today the animals are so numerous that they are considered vermin. One might ascribe the increase to man-made changes in the environment and put it down, in this case, to extensive wheat plantings, but the increase in Kangaroos is general even in the forest country of the extreme South-West.

The lesser marsupials, frequently little known to laymen even in periods of comparative plenty, are apparently on the way back. In early clearing operations, at some time or another, most of the small bush denizens might be encountered, yet here they are appearing in older and more established areas. In the Kent Road Board district farmers are reporting small mouse-like creatures in increasing numbers.

Fat-tailed Dunnarts are often seen at night, by shooting parties spotlighting for foxes, sitting up like miniature kangaroos. From Pingrup have come several specimens of Jerboa-Marsupials, and an unidentified native rat is now in the W.A. Museum. The Red-tailed Wambenger, when introduced to the crowded bar of the Nyabing Inn, caused animated discussion and indeed argument. This was the third of these small carnivores to be taken by that enemy of all small creatures, the domestic cat, in a few weeks. Few, if any, of the local farmers could remember having previously seen this species.

When the first Chuditch came into my possession, for mounting in the school museum, I asked Mr. J. Cuiss, long-time custodian of the Rabbit Proof Fence, from Nyabing to Point Ann, when he had seen his last specimen of "native cat." His answer highlights the wave of plenty theory. He said that had he not caught one in a dog trap the day before he would have had to say "about fifteen years." Some weeks ago a local resident returning from Perth at night disturbed a Chuditch eating a rabbit in the middle of the road (on the Albany Highway, approximately at Bannister).

Numbats are often seen by children travelling to school south of Nyabing and two specimens have been caught and handled this year.

Along the Rabbit Proof Fence frequent unmistakeable diggings indicate the presence of the Quenda, and on more than one occasion the writer has seen paw prints and tail marks that may have been those of the Dalgite. Since he had not seen either animal or print in the previous twenty years, his memory may be at fault.

The dainty little Honey Mouse is often reported from the sandplain and one survived for almost a year in captivity. Clearers frequently come on the Mundarda, and others have found the typical

"green leaf collection" nest in hollow York gums, mallets and morrels. Several pairs have been kept in captivity with varying success and their current frequency is such that when a captive couple was shown to Mr. V. McDougall, the local honorary fauna warden, he decided he would like some. The same afternoon he had two males and a female carrying pouched young to show for his bushmanship.

Possums are not over-plentiful in this area but there is no outright scarcity. In some places where clearing has removed the normal arboreal dwellings Possums have taken to rabbit warrens and there are frequent reports of their being trapped on burrows.

At the depot hut at Point Ann, Mr. Cuiss turns on his radio, and through the open door comes a Kangaroo-Rat (*Bettongia* sp.) for its evening meal of food scraps. The hut is unoccupied for weeks, but over the last few months the little animal has never failed to put in his appearance.

Tammars are still comparatively common in moort (*Eucalyptus platypus*) thickets but judging from local reports are not as plentiful as formerly. However, these views may be regarded with caution since the local farmers are apt to regard an absence of marsupials from old and favoured haunts as an indication of extreme scarcity whereas it may simply indicate a change of occurrence by a few miles. Tammar are at any rate sufficiently plentiful in certain parts of the district for them to be seen in groups of six or seven with the aid of a spotlight.

Brush do not appear to be as plentiful as they were a couple of years ago. It was then a local impression that they were on their way back but for the past twelve months or so I have not recorded them as more than ordinarily abundant.

—R. AITKEN

VII — MANJIMUP

I believe that a surge of prosperity has come to many of our smaller marsupials, and although I have lived here for twenty years —arriving just as the Possum and the Quokka were on the way out —it is only within the last two or three years that I have made the acquaintance of many of the smaller forms for the first time. I have been steadily building up contacts among the original settlers and pioneer stock—men who were born here when the place was a wilderness of forest—and the result is amazing and gratifying. I now have a circle of scouts of undoubted knowledge and ability to read the bush and its ways, people with powers of observation backed with a lifetime of natural interest, many of them with a deep love of all our native things, and all of them with a keen desire to bring me their findings and to talk of their information.

It appears fairly definite from reports over a lengthy period that a pocket bounded by the Tone and Perup Rivers and northward to Lat. 34° 12′ is rich in small marsupials and may well be the local nursery from which this promising flush has its origin. Tammar, Quokka, Brush, Woilie, Numbat and Chuditch are recorded in this

area. Attention could also be given to the thought that our native mammals are only now recovering from the impact of the fox, as there is some significance in the fact that the larger marsupials have not suffered a recession to the same extent as the smaller mammals.

Records of local occurrences are as follows:—

Wambenger.—In October, 1944, a specimen was killed on the road at Middlesex, eight miles south of Manjimup. In January, 1953, another was found on the Pemberton Road five miles south of Manjimup. On April 20, 1954, a live male was received from Frank Angus, at Diamond Tree, ten miles south of Manjimup. On June 12, 1954, a dead male was found on the road close to Manjimup.

Chuditch.—Frank Hunter saw one at Mordallup on April 11, 1954.

Numbat.—On January 23, 1953, a male specimen was caught by Mr. Butler at Corbalup Swamp, 10 miles east of Manjimup (released). On March 24, 1954, Frank Hunter took a female with four young in the Lake Muir area. It was inspected by A. R. Main, photographed by S. R. White and later released.

Quenda.—There is a permanent population one mile north of Manjimup and again three miles west of Manjimup. On July 13, 1952, I received a male specimen alive and uninjured from M. Hind, owner of the latter area. On July 19, 1952, I received another male from Mr. Hind, damaged and dead; taken away by Major Whittell.

Mundarda (Pigmy Possum).—On November 10, 1953, a female, with four young, was sent in to me by Hubert Jay, Pemberton; it had been brought in by mill workers.

Possum.—On June 14, 1952, I noted the first record, for 12 years, of a Possum being caught in a rabbit trap.

Woilie.—I received a pair from Frank Hunter who obtained them at Mordallup on April 12, 1954.

Quokka.—A small macropod of this type was seen at Muddyboo, two miles north of Manjimup, on June 8, 1952, but was not positively identified. Norman Muir has seen Quokka 10 miles north of Mordallup. Norman Woods reported a small wallaby at Broke Inlet. For some time now I have been working on the extent of the penetration of the Quokka and it is my opinion that it went as far as the Frankland River to Lat. 34° 30′, and a report recently gave one identified by a reliable observer at Lat. 34° 12′, a few miles west of the Frankland.

Tammar.—Mervin Muir stated (April, 1954) that there was a small colony at Mordallup. There were definite traces of either Quokka or Tammar at Glenoran.

Brush.—Norman Muir reports (April, 1954) that it is steadily becoming more plentiful and moving gradually westwards; it is seen in districts from which it has been absent for many years. It is reported to be plentiful in areas being bulldozed at Rocky Gully.

—A. D. JONES

VIII — APPENDIX — SCIENTIFIC NAMES

The scientific names of the mammals referred to in the preceding reports are as follows:—

MONOTREMATA:

Family Tachyglossidae:

Echidna or Spiny Anteater, *Tachyglossus aculeatus.*

MARSUPIALIA:

Family Dasyuridae:

Mardo or Yellow-footed Marsupial-Mouse, *Antechinus flavipes.*
Dibbler, *Antechinus apicalis.*
Wambenger, *Phascogale tapoatafa.*
Red-tailed Wambenger, *Phascogale calura.*
Fat-tailed Dunnart, *Sminthopsis crassicaudata.*
Dunnart, *Sminthopsis murina.*
Granule-footed Dunnart, *Sminthopsis granulipes.*
Jerboa-Marsupial, *Antechinomys laniger.*
Chuditch or Western Native Cat, *Dasyurus geoffroyi.*

Family Myrmecobiidae:

Numbat or Banded Anteater, *Myrmecobius fasciatus.*

Family Peramelidae:

Quenda or Short-nosed Bandicoot, *Isoodon obesulus.*
Marl or Western Barred Bandicoot, *Perameles myosura.*
Dalgite or Rabbit-eared Bandicoot, *Macrotis lagotis.*

Family Phalangeridae:

Honey Mouse or Noolbenger, *Tarsipes spenserae.*
Mundarda or South-western Pigmy Possum, *Cercartetus concinnus.*
Western Ring-tail, *Pseudocheirus occidentalis.*
Kumarl or Brush-tailed Possum, *Trichosurus vulpecula.*

Family Macropodidae:

Woilie or Brush-tailed Rat-Kangaroo, *Bettongia penicillata.*
Rock Wallaby, *Petrogale lateralis.*
Hackett's Rock Wallaby, *Petrogale hacketti.*
Quokka, *Setonyx brachyurus.*
Tammar, *Macropus eugenii.*
Brush-Wallaby or Black-gloved Wallaby, *Macropus irma.*
Western Great Grey or Forester Kangaroo, *Macropus ocydromus.*
Red Kangaroo, *Macropus rufus.*
Biggada or Euro, *Macropus robustus.*

MONODELPHIA:

Family Muridae:

Western or Sooty Water-Rat, *Hydromys fuliginosus.*

SOUTH-WESTERN BIRD NOTES

By G. M. STORR, Floreat Park.

From the end of November 1953 to the middle of March 1954 I was working in the south-western corner of the State. My duties took me as far north as Boyanup and south to Flinders Bay. There was little time for bird-study and my notes for the greater part dealt with local status and distribution. Here are some of them.

Emu *(Dromaius novae-hollandiae)*

In *The West Australian* (November 18, 1953) a short notice read: "Three emus were sighted at Witehcliffe, south of Margaret River, this week: old residents cannot remember such a happening for years." Apparently Emus are now rare in the more settled parts of the South-west. I did not see any but was informed by various people that they still linger on (or did so till recently) in the vicinity of Kirup, Nannup, Karridale, and Lake Gingilup (20 miles east of Augusta).

Mallee-Fowl *(Leipoa ocellata)*

This species too has been exterminated in parts of its former range. Discussing the subject with residents, I found no reason for believing that Mallee-Fowl still exist in the Yallingup - Cape Naturaliste - Dunsborough area. Mr. Jack Miller of Busselton told me that the species was still plentiful around Lake Gingilup up to 1948 when he was last in that district.

Indian Dove *(Streptopelia chinensis)*

In the *Birds of Western Australia* this dove is recorded for Busselton. I saw none in or near the town. My only record for the species is of a single bird at Quindalup (9 miles west of Busselton) on February 20. I had only a glimpse of the bird and the record needs confirming.

Tattler *(Tringa brevipes)*

There are so few records of Tattlers for southern Western Australia that I was surprised to see one on my sole visit to the Blackwood estuary at Augusta on December 5. The bird was alone, feeding on the mud-flat exposed at low water. It was probing the mud vigorously and let me approach to within thirty feet of it. Even then it did not fly off but merely paused in its feeding to watch me intently. When I came closer it ran ahead of me. I had to clap my hands together several times, shout, and jump towards it before it flew. In flight it uttered the characteristic double whistling note. It flew for about thirty yards. I followed it up again, the bird running ahead of me only twenty feet away. It was most reluctant to fly, seeming hungry and anxious to feed. Flushed again, it flew for 150 yards and resumed its feeding almost immediately.

Banded Plover *(Zonifer tricolor)*

Considering how few habitats were available to it before European settlement, this species was surprisingly common and widespread.

Red-tailed Black Cockatoo *(Calyptorhynchus banksii)*

A flock of four birds was seen three miles east of Karridale in late February.

Purple-crowned Lorikeet *(Glossopsitta porphyrocephala)*

Lorikeets were only noted at Flinders Bay where a small party flew screeching overhead on each of two successive days in mid-December. Perhaps the scarcity of flowering trees would account for their rarity. Occasional marris *(E. calophylla)* were the only eucalypts seen in flower. Other flowers that might have attracted them, but were not seen to do so, were those of Christmas trees *(Nuytsia floribunda)*, *Banksia grandis*, woody pear *(Xylomelum occidentale)*, and peppermint *(Agonis flexuosa)*.

Elegant Parrot *(Neophema elegans)*

Elegant Parrots were seen at Ruabon and Yallingup, small flocks on each occasion.

Rock Parrot *(Neophema petrophila)*

At Hamelin Bay on February 25 I flushed a pair of Rock Parrots from the *Spinifex* growing on the seaward face of the coastal dunes.

Bee-eater *(Merops ornatus)*

Bee-eaters were fairly numerous on the Cape Naturaliste peninsula, southwards to the vicinity of the Yallingup Caves and eastwards to Dunsborough. They were not recorded elsewhere.

Boobook Owl *(Ninox novae-seelandiae)*

After a long dry spell a brief shower fell at Dunsborough just before midnight on March 12. At the start of the rain a Boobook began calling the normal "boo-book" notes. Gradually the first syllable was suppressed and the second (now the sole note) speeded up. This phase, which lasted for four minutes, might have been mistaken for a pumping plant, had the first part of the call not been heard. Then followed four abnormal "boo-book's", in which the second syllable was both the higher pitched and more strongly accented. Three normal "boo-book's" concluded the call.

Horsfield Bronze Cuckoo *(Chalcites basalis)*

The notes of this species were heard on several occasions during the first half of January in sand-plain country at Ruabon (10 miles east of Busselton).

White-breasted Robin *(Eopsaltria georgiana)*

I was watching a mixed flock of insectivores in cut-over jarrah-marri forest three miles east of Karridale; it comprised several Sittellas and Western Thornbills, a Grey Fantail, a Shrike-Thrush, and a Golden Whistler. Among the many calls was one I could not identify; I was delighted when I traced it to a White-breasted Robin. It was apparently moving through the forest with the other species, but was hard to observe owing to its remaining in the undergrowth, which here was very dense and included at least two species of soft-leaved shrubs more typical of the nearby karri forest. It was easily approached, and under observation called continually. Its notes lacked that piping quality characteristic of such of its relatives as the Yellow Robin. The call consisted of sharp single notes occasionally followed by a brief series of rapidly uttered low croaking notes.

Magpie-Lark *(Grallina cyanoleuca)*

In the extreme South-west corner this species has not been so fast as Magpies, Banded Plovers, and possibly Pipits in colonizing newly cleared country. They are quite common south to the Margaret River and fairly plentiful for another ten miles southward, where a flock of nine was seen at Forest Grove. Southwards from the last-named nearly to Karridale there is (at least along the Bussell Highway) an eight-mile stretch of inferior country which is almost wholly uncleared. Apparently few Magpie-Larks have crossed this forest barrier. In December I travelled twice to and from Flinders Bay, and only a single Magpie-Lark was seen — at the "Cross-Roads," Karridale. Almost the whole of that month was spent at Flinders Bay where no Magpie-Larks were seen, nor at Augusta, two miles to the north, which was occasionally visited. During a week spent at Karridale in February the species was seen only once, a single bird a mile east of the "Cross-Roads."

Black-faced Wood-Swallow (*Artamus cinereus)*

This Wood-Swallow was seen on several occasions in sand-plain country between Wonnerup and Tutunup on the Nannup railway. They were common further north in similar country round Boyanup.

Dusky Wood-Swallow *(A. cyanopterus)*

This species, perhaps without significance, was not recorded south of Cowaramup. The same southern limit was noted for the Red-tipped Pardalote *(Pardalotus substriatus)*.

Grey Butcher-bird *(Cracticus torquatus)*

Butcher-birds were not observed south of Witchcliffe. Their greatest density was in the peppermint scrub around the southern shore of Geographe Bay.

FROM FIELD AND STUDY

Swamp Harriers preying on Senegal Turtledove.—While walking along the edge of Bennett's Brook, Bassendean, on January 25, 1954, I flushed two Swamp Harriers *(Circus approximans)* from a small cleared patch of ground almost surrounded by short reeds (*Juncus* sp.). They had left a freshly-killed immature Senegal Turtledove *(Streptopelia senegalensis)*, partly eaten and with numerous feathers strewn about the ground. The Harriers flew to a tree about 20 yards away but eventually disappeared.

—DONALD N. CALDERWOOD, Beacon.

Flight speed of *Phaps chalcoptera*.—On the afternoon of February 7, 1954, ten miles west of Popanyinning, I paced, in a late model Vanguard car, a Common Bronzewing *(Phaps chalcoptera)* for an approximate distance of 200 yards at, according to the speedometer, a steady 40 miles per hour.

After flying up the road about a chain in front of the car for the estimated distance, it suddenly veered off to the right and disappeared into the scrub. —BRIAN V. TEAGUE, Narrogin.

***Oreoica gutturalis* at Williams in 1945.**—As it extends somewhat the usual range of the species, it may be of some interest to place on record that a Crested Bell-bird *(Orcoica gutturalis)* was observed by me in the immediate vicinity of the 90-mile peg on the Perth-Albany Highway, early in the winter of 1945.

The exact location was on the south side of the road, in a paddock which has since been cleared and tilled, but which at that time was a thicket of regrowth saplings of *Eucalyptus redunca*.

The bird was first heard but not sighted, on May 23, and upon making a special search on May 27 I was, after much patient watching and calling, able to closely though briefly observe it several times. It was, however, extremely shy. The bird was subsequently heard calling, in its unmistakable ventriloquial voice, on the afternoons of June 14 and 15 of the same year.

—BRIAN TEAGUE, Narrogin.

Observations on a Long-tailed Wasp, *Megalyra shuckardi* West.—When walking with me along the banks of the Helena River, West Midland, at 4.30 p.m. on February 14, 1954, my young son Bruce pointed out a black and white spotted wasp on the trunk of a flooded Gum *(Eucalyptus rudis)*. It was one of the Long tailed Wasps *(Megalyra shuckardi* West.*)*. Its ovipositor was inserted into a crack in the dried bark below it. I carefully removed the bark behind the wasp and uncovered the tunnel of a longicorn beetle.

Making sure I did not alarm the wasp, I worked up towards her and almost immediately came across a beetle nymph. Further cutting disclosed the ovipositor of the wasp still working down towards the nymph. Anxious to see whether the wasp bored through the wood or worked its ovipositor through cracks, I

opened up the remainder of the tunnel at 5.05 p.m. but disturbed the wasp. However, I held the ovipositor in my fingers to be sure it remained in position. The ovipositor had passed through the outside centre plug of chewed wood which blocked the entrance and entered the tunnel close to the wood on the bottom of the gallery. It had followed cracks, but had forced the silk lining of the inside of the plug.

I brought home both the nymph and the wasp. On February 23 the nymph passed its final stage, and the resultant beetle was identified as *Tryphocaria princeps* Blkb. (W.A.M. 54. 1577).

This longicorn beetle is common in the flooded gum, and always excavates its typical chamber under the bark before retiring to its burrow, which it then seals with a plug of chewed wood with silken material inside, prior to the metamorphosis that changes it to the adult.

This specimen was too far down the tunnel for the wasp to have reached it with its ovipositor.

—A. DOUGLAS, W.A. Museum.

Notes on the Behaviour of Bee-eaters.—Between January 1 and 3, 1954, a Bee-eater's *(Merops ornatus)* nest at Mooliabeenie (approximately 60 miles north of Perth) was under observation from a hide sited nearby. The burrow had been drilled at a shallow angle into sandy ground and the ramp of excavated spoil emphasised the position of the nest which was directly beneath a roadside telephone line. From the persistence of their calls well-grown young were in occupation. Bee-eaters were locally abundant here. A good deal of this pair's prey was sighted from their perches on the wires and branches near the nest; dragonflies and bees seemed to predominate in their catch. Insects were always held at the tip of the beak and no attempt was made to remove the wings before carrying to the young. The larger dragonflies proved difficult to handle and the birds would beat them against the wires or branches until dead. On one occasion a bird flew to the wire with food and after alighting handed the prey to its mate; whether this was an instance of male feeding female or vice versa it was impossible to tell since the sexes were not separable. The close relationship of the Bee-eaters to the kingfishers was evident in several aspects of their behaviour quite apart from obvious anatomical similarities e.g. the very short legs. Thus the motions involved when a bird flicked a dragonfly into the air to regrasp it in a more convenient position seemed precisely the same as are used by the European Kingfisher *(Alcedo atthis)* when it flicks a fish into the air to adjust it ready for shipping into the maw of one of the nestlings. Again, the Bee-eaters did not find it necessary to go far down the tunnel to dispose of their food; presumably the young came part way towards the entrance to meet them. The old birds emerged tail first just as the European Kingfisher does in the same circumstances. Likewise the chirruping chorus of the nestlings which began as soon as the calls of the adult Bee-eaters were heard from their perches

overhead was surprisingly reminiscent of the nestling chorus of *Alcedo atthis*.

The Bee-eaters' calls appeared to fall into the following groups:—

1. The young ones' food calls — a murmured *"joy, joy, joy, joy,—"*

2. The *"pirr, pirr . . ."* note given in Serventy and Whittell's *A Handbook of the Birds of Western Australia*. Uttered in rapid succession, these calls are given when one adult flies and perches beside its mate; at the same time both birds raise their bills skywards and shiver their slightly fanned tails from side to side. This call is also given when a Bee-eater drops down to the nest entrance before going inside. The note appears to be primarily associated with courtship and territory. Several variants were noted one of which was written down as *"pirr, blurry, pirr, blurry, pirr . . ."*

3. *"Prrip, prrip . . ."* Staccato, clear, far-carrying, this is I believe, the alarm note.

4. A quiet *"tip, tip"* or *"tip, tip, chirrah, tip"* with variants, was often heard when a bird was perched and the level of excitement seemed to be low.

—JOHN WARHAM, Leederville.

Comments on Gilbert's Note-book on Marsupials.—The recent publication of the text of a note-book of John Gilbert's on Australian mammals (Whittell, *W.A. Nat.*, vol. 4, 1954, pp. 104-114) calls to mind a couple of problems associated with Gilbert's Western Australian collections, which are still referred to in present-day works, e.g., Troughton's *Furred Animals of Australia*, 5th (revised) edition, 1954.

The first problem is concerned with Gilbert's description of the nests of the Dunnart, *Sminthopsis murina fuliginosa* (Gould) (Whittell, p. 108), which was published by Gould. Troughton (p. 39) summarises Gould's description as follows: "Said to burrow out a cavity and fill it with short pieces of fine twigs and grass, forming a structure from ten to fifteen inches in depth with holes in the top leading to galleries which run out amongst the roots of the scrub, providing means of escape. By accident or design, these nests are precisely similar to structures built by a small species of black ant." There can be little doubt that these structures inhabited by the Dunnart *were* the nests of ants. *S. murina* has not been recorded as a builder of such nests in any other part of its extensive range or by any other observer. The species of ant which builds the nests is *Iridomyrmex conifer* Forel and it is restricted in its distribution to South-western Australia. It is of interest that as long ago as 1866 Krefft (*Proc. Zool. Soc., London*, p. 433) recorded that he had been informed by George Masters who had recently returned from a collecting expedition to King George's Sound that this species was "generally found in deserted ants' nests."

Another problem concerns the type locality of the western race of the Pig-footed Bandicoot, *Chaeropus ecaudatus occidentalis*

(Gould). Gilbert recorded that his two and only specimens came from the "Walyemara district about 45 miles north-east of the Townsite of Northam" (Whittell, p. 111). Gould does not say where the specimens came from but gives the aboriginal names of the animal as recorded by Gilbert, from the York and Walzemara *(sic)* districts. In 1888, Thomas (*Cat. Mars. Monotrem. Brit. Mus.*, p. 252) stated that the type locality of *Ch. occidentalis* was "Boorda, Kirltana, W.A." Authors (e.g., Troughton, p. 78) have given this locality in quotation marks and its geographical position is apparently not known with certainty.

"Boorda" is, of course, the aboriginal name of the animal and Thomas had not realized this fact when transcribing the information on the label of the type specimen. The problem therefore is to find the location of "Kirltana." With the kind assistance of Miss K. C. Cammilleri, a search was made in the Western Australian Archives, and Mr. H. E. Smith, Under-Secretary for Lands, kindly searched the records of the Lands and Surveys Department. No record of "Kirltana" could be found. It was probably a spring but never seems to have been marked on any map.

However, "Walyemara" is placeable. Copies of letters preserved in the W.A. Archives *(W.A.A.*, 53, *Journals of Explorations)* from A. Durlacher, a well-known public servant who at one time was an officer of the Survey Department, to J. S. Roe, Surveyor General, spell the word, which was the name of the spring, as "Wolyumary" (1843) and "Wal-yare-maury" (1846). Robert Austin (*Journal*, 1855, p. 7) passed through the region in 1854 and described the swampy character of the area. He recorded the name as "Walyourmouring" and described it as a ravine with a granite rock and pools of water. He gave the position of the locality accurately as 10 miles north 3 degrees east from a spring called Goomalling. It is to be noted that this place is north-north-east rather than north-east of Northam. On modern maps (e.g., the *10 Mile Topographical Series*, Dept. Lands and Surveys, Perth) there is a lake in this area called "Walyormouring."

There can be little doubt that this area is also the "Walyema Swamps about forty miles north-east of Northam," which is the type locality of the Broad-faced Rat-Kangaroo, *Potorous platyops* (Gould), the type of which was collected by Gilbert. Gould gives the locality as "Walyema swamps near Northam in the interior," but Waterhouse (*Nat. Hist. Mamm.*, vol. 1, p. 232, 1846) states that the more precise locality given above is written on the label of the type.

Incidentally, Tate (*Bull. Amer. Mus. Nat. Hist.*, vol. 91, art. 2, 1948, p. 262) says that the type locality of *P. platyops* is "Walyema Swamps, 40 miles north-east of Latham, Victoria county." How he came to make this error is not apparent. Another error in this paper (p. 273) of interest to Western Australian naturalists is the statement that the type locality of the Rock Wallaby, *Petrogale lateralis* (Gould) is "Liverpool Plains, New South Wales." In actual fact, Gilbert collected the type specimens of this wallaby at "Swan River, Western Australia."

—J. H. CALABY, Nedlands

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NESTING SEASONS OF WESTERN AUSTRALIAN BIRDS

By I. C. CARNABY, Carnarvon.

I have kept detailed records of my discoveries of birds' nests in Western Australia since 1926 and have recently analysed the data to demonstrate the differences in the nesting seasons in the various districts in which I have made the observations. As bird observing has been very much a spare-time activity, the data are naturally not as perfect as they might be for frequency analysis, but nevertheless they bring out fairly clearly the periodicity which characterises the South-west, the outer Wheatbelt and parts of the North-west.

Marine birds are not considered, and I have excluded any markedly colonial species which would introduce a serious bias in the frequency tables in view of the relatively fewer number of nests of the other species which are dealt with.

In 1926 and 1927, the observations were mainly carried out at Parkerville, in the Darling Range, with some data included from neighbouring localities and a few from the metropolitan area as well. Between 1928 and 1932 observations were based on Lake Grace, in the Wheatbelt. Between 1934 and 1938 I lived in the North-west, after which war duties and other activities compelled a discontinuance of the detailed records which I formerly kept, except for 1943, when I was stationed at Exmouth Gulf with the A.I.F.

Table I gives the frequencies of nests, containing eggs, which were found, arranged in class intervals of half-months. Thus, August I represents the first half of August and August II the second half, and so on.

The individual nesting records for each district and year are too voluminous to reproduce in full, but Tables II, III, IV and V give details of representative years in the Parkerville, Lake Grace and North-west districts. In each table the nest discoveries for the particular season are set out in chronological order, the species being listed successively as found. Thus one may tell at a glance the order in which the species were found nesting, and the "spread" of the egg-laying. Vernacular names only are given, those in Serventy and Whittell's *Handbook of the Birds of Western Australia* being adopted, to which work the reader is referred for the scientific nomenclature.

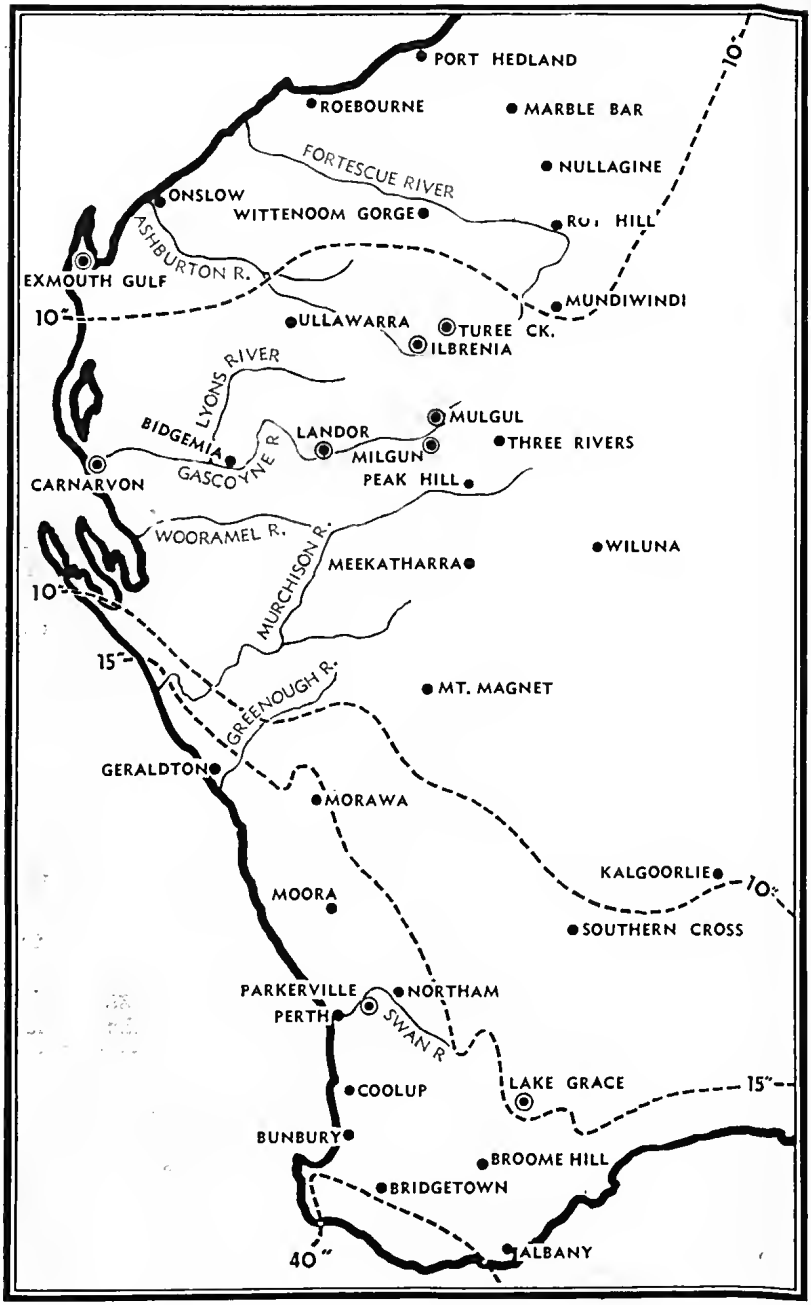

Fig. 1.—Locality map with some isohyets. The observing stations mentioned in the text are encircled. Scale about 165 miles to the inch.

PARKERVILLE

This district (Lat. 32°S.), 17 miles east of Perth, is representative of the heavily timbered jarrah forest belt of South-western Australia, with its very dependable climate of winter rains and dry summers. Nesting takes place regularly each year in the spring and early summer, with virtually no "out of season" breeding. Egg laying usually begins in early August and attains a peak in late September and early October, tailing off rapidly in December.

LAKE GRACE

Lake Grace (Lat. 33°S.), in the south-eastern Wheatbelt, 170 miles south-east of Perth, has in general a nesting regime similar to that in the wetter portions of the South-west. The peak of egg-laying is approximately the same but the start is earlier and it may continue later. With out of season rainfall, it is conceivable that over a long period of years an observer might build up nesting records for every month of the year. Fairly regular seasons were experienced during my years of observing at Lake Grace (1928 to 1932), excepting that 1930 was an unusually wet year. It will be recalled that it was in this particular year that Mrs. B. E. Cannon first recorded the nesting of Banded Stilts on the salt lake there.

THE NORTH-WEST

Nesting seasons in the North-west of Western Australia are closely dependent on the rainfall and the various species differ in the speed of their response to it. The main categories in which the nesting behaviour can be divided have already been given by me (*Western Australian Bird Notes,* 4, 1948, pp. 8-9). The main nesting takes place, in ordinary seasons, in the winter and spring but irregular rains, such as may accompany thunder-storms or cyclones, will induce nesting among certain species outside of these times, and nesting may occur at any time of the year. Local thunderstorms may permit breeding in very circumscribed areas and yet only a mile or so away there will be nothing.

— 1934 —

The year 1934 was a very favourable one throughout the North-west. At Landor Station (formerly Upper Clifton Downs, Lat. 25°S.), on the Gascoyne River 200 miles easterly of Carnarvon, there were good falls of rain at the end of March and in April, and conditions were perfect for nesting during the period I spent there — from early April until the end of August. Nesting began soon after my arrival and the first nest was found on April 7. As breeding was still in full swing when I left, the frequency data in Table I are incomplete. However, two peaks of egg laying stand out clearly. The earlier group consists of birds which nest immediately after rain, the latter those which breed in the late winter and spring when conditions are favourable.

It will be noted that in certain species some individuals nested early in the season while others had eggs only in the latter

part, with no records of layings in between. These species included the Magpie Lark, Crested Bell-bird, Yellow-throated Miner (the earlier nesting group had almost all a clutch of 3 eggs while in the latter were a greater proportion of 4-egg clutches), Red-throat, Black-faced Cuckoo-Shrike, Grey-crowned Babbler, Singing Honeyeater, Ground Cuckoo-Shrike, Tree-Martin, Zebra Finch and Little Crow.

— 1935 —

This was a year of severe drought in the area in which I worked — Carnarvon to about 250 miles inland. I was in the field from April 24 to September 27 and throughout that period found only six nests. These were: White-plumed Honeyeater (April 24, September 22), Zebra Finch (April 28), Diamond Dove (April 30), Little Quail (May 8) and Wedge-tailed Eagle (June 12).

— 1937 —

Good rains accompanied cyclones and thunderstorms between January and April and the season was a good one at my Ilbrenia Station (Lat. 24°S.), at the junction of the Ashburton River and Tunnel Creek (some 150 miles north of Peak Hill), where I operated this year. Nesting started in January and probably ran the same course as it did on Landor in 1934, but I had to leave the north early in April and have no records of its progress after that date.

— 1938 —

From May to the end of the year I was in the same general area as in 1937 — in the country between the Gascoyne and Ashburton Rivers where their courses approach each other so that they are barely sixty miles apart (the so-called Ashburton Divide), on Ilbrenia, Mulgul and Milgun Stations (Lat. 25°S.), and I also spent some time on Turee Station (Lat. 24°S.), north of the Ashburton. It was a fairly dry season on the whole but in June-July good rain fell at Turner's Creek (a tributary of the Gascoyne), resulting in favourable conditions in a very restricted area. In this "thunderstorm patch", about one mile in width by about four miles in length, there was lush vegetation with a carpet of everlastings knee-deep compared with the 1-6 inch growth elsewhere, where only light rain fell. The first nest was found on July 28 and I only found three nests until I went to the Turner Creek "oasis" on August 18. I stayed here until September 7 and recorded no less than 32 nests with eggs. On my return to the light rainfall country I found only 16 nests between September 8 and October 16 — the date of the last nest found. In this drier area, at Mulgul Station a nest of the Black-throated Butcher-bird was found which contained only one egg, which was its full clutch (the average is 3-4 eggs).

— 1943 —

I was stationed with the A.I.F. near the Learmonth Airfield ("Potshot") at Exmouth Gulf (Lat. 22°S.) from the first week in

January until late in Oetober, and had one day a week available for bird observing. During this period I obtained records of 107 nests with eggs but many species bred on whieh I was not able to obtain preeise data, and visits to some important areas were banned in May and June because of unfounded reports that Japanese had landed.

It was a good season. The weather was very hot eonstantly. About February 12 a eyelone worked up and brought high winds and several inehes of rain. This lasted over a week. About three months later there were further good rains. Vegetation flourished; Sturt Peas grew to knee-height and annuals were up to four feet. Birds started to breed in February and nesting was still in full progress when I left in October. There was, however, a gap in the nesting between mid-April and early August. The reeords as given in Tables 1 and 5, however, unduly emphasise the distinetness of this gap. The absenee of records during this period is only partly due to a real diminution of nesting aetivity but also to the faet that I was not able to engage in field work during mueh of the time. Thus the general situation in 1943 really mueh more nearly resembled that of 1934 than the aetual figures indicate.

TABLE I — NEST FREQUENCIES

	Parkerville		Lake Grace					North-west				
	1926	1927	1928	1929	1930	1931	1932	1934	1935	1937	1938	1943
Jan. I	0	0	0	0	0	0	0	—	—	0	—	0
Jan. II	0	0	0	0	0	0	0	—	—	9	—	0
Feb. I	0	0	0	0	0	0	0	—	—	6	—	0
Feb. II	0	0	0	0	0	0	0	—	—	8	—	5
Mar. I	0	0	0	0	0	0	0	—	—	5	—	22
Mar. II	0	0	0	0	0	0	0	—	—	4	—	23
Apr. I	0	0	0	0	0	0	0	31	—	—	—	5
Apr. II	0	0	0	0	0	0	0	41	3	—	—	0
May I	0	0	0	0	0	0	0	5	1	—	—	0
May II	0	0	0	0	2	1	0	13	0	—	0	0
June I	0	0	0	0	0	0	0	6	1	—	0	0
June II	0	0	0	0	1	2	0	8	0	—	0	0
July I	0	0	0	0	1	1	0	6	0	—	0	—
July II	0	0	9	5	2	3	1	3	0	—	1	0
Aug. I	0	3	7	0	5	4	3	37	0	—	2	6
Aug. II	11	13	15	4	10	4	6	40	0	—	16	12
Sept. I	9	17	25	22	20	6	8	—	0	—	20	18
Sept. II	21	8	23	18	12	12	8	—	1	—	3	5
Oet. I	5	16	—	12	32	6	5	—	—	—	7	4
Oet. II	5	7	1	22	16	5	—	—	—	—	1	6
Nov. I	6	5	6	7	7	—	3	—	—	—	0	—
Nov. II	5	0	6	2	8	—	1	—	—	—	0	—
Dec. 1	4	0	3	0	1	—	0	—	—	—	0	—
Dee. II	2	0	2	0	0	—	2	—	—	—	0	—
Jan. I	1	0	2	0	0	—	0	—	—	—	0	—

TABLE 2 — NESTING RECORDS FROM PARKERVILLE, 1927.

Yellow-tailed Thornbill	Aug. 10, 16, 25; Sept. 1; Oct. 25; Nov. 15.
Western Spinebill	Aug. 14, 27; Sept. 10.
Scarlet Robin	Aug. 14, 18; Sept. 1, 18.
Little Wattle-bird	Aug. 19, 21, 21, 25; Sept. 1, 12, 12; Oct. 3.
Raven	Aug. 23.
White-browed Babbler	Aug. 23, (at the 43-mile peg, York Road)
Western Silver-eye	Aug. 29; Nov. 13.
Western Magpie	Aug. 29; Sept. 1, 9, 12, 12, 24, 31; Oct. 3.
Red Wattle-bird	Aug. 30; Sept. 6, 6.
Tawny Frogmouth	Sept. 6, 24.
White-faced Heron	Sept. 7 (York).
Yellow Robin	Sept. 9, 19.
White-naped Honeyeater	Sept. 14.
Pallid Cuckoo	Sept. 14, 19.
Western Thornbill	Sept. 30; Nov. 6.
Australian Pipit	Oct. 4.
Black-capped Sittella	Oct. 7, 12.
Kookaburra	Oct. 9.
Banded Blue Wren	Oct. 13, 17; Nov. 6, 18.
Squeaker	Oct. 17.
Western Warbler	Oct. 20; Nov. 5, 20.
Brown Hawk	Oct. 22.
Rufous Whistler	Oct. 30 (Perth).
Red-tipped Diamond-bird	Nov. 5.
Golden Whistler	Nov. 5.
Sacred Kingfisher	Nov. 7, 20.
Black-faced Cuckoo-Shrike	Nov. 28.

TABLE 3 — NESTING RECORDS FROM LAKE GRACE, 1930.

Banded Plover	May 17, 19; June 27; Sept. 17.
Striated Field-Wren	July 6; Sept. 13.
Wedge-tailed Eagle	July 20.
Tawny-crowned Honeyeater	July 26; Aug. 3.
Red Wattle-bird	Aug. 3; Oct. 5.
Australian Pipit	Aug. 6, 11; Sept. 3, 5, 6; Oct. 22.
Squeaker	Aug. 10.
White-tailed Black Cockatoo	Aug. 17; Sept. 14, 20.
Mountain Duck	Aug. 22, 31.
Hoary-headed Grebe	Aug. 27, 27, 27, 27; Sept. 7, 10, 13, 13; Oct. 7, 12, 12, 12, 12.
White-fronted Chat	Aug. 20; Oct. 17.
Grey Teal	Aug. 30; Sept. 3; Oct. 14.
Musk Duck	Aug. 31; Sept. 13, 13, 16; Oct. 12; Nov. 16.
White-faced Heron	Sept. 3; Oct. 5.
Tawny Frogmouth	Sept. 4, 6.
Common Bronzewing	Sept. 7; Oct. 23.
Pallid Cuckoo	Sept. 7.
Western Rosella	Sept. 10, 13, 14, 27.
Twenty-eight Parrot	Sept. 13, 18.
Willy Wagtail	Sept. 16.
Hooded Robin	Sept. 17.
Chestnut Teal	Sept. 19.
Stubble Quail	Sept. 21; Oct. 8, 18, 20.
Smoker Parrot	Sept. 30, 30.
Brown Honeyeater	Sept. 30.
Boohook Owl	Oct. 3.
Australian Goshawk	Oct. 3.
Dusky Wood-Swallow	Oct. 5.
Red-capped Dotterel	Oct. 7, 8, 8, 11, 11, 12, 15, 19, 19, 19, 22, 22, 22; Nov. 9, 9, 9, 9, 23, 23.
White-headed Stilt	Oct. 7, 7, 8, 8, 8, 8, 12, 14, 22.
Hooded Dotterel	Oct. 11, 11, 22.

Black Swan	Oct. 11.
Spotted Harrier	Oct. 23.
Red-tipped Diamond-bird	Oct. 29; Nov. 16.
Kestrel	Oct. 29; Nov. 3.
Brown Flycatcher	Nov. 1.
Grey Fantail	Nov. 9.
Bee-eater	Nov. 16, 16.
Western Silver-eye	Nov. 23.
Purple-crowned Lorikeet	Nov. 23.
White-fronted Heron	Dec. 12.

TABLE 4 — NESTING RECORDS FROM LANDOR STATION, 1934

Magpie Lark	April 7, 7, 7; Aug. 11, 23.
Crested Pigeon	April 7, 8, 9.
Crimson Chat	April 7.
Crested Bell-bird	April 8, 17, 23; Aug. 19.
Yellow-throated Miner	April, 8, 8, 9, 9, 9, 9, 11, 11, 11, 11, 11, 13, 14, 14, 14, 27; Aug. 3, 10, 18, 21, 22.
White-plumed Honeyeater	April 11; Aug. 21; Sept. 30.
Brown Song-Lark	April 11.
Australian Pipit	April 11, 24, 24.
Redthroat	April 13, 19, 22; Aug. 18.
Blue-and-white Wren	April 13, 14.
Black-faced Cuckoo-Shrike	April 14; Aug. 15.
Variegated Wren	April 14, 19, 19, 24, 26, 30; May 3.
Grey-crowned Babbler	April 16; Aug. 11.
Whiteface	April 17, 21, 26; May 11, 22.
Black-faced Wood-Swallow	April 17, 19, 21, 21, 24.
Banded Blue Wren	April 17, 24, 24.
Western Shrike-Thrush	April 18.
White-browed Tree-creeper	April 19, 28.
Singing Honeyeater	April 20, 24; Aug. 7.
Hooded Robin	April 21.
Black-capped Sittella	April 23.
Zebra Finch	April 24, 30; May 20, 24, 25, 26; July 15, 20; Aug. 2.
Wedgebill	April 24.
Banded Whitefaee	April 24, 25, 25, 27, 29; May 22; June 25; Aug. 8.
Rufous Whistler	April 24.
White-faced Heron	May 3.
Robust-billed Thornbill	May 11.
Ground Cuckoo-Shrike	May 17; Aug. 7, 19.
Willy Wagtail	May 22, 24.
Emu	May 22; June 14.
Tree-Martin	May 24; Aug. 10.
Little Crow	May 24; Aug. 11, 22.
Whistling Eagle	May 29; June 18.
Little Pied Cormorant	June 11.
Yellow-tailed Thornbill	June 12; July 15; Aug. 21, 21.
Little Black Cormorant	June 12, 12, 12.
Budgerygah	June 21, 21, 22, 26, 28; July 11; Aug. 2, 3, 3.
Brown Thornbill	July 5.
Little Eagle	July 9.
Grey Teal	July 10.
Chestnut-tailed Thornbill	July 19.
Galah	July 20; Aug. 1, 12, 12, 12, 13, 13, 13, 15, 15, 19, 20, 20, 23.
Kestrel	Aug. 3, 9, 11, 12, 17, 21, 23, 23, 23, 23, 24, 26.
Brown Hawk	Aug. 3, 9, 23.
Tawny Frogmouth	Aug. 4, 7, 7.
Red-capped Robin	Aug. 6, 8.
Grey Butcher-bird	Aug. 7.

Cinnamon Quail-Thrush	Aug. 7, 29.
Pied Butcher-bird	Aug. 11, 28.
Owlet Nightjar	Aug. 12, 24.
Mulga Parrot	Aug. 17.
Twenty-eight (Ringneeked) Parrot	Aug. 14, 21.
Black-backed Magpie	Aug. 15, 18.
Little Corella	Aug. 20, 20, 21, 23, 23.
Spotted Harrier	Aug. 26.
Little Falcon	Aug. 26.
Bee-eater	Oct. 22.

TABLE 5 — NESTING RECORDS FROM EXMOUTH GULF, 1943.

Diamond Dove	Feb. 19, 26; March 28; Aug. 31; Sept. 11, 11.
Singing Honeyeater	Feb. 26, 27; March 8, 11, 11, 19, 28; Aug. 15, 24.
Variegated Wren	Feb. 27; March 9, 10, 12, 14, 24.
Crested Pigeon	March 8, 14, 14, 28.
Black-faced Cuckoo-Shrike	March 8, 16, 22, 24; Sept. 1.
Wedgebill	March 8, 9, 10, 11, 11, 16, 19, 28.
Black-faced Wood-Swallow	March 8, 14, 28; Oct. 23.
Blue-and-white Wren	March 10.
Little Quail	March 11, 12; April 11.
Narrow-billed Bronze Cuckoo	March 12.
Crested Bell-bird	March 14, 16, 16, 17, 19, 23, 24.
White-plumed Honeyeater	March 16; Sept. 1, 9, 22.
Western Shrike-Thrush	March 18, 24; April 5.
Grey-headed Honeyeater	March 21; Aug. 8, 22, 22, 24; Sept. 26, 26.
Zebra Finch	March 30; April 2; Sept. 11, 11.
Budgerygah	April 2.
Hooded Robin	April 4.
Wedge-tailed Eagle	July 4.
Twenty-eight (Ringneeked) Parrot	Aug. 8, 8.
Galah	Aug. 8, 15.
Spiny-cheeked Honeyeater	Aug. 15; Oct. 5.
Pied Oyster-catcher	Aug. 22; Sept. 4.
Brown Hawk	Aug. 25, 31.
Crow	Aug. 28; Sept. 14; Oct. 6.
White-winged Triller	Aug. 31; Sept. 4.
Red-browed Diamond-bird	Sept. 4, 6, 6, 11, 11; Oct. 17, 17.
Little Eagle	Sept. 11.
Crimson Chat	Sept. 11.
Australian Bee-eater	Sept. 11, 26.
Kestrel	Sept. 20; Oct. 12.
Red-backed Kingfisher	Oct. 14, 17, 17, 23.

TWO NEW SPECIES OF BURROWING FROGS OF THE GENUS *HELIOPORUS* GRAY FROM SOUTH-WESTERN AUSTRALIA

By A. K. LEE and A. R. MAIN, Zoology Department, University of Western Australia.

In the course of an ecological survey of the genus *Helioporus* Gray two apparently unnamed frogs have been found. A review of the literature indicates that the two may have been confused with *H. eyrei* and *H. albopunctatus* through morphological similarity. However, constant behavioural, reproductive and ecological

differences exist between these forms and, so far as present data indicate, each warrants species status. A fuller description will be published elsewhere.

Helioporus psammophilus, sp.n.

Type specimen. 364/54.

Type locality. Beechina, Western Australia.

Description. Head broad, depressed, snout rounded, nostril equidistant or nearer eye than snout; papillae in anterior corner of eye usually indistinct. Tympanum distinct, oval to vertically oval. Arms weak. Fingers well developed. Toes separated by reduced web, outer shorter than third; large white compressed metatarsal tubercle or shovel on foot (Main, 1954).

Dorsal surface minutely warty; paratoid glands present but indistinct. Anal region and flanks granular. Ventrally smooth. White gland in groin.

Male spined on first finger; largest spine on metacarpophalangeal knuckle.

Colour (specimens fixed in 80% alcohol transferred and kept in 70% alcohol for three months). Dorsally, dark brown to grey, with dark grey or brown marblings; a white streak on snout. Flanks and anal regions with fine white spots; white streak anterior to angle of jaw. Ventrally white; throat of both sexes washed with brown or grey, female often white. Colour description of live material agrees with that above.

Length. Snout to cloaca. ♂ 4.77 cm. (S.D. ± 0.42) (18 specimens). ♀ 4.70 cm. (S.D. ± 0.21) (2 specimens).

Range. Strawberry (near Dongara), then south along Darling Scarp and east along south coast to beyond Denmark.

Habitat. Confined to the fine sands and white sandy clays of the Darling Scarp and foothills.

Diagnosis. Morphologically similar to *H. eyrei*, differs from that species in having no yellow on adult, and spined males. *H. eyrei* adults are significantly longer than *H. psammophilus*. Cannot be confused with adults of any other species of *Helioporus*. (As yet the females of *H. eyrei* and *H. psammophilus* cannot be separated with certainty). *H. eyrei* is sympatric with *H. psammophilus* but field observations indicate that hybrids are of very rare occurrence.

Call. Short high-pitched repetitive call resembling the noise of a motorboat or lighting plant (*H. eyrei* calls with a long low moan).

Helioporus inornatus, sp.n.

Type specimen. 155/54.

Type locality. Beechina, Western Australia.

Description. Head broad, depressed, snout rounded, nostril always nearer eye than snout; papillae in anterior corner of eye

prominent. Tympanum usually distinct, circular to vertically oval. Arms strong. Fingers well developed. Toes with rudiments of fleshy web, outer toe shorter than third; compressed white metatarsal tubercle on foot.

Dorsally minutely warty; paratoid complex present but indistinct. Anal region and flanks granular. Gland in groin usually brown. Smooth ventrally.

Colour (preserved as with *H. psammophilus*). Dorsally, dark brown, rarely marbled, occasionally grey with few grey marblings; fine white spots on flanks, concentrated in area anterior to angle of jaw; anal region white spotted. White stripe on snout usually absent. White ventrally. Both males and females with dusky brown markings on throat. Live material agrees with the above description.

Males with one, two or three black-capped spines on first finger, largest on metacarpo-phalangeal knuckle.

Length. Snout to cloaca. ♂ 5.44 cm. (S.D. ± 0.30) (18 specimens). ♀ 5.98 cm. (S.D. ± 0.39) (2 specimens).

Range. Muchea south along Darling Scarp and east along south coast to Denmark.

Habitat. Confined to the acid bogs of the Darling Scarp. Occurring with *H. eyrei, H. psammophilus* and *H. albopunctatus* at Beechina but ecologically separated. Burrows confined to friable black sand in the *Xanthorrhoea* zone surrounding swamps. Unlike other members of this group the complete larval life is confined to the burrow.

Diagnosis. Similar morphologically to *H. albopunctatus*. Differs in having no large white spots dorsally and occasionally possessing marblings. Preserved *H. albopunctatus* may lose the white spots. Cannot be confused with adults of other species of *Helioporus*.

Call. "Woop Woop . . . . Woop Woop Woop . . . ." (*H. albopunctatus* has a single short high "Coo".)

Material used in these descriptions is part of the collection at the University of Western Australia to be transferred to the collection of the Western Australian Museum.

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THE RELATIONSHIPS OF THE QUOKKA *(SETONIX BRACHYURUS)*

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INTRODUCTION

The macropod marsupial genus *Setonix* is represented by the single species *Setonix brachyurus* (Quoy and Gaimard) — the Quokka of South-western Australia. The relationships of *Setonix* are rather obscure and authorities have not reached general agreement as to its phylogenetic position. It is not, however, intended, in this paper, to assess the relative merits of the conclusions drawn by earlier workers but rather to put forward some new evidence based on characters not hitherto considered. Museum collections of mammals are often limited to skins and skeletal material, the internal organs being discarded. Consequently phylogenetic studies are usually based only on dentition, foot structure or other external characters. These are, however, subject to some limitations. Thus the Bandicoots (Peramelidae) show a polyprotodont dental condition allying them to the carnivorous Native Cats and Wambengers (Dasyuridae), but have the same syndactylous foot arrangement as the herbivorous marsupials. The dentition of *Setonix* closely resembles that of the Tree Kangaroos *(Dendrolagus)* but the similarities may merely reflect similar feeding habits in taxonomically widely separated genera.

It has been shown in many groups of organisms, that the chromosome number is a relatively stable character which provides a reliable guide to the relationships of the various species. A list of known chromosome numbers in marsupials has been published (Sharman and Barber, 1953) and reference to this (with some additional unpublished data) indicates the chromosome number to be a relatively stable character. Thus assemblages of marsupials characterised by the same chromosome number include the American Didelphidae (with a diploid number of 22 chromosomes), the Dasyuridae (14 chromosomes) and the Peramelidae which also have 14 chromosomes but which differ from the Dasyuridae in the morphology of the sex chromosomes. Within the Australian Possums (Phalangeridae) and Kangaroos (Macropodidae) various chromosome numbers are found but certain groups of species are characterised by a constant number. Some members of these latter families have 22 chromosomes, like the Didelphidae, but this American group differs from all Australian species so far studied in having all rod-shaped chromosomes (i.e. with subterminal centromeres).

The danger of attaching great phyletic importance to tooth and foot structure which are readily susceptible to modifications associated with habitat, has been stressed by various authorities (e.g. Gregory, 1910). Gregory considers the urogenital system, brain and skull present more reliable evidence of phyletic relationships. Pearson (1945 and later papers) has emphasised the

stability of the urogenital system and its importanee as a guide to the relationships within the marsupials. In this paper I have attempted to assess the relationships of *Setonix* by a comparison of its ehromosome number and urogenital system with those of related species.

Bensley (1903) showed that *Setonix* resembled *Dendrolagus* in the eharaeters of the ineisors, molars and seetorial premolars. He eonsidered, however, that the small size, complete absenee of canine teeth, terrestrial charaeter of the pes, and distribution of *Setonix* removed it from elose relationship to *Dendrolagus*. He concluded *Setonix* to be a member of "the Small Wallaby seetion of genus *Maeropus* whieh has assumed feeding habits similar to those of the tree-living *Dendrolagus*." Bensley followed Thomas (1888) in dividing the genus *Macropus* into small wallabies, large wallabies and kangaroos. Although the Kangaroos (*Macropus*) and Wallabies (now usually elevated to generic level as *Protemnodon* (=*Wallabia*) are homogeneous groups the small wallaby seetion is not. Thomas ineluded here *eugenii* (the Tammar of S.W. Australia) and the allied speeies *parma* now shown, in spite of their small size, to belong to *Protemnodon* (Raven and Gregory, 1946; Tate, 1948).

Wood Jones (1924) followed Bensley in dividing the larger maeropod marsupials into braehyodont and hypsodont series. This author does not, however, aeknowledge the possibility of convergenee in the teeth patterns and plaees *Setonix* together with *Dendrolagus* and *Dorcopsis* in his elassifieation. Raven and Gregory (1946) note the convergent resemblanees between *Setonix* and the Rat Kangaroos but state that its nearest relatives belong to *Thylogale*, which genus they inelude in the braehyodont seetion with the Quokka and the Tree Kangaroos. Tate (1948), however, does not agree with any of the above authors and regards *Setonix* as a derivative of *Protemnodon*, probably of the *P. eugenii* group. This author, diseussing Wood Jones' plaeing of *Setonix* in the braehyodont seetion as opposed to the hypsodont seetion, states that he is unable to appreciate this distinetion in praetiee.

Systematie works on the maeropod marsupials are numerous and no eomplete agreement has yet been reaehed with regard to the delimitation of genera. There appears to be no justifieation for the extreme splitting of Iredale and Troughton (1934) who have divided the genus *Maeropus*, as Bensley (1903) understood it, into no less than five genera. In this paper I have followed the elassifieation of Simpson (1945).

THE DISTRIBUTION OF *SETONIX BRACHYURUS*

Setonix brachyurus was once widely distributed in the Southwest of Western Australia (Shortridge, 1909). Today it appears to be eommon only on Rottnest and Bald Islands although isolated colonies exist in some mainland areas. Early in 1954 a skull of *Setonix* was brought from Toolbrunup in the Stirling Ranges by a member of this department. Other naturalists (*W.A. Nat.*, vol. 4,

1954, pp. 128-141) have reported seeing specimens and the positive identification of these animals would be of interest with regard to establishing the present distribution of *Setonix*. White (1952) has discussed the status and past abundance of the Quokka in S.W. Australia.

When Bald and Rottnest Island animals are seen side by side in captivity certain differences are apparent. The Bald Island animals appear to have a thinner and shorter tail and a slightly different shaped head when compared to Rottnest animals. Measurements of head and body and tail length, however, fail to show any constant differences in body proportions. No colour differences are apparent but the fur of the Bald Island animals appears to be softer than in animals from Rottnest.

When the skulls of fully grown Bald and Rottnest Island animals are compared there are, in the small sample available for study, some differences which appear constant (Fig. 1, Table 1). In six Bald Island skulls (1 ♂, 5 unknown sex) examined the maxilla is between 2.7 and 3.1 times the length of the premaxilla with a mean of 2.9. In twelve Rottnest skulls (2 ♂, 10 ♀) the proportions of length of premaxilla to length of maxilla vary from 2.0 to 2.6 (mean 2.2). Through the courtesy of Mr. L. Glauert, Curator of the W.A. Museum, I have examined skulls of 5 mainland specimens (2 ♂, 2 ♀, 1 unknown sex). One other mainland specimen of unknown sex has also been examined. These specimens have been collected at various mainland localities and the proportions of the lengths of maxillary bones vary between 1 : 2.2 and 1 : 2.7 (mean 1 : 2.4). From these figures it could, perhaps, be concluded that the mainland population is intermediate between

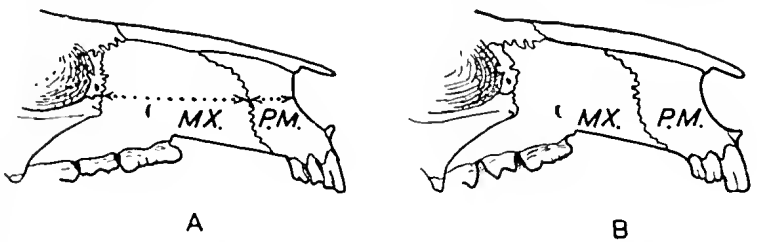


Fig. 1.—A comparison of the anterior skull region in an animal from Bald Island (A) and an animal from Rottnest (B). Note the short premaxilla (P.M.) in the Bald Island skull compared to the same bone in the Rottnest skull. The lengths of maxilla (MX.) and premaxilla were measured along the dotted lines shown in A. Both figures x 1.

TABLE 1—LENGTHS OF MAXILLA AND PREMAXILLA IN SETONIX

Locality	No. of skulls measured	Mean length of maxilla	Mean length of premaxilla	Length maxilla / Length premaxilla
Bald Island	6	18.5 mm.	6.3 mm.	2.9
Mainland, S.W. Aus.	6	17.2 ,,	7.2 ,,	2.4
Rottnest Island	12	16.1 ,,	7.3 ,,	2.2

the two island populations, with regard to this character, but the sample is small and by no means representative considering the previous wide distribution of *Setonix*. Alternatively, when a large series is measured, it may be found that the whole population of *Setonix* can be considered as a cline with the Rottnest and Bald Island animals near the extremes. It is proposed to examine further material and prepare a full taxonomic analysis later.

THE CHROMOSOME NUMBER

Drummond (1933) showed the Quokka to have 22 chromosomes and this has been confirmed on material from both Bald and Rottnest Islands (Fig. 2A). The sex chromosomes (X and Y) are among the smallest of the set and the majority of the autosomes have near terminal centromeres. The Tasmanian Pademelon *(Thylogale billardierii)* also has 22 chromosomes (McIntosh and Sharman, 1953) and these appear morphologically similar to the chromosomes of *Setonix*.

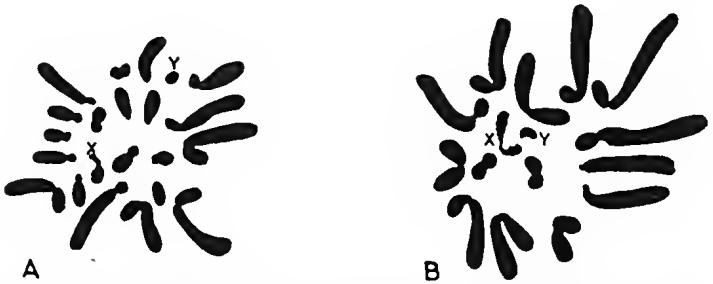


Fig. 2—The chromosomes of *Setonix brachyurus*, 2 N = 22 (A) and *Protemnodon eugenii*, 2 N = 16 (B). X and Y denote the sex chromosomes. Both figures drawn from male spermatogonial mitoses (x 2,250).

The chromosome number in the Tammar *(Protemnodon eugenii)* is 16 (Fig. 2B). The Sandy Wallaby *(P. agilis)* and the Brush *(P. irma)* also have 16 chromosomes as have *P. elegans* (Matthey, 1934) and the Red-necked Wallaby *(P. rufogrisea)* (McIntosh and Sharman, 1953). The findings of Raven and Gregory (1946) and Tate (1948) who removed *eugenii* from *Thylogale* to *Protemnodon* are thus confirmed on cytological grounds. Troughton (1954) follows Iredale and Troughton (1934) in placing *eugenii* in the genus *Thylogale*. For this there can be no justification unless the size of the animal is regarded as being of prime importance in determining its relationships.

The derivation of *Setonix* from the *P. eugenii* group as suggested by Tate (1948) does not appear likely when the chromosome numbers are considered. Cytological evidence makes it far more likely that Raven and Gregory (1946) correctly stated the relationships of *Setonix* when they emphasised its resemblances to *Thylogale*. Of the Macropodinae studied cytologically only *T. billardierii* and *Setonix* have 22 chromosomes, nine other species have less than 22. Two of the four Phalangeridae whose cytology

is known have 22 chromosomes and this, perhaps, indicates that *Thylogale* and *Setonix* are closer to the Phalangers than are the remaining present-day Macropodinae.

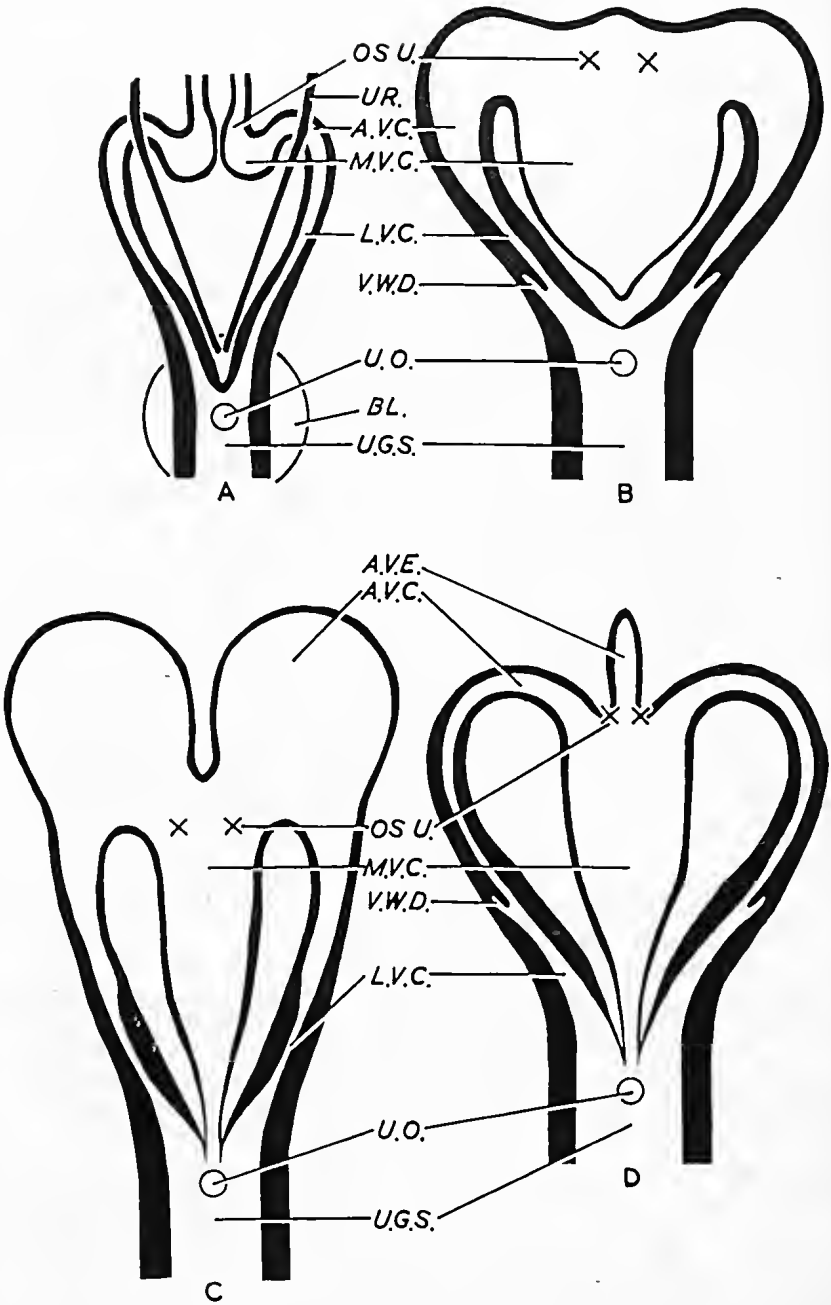
THE FEMALE UROGENITAL SYSTEM

The anatomy of the urogenital system in the female marsupial differs fundamentally from the plan found in the higher (eutherian) mammals. In the marsupials the ureters pass between the embryonic Mullerian ducts (Fig. 3A) which later in life become specialised as oviducts, uteri and vaginae. In the eutherian mammals the ureters pass outside the Mullerian ducts which become fused in the vaginal region to form a single structure. The fusion of the lateral vaginae of marsupials into a common structure is impossible owing to the position of the ureters, but in spite of this primary obstacle a median vaginal structure has been developed. This has been achieved by the elongation and development of the anterior vaginal culs-de-sac (Fig. 3A). At birth the embryo passes from the culs-de-sac through the intervening tissue directly to the urogenital sinus, the passage thus opened, lying between the ureters, being called the pseudo-vaginal canal. The distance separating the lower end of the culs-de-sac from the urogenital sinus (the pseudo-vaginal gap) is variable, being greater in the more primitive marsupials. In *Setonix,* and probably in all other macropod marsupials, the pseudo-vaginal canal remains permanently open after the first parturition.

The urogenital system of *Setonix* has previously been described (Waring *et al.,* 1955). The following description only deals with those parts of the vaginal complex which are compared with like structures in the Common Possum *(Trichosurus vulpecula)* and the Tammar *(Protemnodon eugenii).* The vaginal structures of the three species are shown in diagram form in Fig 3. The diagrams represent the oestrous condition as found in parous females.

Anterior vaginal canals. In *Protemnodon eugenii* and in other kangaroo-like marsupials (Pearson 1950), the anterior vaginal canals become enormously hypertrophied at oestrus and serve as ducts for the reception of spermatozoa. In the oestrous specimen described here (Fig. 3C) the anterior vaginal canals are of several hundred times greater diameter than at other phases of the oestrous cycle and are entirely filled with seminal fluid. In the oestrous *Trichosurus* (Fig. 3B) the anterior vaginal canals, though large are not as hypertrophied as in *Protemnodon.* In the oestrous *Setonix* (Fig. 3D) they remain of small diameter.

Vaginal culs-de-sac. In all three species the culs-de-sac are distended and contain abundant seminal fluid. Those of *Trichosurus* are larger than in either of the above species and from them a large swollen diverticulum full of spermatozoa projects in a ventral direction so that a longitudinal section (Fig. 3B) inadequately illustrates the actual condition. *Setonix* and *Protemnodon* show similar degrees of enlargement of the culs-de-sac. Two of the three specimens of *Trichosurus* examined were parous but an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OS U.
M.V.C.
V.W.D.
L.V.C.
U.O.
U.G.S.
C
D

FIG. 3.

examination of these revealed a closed median vaginal canal (Fig. 3B). *Trichosurus* thus differs from another phalanger, the Honey Mouse *(Tarsipes),* in which the pseudo-vaginal canal remains open after parturition (de Bavay, 1951).

Lateral vaginal canals. In all three species these have thick muscular walls. Those of *Setonix* and *Trichosurus* share one common feature not found in *P. eugenii* in that a short blind diverticulum (Fig. 3, V.W.D.) is present. This is probably the caudal remnant of the Wolffian duct which occurs as a constant feature in the lateral vaginae of many dasyurids (Pearson and de Bavay, 1953). de Bavay (1951) has described the reproductive system of an adult *Tarsipes* in which the embryonic Wolffian duct has been retained. de Bavay considers the specimen to have been abnormal, and this appears likely since other specimens do not show a similar condition. No trace can be found of this remnant in *Protemnodon* nor have I been able to confirm its presence in the vaginal complex of any adult macropod other than *Setonix,* where it is always present.

Anterior vaginal expansion. Setonix appears unique amongst the Macropodinae in possessing an anterior vaginal expansion. It is not known whether this structure is homologous with the structures of the same name described by Pearson (1945) in the Rat Kangaroos (Waring *et al.,* 1955). Spermatozoa are found in the anterior vaginal expansion following copulation.

LEGEND TO FIG. 3

A.—Hypothetical primitive vaginal condition in marsupials, dorsal view. Anterior vaginal canals not fused and showing little development of the culs-de-sae. The ureters pass over the anterior vaginal canals and between the lateral vaginal canals before joining the bladder, which lies in a ventral position.

B.—Vaginal complex of *Trichosurus vulpecula* drawn from a parous specimen in oestrus. Note the large median vaginal culs-de-sae and vestigial Wolffian duct. Sagittal section (x $2\frac{1}{2}$).

C.—Vaginal complex of *Protemnodon eugenii* drawn from a parous specimen in oestrus and showing the greatly hypertrophied anterior vaginal canals. Sagittal section (x 1).

D.—Vaginal complex of *Setonix brachyurus* drawn from a parous specimen in oestrus. Note the enlarged median vaginal culs-de-sac, vestigial Wolffian duct and resemblance to the vaginal complex of *Trichosurus vulpecula.* Sagittal section (x $2\frac{1}{2}$).

A.V.C. .... anterior vaginal canal.
A.V.E. .... anterior vaginal expansion.
BL. .... bladder.
L.V.C. .... lateral vaginal canal.
M.V.C. .... median vaginal culs-de-sac.
OS.U. .... position of os uterus.
U.O. .... position of opening of bladder into urogenital sinus.
U.G.S. .... urogenital sinus.
UR. .... ureter.
V.W.D. .... vestigial Wolffian duct.

DISCUSSION

Previous authorities have not found agreement as to the phyletie position of the genus *Setonix*. This study supports the eonelusions of Raven and Gregory who believe the elosest relatives of *Setonix* are to be found in the genus *Thylogale*.. The affinities, as shown by the ehromosome number, definitely support this hypothesis. I believe, however, that even more interesting evidence of relationships is shown by the morphology of the vaginal eomplex. A relatively primitive state is seen in *Setonix* where the anterior vaginal eanals do not show the speeialised eondition found in *Protemnodon* and many other maeropods. I have not had available for study a reproduetive system from an oestrous *Thylogale,* but through the eourtesy of Dr. J. Pearson, then direetor of the Tasmanian Museum, I have earried out a brief examination of one of his speeimens of the Tasmanian Pademelon *(T. billardierii),* taken shortly after eopulation. The anterior vaginal eanals show the same speeialised eondition as is found in the Tammar *(Protemnodon eugenii).* Pearson (1946) has deseribed the reproduetive system of *Thylogale billardierii* but does not reeord the presenee of vestigial Wolffian duets in this speeies. A re-examination to find whether these are present would be of interest. It is however suffieient, for the purpose of this paper, to reeord the similarities between the vaginal eomplex of *Setonix* and the phalanger *Trichosurus vulpecula.* Adults of both have a vestigial Wolffian duet and in both the main region used for the reeeption of spermatozoa, by the oestrous female, is the median vaginal euls-de-sae. It is generally eoneeded that the Maeropodidae rose from phalanger-like aneestors and the presence of these phalangerine eharaeters in the reproduetive system of *Setonix* indieate that, in spite of some speeialised eharaeters (e.g. dentition), this genus must be regarded as rather elose to the stem from whieh the remaining kangaroo-like marsupials arose. It is here unneeessary to diseuss the question as to whieh of the maeropod groups — Maeropodinae and Potoroinae (Rat Kangaroos) are the more primitive. Probably they are in a sense parallel groups sharing a phalanger-like aneestor. Pearson (1946, 1950) in studies of four of the five living genera of Rat Kangaroos has drawn attention to the speeialised eharaeters of their urogenital systems whieh appear to preelude this group as direet aneestors of the Maeropodinae.

It is eoneluded from this study that the nearest relatives of *Setonix* are probably to be found in the genus *Thylogale.* The unspeeialised nature of the reproductive system of *Setonix* and the eommon features shared with the phalangers, however, indieate a more primitive phylogenetie position than that of *Thylogale.* Thus *Setonix* may be eonsidered to share common features with the stoek from whieh *Thylogale* and henee the Kangaroos *(Macropus)* and Wallabies *(Protemnodon)* arose. The relationship of *Setonix* and *Thylogalc* postulated here is not untenable on zoogeographie grounds. Most S.W. Australian animals have their eounterparts in the fauna of Eastern Australia. An analysis of this type of

distribution has been made for species-pairs of birds (Serventy, 1953). The Quokka antedates this distribution and represents a more ancient fauna, the eastern counterpart of which does not exist. The Western Australian King Parrot *(Purpureicephalus)* (Serventy and Whittell, 1951, p. 59) may be taken as a representative of this same distribution. Other elements in S.W. Australia agree with this interpretation and may be taken as representing the truly autochthonian fauna (A. R. Main, ms.).

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APPENDIX

MEASUREMENTS OF THE MAXILLARY IN A SERIES OF SKULLS OF SETONIX BRACHYURUS

Locality	No.	Sex	Length of maxilla (mm.)	Length of premaxilla (mm.)	Ratio of Max. to P.M.
Rottnest Is	1	♂	16.0	8.0	2.0
,,	2	♂	16.5	7.5	2.2
,,	3	♀	16.0	7.0	2.3
,,	4	♀	16.0	7.5	2.1
,,	5	♀	15.5	7.5	2.1
,,	6	♀	17.0	6.5	2.6
,,	7	♀	16.0	7.0	2.3
,,	8	♀	15.0	7.5	2.0
,,	9	♀	17.5	7.5	2.3
,,	10	♀	16.0	7.5	2.1
,,	11	♀	14.5	7.0	2.1
,,	12	♀	17.0	7.0	2.4
Mean. Rottnest Is.			16.1	7.3	2.2
Mundaring Weir	M1285	♀	17.0	7.5	2.2
Capel	M1063	♂	16.5	7.5	2.2
Karridale	M1121	♀	17.0	6.5	2.6
Toolbrunup	Msm1	?	17.0	7.0	2.4
Big Grove, King George's Sound	M518	♂	15.5	7.0	2.2
?	M1869	?	20.0	7.5	2.7
Mean. Mainland			17.2	7.2	2.4
Bald Is.	1	♂	18.5	6.0	3.1
,,	2	?	17.5	6.0	2.9
,,	3	?	19.0	6.5	2.9
,,	4	?	17.5	6.5	2.7
,,	5	?	20.0	7.0	2.9
,,	6	?	18.5	6.0	3.1
Mean. Bald Is.			18.5	6.3	2.9

REPORTS OF EXCURSIONS

HELENA GORGE

On October 3, 1954, members of the W.A. Naturalists' Club visited for the first time that part of the Helena valley, due south of Darlington, which is known as the Helena gorge. Access was by means of the valley of the river which was followed from South Guildford through Bushmead. After passing from the south to the north bank of the river at the Darlington turn-off the party travelled along a gravel road until this joined the dirt track leading to Mundaring Weir. When the buses could proceed no further, about 2½ miles within the scarp, they were left and members continued on foot to explore the valley.

The narrow steep-sided and physiographically young valley, where most of the collecting was done, lies in granite gneiss. Settlement has only advanced along the valley floor to the eastern limit of the alluvial loams. East from where these loams pinch out the valley is in a relatively untouched state, except for the pipeline from Mundaring and the track from which the pipe is serviced.

Notes on the flora were made by Miss S. Elliott who recorded the following: Along the slopes the most plentiful forms were *Stackhousia Huegelii, S. Brunonis, Conostylis setigera, C. candicans, Dryandra nivea, Phyllanthus calcinus, Sowerbaea laxiflora, Burchardia multiflora, Hibbertia hypericoides, H. montana, Dampiera cuneata* and *Pimelea roseus.* Less common were *Sphaerolobium medium, Chorizema Dicksonia, Grevillea pulilifera, G. Endlicheriana, Tetratheca viminea, Orthrosanthus laxus, Londonia aurea, Calothamnus quadrifidus, Kennedya prostrata, Haemodorum paniculatum* and *Drosera Menziesii. Gastrolobium spinosum, Kennedya coccinea* and *Anigozanthus bicolor* were noted but not plentiful. Along the roadside to the gorge *Leschenaultia biloba* was common. In the more open sections *Stylidium neglectum* was blooming profusely as was *Stypandra imbricata.* Along the creek were flowering *Agonis linearifolium, Acacia* sp., *Kunzea* sp. and *Albizzia distachya.* Adjacent to the river were noted *Trymalium ledifolium, Thomasia macrocarpa* and *Darwinia citriodora, Borya nitida* was common on rocky slopes. The introduced Cape Tulip *(Homeria collina)* was flowering along the creek edge.

The aquatic fauna of the river, whilst not rich, did show indications of a relatively little disturbed environment. Beneath rocks in the swift-flowing parts of the stream a sponge was common and although no gemmules were present it was quite clearly a species of *Spongilla.* An apparently similar sponge occurs in identical situations in the Brockman River further north. Large numbers of nymphs of *Austroaeschna anacantha* (Odonata) and larvae of Trichoptera (Fam. Philopotamidae) were also present beneath stones. Nymphs of Stone-flies and Mayflies were scarce. The Jilgie *(Chaeraps quinqueearinatus)* was common but found to be most frequent in the stiller waters where the Mussel, *Westralunio ambiguus,* abounded. Attached to the upper surfaces

of roeks in the rapidly flowing parts of the stream were large numbers of the larvae and pupae of *Simulium tonnoiri* (Diptera).

In the ealmer parts of the stream and the adjacent pools were tadpoles of a speeies of *Helioporus* and of a *Crinia*. The following adult frogs were identified: *Crinia glauerti, C. georgiana, C. leai, Hyla adelaidensis* and speeimens of the Wheatbelt raee of the species named *Crinia signifera* in *Key to the Frogs of South-western Australia*. The fishes eolleeted were a goby *(Lizagobius olorum)* and an Atherine *(Atherinosoma edelensis)* — both identified by Mr. G. P. Whitley — and the Pygmy Pereh *(Edelia vittata)*. The Freshwater Cobbler *(Tandanus bostoeki)* and a *Galaxias* sp. were seen.

Of the terrestrial invertebrates those which attraeted the most attention were the abundant trapdoor spiders *Synothele miehaelseni* (Baryehelidae) and *Arbanites festivus* (Ctenizidae); both of these build burrows in the moist clay banks of the stream. The native snail *Bothriembryon serpentinus* was found in a number of loealities.

As it was a hot day birds were not mueh in evidenee. Dr. D. L. Serventy reported the Kookaburra, Saered Kingfisher, Golden Bronze Cuekoo (ealling), Grey Fantail, Rufous Whistler, Western Warbler, Brown Thornbill, Banded Blue Wren, Red-tipped Diamond-bird, Silvereye, Brown Honeyeater, Red Wattle-bird, Raven, Grey Buteher-bird and Magpie.

The area deserves to be eolleeted more thoroughly for it appears to be near to the northern limit of *Crinia leai, Arbanites festivus* and *Bothriembryon serpentinus,* and is the southern limit of *Synthele miehaelseni.* In addition the valley aets as a eorridor through whieh at least the Wheatbelt raee of *Crinia signifera* has penetrated.

A fuller study of the fauna may indicate a great mixing of northern, southern and eastern faunas in this part of the valley.

—A. R. MAIN

FROM FIELD AND STUDY

Early Nesting of Black-faced Wood-Swallow *(Artamus melanops).*—The Blaek-faeed Wood-Swallow has been referred to as a November-January breeder in the south-west of this State (Serventy and Whittell, *Birds of Western Australia*). It has eome under our notiee that this is not always the ease. In Oetober, 1953, we observed a group of Blaek-faeed Wood-Swallows whieh beeame agitated and annoyed at our presence in their vicinity whieh is unlike them in their off-nesting period. This was found to be due to the group of wood-swallows proteeting three young. It seemed that this speeies had a eommunal habit in the raising of their young, as there were only three fledglings and 12 adult birds. We eoneluded that nesting aetivities must have eommeneed during September.

—J. R. and W. C. FORD, Fremantle.

Influx of Smokers *(Polytelis anthopeplus).*—On August 24, 1954, about 50-60 Smokers were observed at the 18-mile peg along Forrest Road, Armadale. The flock was moving in a westerly direction. Another two were observed in flight in the vicinity of Jandakot on August 6, 1954. It appears from reports over the last few years that this species is gradually extending its range southwards.

—W. C. FORD, Fremantle.

Reef Heron in Fremantle Harbour.—It may be of interest to note the sighting of the Reef Heron *(Demigretta sacra)* within the Inner Harbour, Fremantle. One bird, an individual of the dark phase, was seen at sunset on September 17, 1954, flying seawards adjacent to C Shed. Recognition was definite and easy as I had previously observed the species on three occasions at Point Peron. On the last, May 13, 1954, two birds were studied through a telescope for about 5 minutes whilst they were not 30 yards off.

—G. CATTERMOLE, Fremantle.

Large Concentration of *Neophema elegans* at Neeralin Pool.—At 9 a.m. on February 20, 1954, I disturbed the largest flock of Elegant Grass-Parrots *(Neophema elegans)* that I have ever seen.

Quick counting of the birds whilst they were on the wing, revealed that there were approximately 100 individuals.

The situation was in partially cleared scrub land beside the Great Southern Railway, two miles north-west of Neeralin Pool, which is 18 miles south of Narrogin.

This place is rather flat, and consequently somewhat wet during the winter months.

—BRIAN V. TEAGUE, Narrogin.

Quenda near Perth.—Cycling along the Welshpool-Lesmurdie Road during Christmas week, 1953, I passed, close to the Industrial Centre, what I thought to be a dead cat lying alongside the road. I had gone two or three chains when I remembered it had a rat-like tail so I went back to investigate. It was a Quenda or Short-nosed Bandicoot *(Isoodon obesulus).* The animal bore no sign of injury but as I had no means of getting it to the Museum I left it on the roadside. I mentioned finding it to several Welshpool residents later and all said they had never seen one.

Recently my daughter, at Roleystone, saw a Quenda near her house in that district.

—J. W. BAGGS, East Cannington.

Occurrence of the Great-winged Petrel at Wyalkatchem.—On October 22, 1954, during the Northam Wildlife Show, Mr. C. G. Jessup brought in for identification a petrel which had been picked up the previous day by Mr. W. L. McClure on the railway line one mile west of Wyalkatchem. The bird proved to be the Great-winged Petrel *(Pterodroma macroptera).* It was fed and subsequently released.

This locality may now be added to the list given in Serventy and Whittell's *Handbook* (p. 100) — Maddington, Northam, Cunderdin, Nungarin and Mukinbudin — and which these authors believe to point to the existence of a breeding area, hitherto undiscovered, on the west coast, possibly at the Abrolhos Islands. There was a very strong westerly wind blowing at the time of the Wyalkatchem find.

—W. H. BUTLER, Inglewood.

"Clifton Downs" as a Collecting Locality for Birds.—In 1905 G. C. Shortridge, in the course of a collecting trip in Western Australia on behalf of the British Museum of Natural History, had a base on the Gascoyne River which in the published account of the birds of the expedition (by W. R. Ogilvie-Grant, *The Ibis*, 1909, p. 650; 1910, p. 156) was referred to as Clifton Downs Station. There is no such station at present in Western Australia but older pastoral maps show two Clifton Downs in the Gascoyne district — Lower Clifton Downs about 100 miles east of Carnarvon and Upper Clifton Downs some 120 miles further east, above the great triangular bend of the Gascoyne. The former is now known as Bidgemia Station and the latter as Landor Station. According to records at the Lands and Surveys Department in Shortridge's time only Lower Clifton Downs was in existence, then known simply as Clifton Downs. Thus the type locality for *Climacteris wellsi* Grant should be referred to in modern records as Bidgemia Station.

—I. C. CARNABY, Carnarvon.

Early Nesting of Little Wattle-bird *(Anthochaera chrysoptera).* —This species has been found to be an early breeder in the Bibra Lake area and hence, no doubt, this would apply for the remainder of the Swan coastal plain.

The earliest record for 1952 was a nest with one fresh egg on July 16. Several other nests were examined but the owners of these nests had not commenced egg laying. On July 26 a nest with one large young was found.

During 1953 this species must have commenced nesting in the early part of June, since on July 5 we observed a nest with a young which could be seen protruding above the nest. Three other nests were also found on the same day, one of which contained a partly incubated egg. Again on July 11 a nest was found to contain one large young and a second nest contained a freshly laid egg.

This year (1954) the wattle-bird appeared to be a little late with nesting activities which may have been due to the particularly dry May and June months. During July several empty nests were found but only one nest contained a young.

It may also be of interest to note that we have records of this bird nesting to the latter parts of December and this would place the Little Wattle-bird in the category of long-season breeders.

—J. R. and W. C. FORD, Fremantle.

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REMOVAL OF HOST'S EGG BY THE CUCKOO?

By JULIAN R. FORD, Fremantle.

In the Bibra Lake District, Fremantle, the principal host of the Pallid Cuckoo *(Cuculus pallidus)* has been found to be the Red Wattle-bird *(Anthochaera carunculata)*, no doubt, due to the similarity in the colour of their eggs. Below is a list of the number of wattle-birds' eggs when the nest has been found to contain a Pallid Cuckoo's egg.

Nest	Cuckoo's Eggs	Wattle-birds' Eggs
A	1	2
B	1	2
C	1	2
D	1	2
E	1	1
F	1	2
G	1	–

Nests A, B, C and D contained two eggs of *Anthochaera carunculata* and so the cuckoo may have deposited its egg in the nest, (i) before the host, or (ii) after the host laid its eggs. Only on one occasion have I known *Anthochaera carunculata* to have a clutch exceeding two eggs, and on that occasion there were three eggs. Hence it can be assumed that in all the cases under consideration the wattle-bird only laid two eggs. Nest D was found with all the eggs broken, possibly by the wattle-bird on finding a cuckoo's egg in its nest, and in this case the cuckoo would have deposited its egg after the wattle-bird had laid its two eggs. In nests A, B and C it would appear that the first alternative would apply. The reason for this assumption will be evident later. Nest E contained only one egg of *Anthochaera carunculata* and further observations on this nest proved that the wattle-bird did not increase its clutch and so it appears that the cuckoo may have removed an egg, after depositing its own. In the case of nest F, the nest was found when it only contained one cuckoo's egg, but on subsequent observations, the nest was observed to contain an additional two eggs of the wattle-birds. Obviously in this instance the cuckoo laid its egg first. Observations on nest G proved interesting. On the initial observation this nest only contained a cuckoo's egg and at no time later were any wattle-birds' eggs observed in the nest. Perhaps the adult cuckoo had earlier removed both of the wattle-birds' eggs, as the cuckoo's egg was subsequently hatched and the chick raised to maturity.

Two other records on *Cuculus pallidus* are worth noting, but on both occasions the host concerned was the Little Wattle-bird *(Anthochaera chrysoptera)*. A distance of some ten yards separated these nests and in both cases the nest was found to contain a Pallid Cuckoo's egg, but only one nest contained an egg of *Anthochaera chrysoptera*. Later the other nest was observed to contain, additionally, an egg of *Anthochaera chrysoptera*, and since the last-named species lays a single egg in Western Australia, it was apparent that the Cuckoo did not remove the host's egg. It may be also interesting to note that both cuckoo eggs were exactly similar (a darker zone marked on the larger end), and it was assumed the same cuckoo hen deposited both eggs. Perhaps this has little significance, but it may mean that only some cuckoos possess the instinctive desire to remove an egg of the host.

Previously I stated the opinion that *Cuculus pallidus* would, on most occasions, deposit its eggs before the host laid any eggs. Glancing through my records, it is evident that this would predominantly apply except whenever it appears that the cuckoo removed one of the eggs. The reason may be as follows. It is a well established fact that the cuckoo chick will eject the host's chicks or eggs and to do this it must be strong enough to meet these demands. So, the cuckoo lays its egg first. This induces the host to commence incubation at an earlier stage and perhaps before it has laid its own clutch, and finally the cuckoo chick hatches a little earlier than the host's chick. The result is that the cuckoo is much stronger than the host's chicks and so is able to eject them from the nest. However, when the cuckoo deposits its egg after the host has laid its eggs, the cuckoo removes an egg, which situation will result in easing the demands later on the young cuckoo chick.

Hence, in conclusion, it can be assumed that *Cuculus pallidus* will remove an egg of the host wherever the host's clutch has already been laid, and time permits the complete transaction. Referring back to nest D it will be seen that all the eggs of both species were broken. This was most probably due to the cuckoo having insufficient time for the transaction and one of the wattle-birds may have observed the cuckoo at the nest.

HERPETOLOGICAL MISCELLANEA

By L. GLAUERT, W.A. Museum, Perth.

V.—WESTERN AUSTRALIAN GECKOES, PART 1

The lizards of the Family Geckonidae are easily distinguished. They have no overlapping scales on the back, and are usually velvety in appearance and soft and flabby to the touch.

All the Australian forms have well developed, functional limbs with five digits; the body is more or less depressed and the tail may assume a variety of shapes according to the species. This appendage is easily shed and substituted by a replacement, usually differing in colour and outline from the lost portion.

Beeause Geckoes are nocturnal bright eolours are rarely present, exeept in some speeies of *Nephrurus*.

The classifieation here adopted is mainly based upon the characters of the digits, whieh are persistent within the genus. Only in the case of *Nephrurus* has the tail been used as a means of identification.

KEY TO GENERA

a.—Tail terminating in a distinct knob .... *Nephrurus*
aa.–Tail without terminal knob, pointed.
b.—Digits simple with non-tractile claws.
c.—Digits straight.
d.—Digits granular below, rostral and mental plates projecting, nail-like; no other labials ..... *Rhynchoedura*
dd.–Digits with overlapping scales below, rostral and mental not nail-like; labials normal .... *Lucasius*
cc.–Digits angularly bent at the tip.
e.—Claw sheath overlapping below .... *Gymnodactylus*
ee.–Claw sheath split to the base .... *Heteronota*
bb.–Digits dilated at the tip with retractile claws.
f.—All the digits with claws.
g.—Digits dilated at the tip only.
h.—The distal expansion above covered with scales similar to those of the basal basal part .... *Phyllodactylus*
hh.–The distal expansion above covered with scales different from those of the part .... *Diplodactylus*
gg.–Digits dilated at the base and tip.
i.—Distal lamellae paired .... *Oedura*
ii.– Proximal lamellae paired .... *Oedurella*
ff.–Inner digits clawless .... *Peropus*

GENUS *Nephrurus*

Head large and triangular, very distinct from the neck; eyes large; ear-opening long; body short; limbs slender, digits short, clawed, cylindrical. Tail more or less flattened, heart- or leaf-shaped, terminating in a knob. Usually found on the ground under stones or logs. Three species are known.

KEY TO SPECIES

a.—Smooth conical tubercles scattered among the granules on the back, sides and tail .... *laevis*
aa.–Tubercles on the back surrounded by a ring of enlarged granules.
b.—Tubercles on the back and tail, sharply spinose .... *asper*
bb.–Tubercles on the back and tail, conical not spinose ... *wheeleri*

Nephrurus asper Guenther

Head, body, limbs and tail finely granular with numerous distinct rosettes of larger conical granules surrounding a spinose

tubercle on the back, limbs and tail; absent on the head and under surface. Grows to about 5 in.

Colour: Said to be "Brownish above with many of the tubercles white; faint indications of whitish transverse lines on the back. Head with wide-meshed network of blackish lines, lower parts whitish". The single specimen in the Museum is old and very faded.

Distribution: In Western Australia known only from the Kimberley Division.

Nephrurus laevis De Vis

Head, body, limbs and tail finely granular with numerous rosettes of conical tubercles surrounded by a ring of granules no larger than those covering the rest of the body, scattered over the back and arranged in lines across the upper surface of the tail, at the sides many of these sharply pointed. Lower surface more or less finely granular with a few rounded tubercles on the chin. Grows to about 5 in.

Colour: In the original description De Vis states: "above light brownish-grey, a pale band across the occiput, a second across the nape, a third, very angular, across the shoulders, the former two enclosing a crescent, the latter, a triangle". These markings are present on the specimens in the Museum collection but the body markings vary geographically as follows:

(1) Those from Denham and north to De Grey Station have a dark patch on the sacral region and a dark tail.

(2) From Landor Station on the Gascoyne and inland south to Coweowing Lake, the specimens show a distinct dark vertebral stripe on which the tubercles are white — a specimen from Jibberding, when alive, had the trunk light salmon orange, the legs more yellowish, the head greyish and the cross-bands, vertebral stripe and tail chestnut.

(3) Specimens from coastal localities, from Cardabia Station in the north to Yuna and Mullewa in the south, have the body more or less uniform with numerous white tubercles, the sacral region and the tail, above being somewhat darker with transverse rows of white tubercles. Colour sketches made from life show that the ground colours may vary from neutral grey to orange-cinnamon and a combination of colours too complicated to describe. In every case, the under parts and the inner sides of the limbs are whitish. The third colour form may eventually prove to be distinct from the others.

Nephrurus wheeleri Loveridge

Head, back, limbs and tail finely granular with rings of enlarged granules surrounding a large conical tubercle, scattered over the head, neck, back and tail. On the limbs, the granules surrounding the central tubercle are not enlarged. It grows to about 5 in.

Colour: A living specimen from Austin Downs Station near Cue was vinaceous pink with mikado-brown eyelids, a broad cross-band over the shoulders, another on the sacral region extending on to the hind limbs, a third on the base of the tail and a terminal area including the bulb-like extremity. The fore-limbs are vinaceous pink and the under surface whitish.

Distribution: In Western Australia known from the interior of the North-West, from the Forteseue in the north to Sandstone in the south from where the range extends into Central Australia.

GENUS *Rhynchoedura*

Digits, cylindrical, clawed, covered with uniform small granules. Scales on the body uniformly granular, largest on the tail. Two preanal pores.

Rhynchoedura ornata Guenther

Head resembling that of a young bird, high, the snout pointed and beak-like. Body elongate, limbs rather long, digits slender, clawed, granular, granules smaller than those on the back. Tail cylindrical, tapering, covered above with granules larger than those on the body. Scales on the under surface smallest on the throat, largest on the tail and near the vent. Length up to 3½ in.

Colour: Light greyish brown above with faint whitish spots, extending on to the limbs and tail. A blackish recurved band across the occiput and more or less regular dark festoons along the sides and extending on to the tail.

Distribution: In Western Australia known from the Fitzroy River in the north to Yalgoo and Gnows Nest in the south, inland to Laverton and Central Australia.

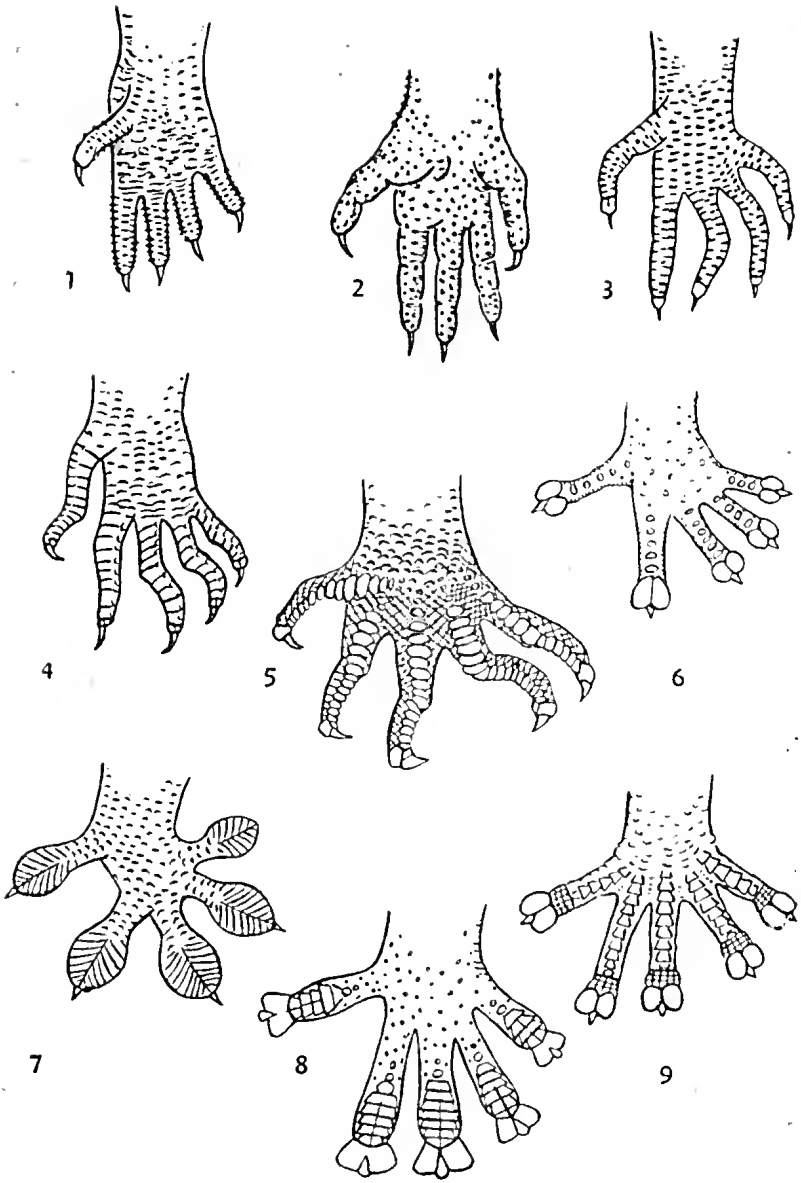
GENUS *Lucasius*

Digits cylindrical, covered above with slightly overlapping scales, and on the sides and under surface with small spine-like tubercles. The claws beneath a nail-like scale and surrounded at the sides and below by a rosette of small spine-like tubercles. Tail with squarish imbricate scales. Grows to 3½ in. This gecko is not represented in the collection; the descriptions are extracted from literature.

Lucasius damaeus (Lucas and Frost)

"Head large, snout obtusely pointed, body slightly depressed; limbs moderate, digits long, tail long and slender, tapering to a point. Rostral and mental normal, eleven upper and eleven lower labials."

Colour: "Pale whitish grey above, darkest on the sides, a brownish, more or less broken band from the snout along each side of the back to the tail; a broad whitish vertebral band from the neck on to the tail. Head spotted and reticulated with dark brown, sides with two longitudinal series of roundish white spots; limbs and under surface uniform whitish."



Characters of the digits in Geckoes: 1. *Lucasius damaeus.* 2. *Nephrurus laevis.* 3. *Rhynchoedura ornata.* 4. *Heteronota binoei.* 5. *Gymnodactylus milii.* 6. *Diplodactylus vittatus.* 7. *Peropus variegatus.* 8. *Oedura marmorata.* 9. *Phyllodactylus marmoratus.*

—O. Seymour del., after Waite.

Distribution: A Central Australian form ranging into Queensland, Western New South Wales and northern South Australia. Two specimens in the Australian Museum are said to come from near Perth, but are probably from the Eastern Goldfields.

Remarks: This species can be distinguished from the preceeding by the shape of the head, the presence of labials, both upper and lower, and the spine-like tubercles on the digits.

GENUS *Gymnodactylus*

Digits clawed, compressed and angularly bent at the tip, with transverse plates below. The scales forming the lower claw sheath overlap.

Gymnodactylus milii (Bory)
Barking Lizard

Head triangular, flattened, distinct from the neck; body depressed; limbs short, tail constricted at the base, flattened, more or less leaf-shaped, terminating in a point. The whole of the upper surface, including the limbs covered with fine granules, larger on the snout, tail, elbows and knees of the limbs, intermixed with conical tubercles, usually white and arranged in irregular rows across the body and tail. Rostral much wider than high, labials numerous, mental much larger than the adjacent shields. Under surface granular; the granules smallest on the chin, largest and flattened on the abdomen. Grows to about 6 in.

Colour: Dark brown or chocolate brown, a white cross-band often present on the occiput and another on the shoulders. Most of the conical tubercles white; the under surface whitish. Replacing tail often peppered with rusty.

Distribution: Widely distributed south of the Kimberley Division. Present on many islands off the coast.

GENUS *Heteronota*

Digits clawed, with a row of plates below, claw between three enlarged scales, those on the lower surface not overlapping. Body covered with granules and tubercles, the latter arranged in longitudinal rows. Males with from 4 to 7 preanal pores and a group of two or three enlarged blunt tubercles at the side of the vent.

Heteronota binoei Gray
Bynoe's Gecko

Head oviform, somewhat flattened, body rather short. Moderately depressed, limbs normal, digits long and slender, snout covered with larger granules, rostral squarish, twice as wide as high, divided above, seven or eight upper and six or seven lower labials; mental large, pentagonal, two large chin shields forming a suture behind the mental. Tail long cylindrical, tapering to a point, not constricted at the base. The enlarged tubercles in bands across the upper surface; below with a series of enlarged transverse plates.

Colour: Light brown above with a number of dark cross-bands, some in pairs enclosing a narrower pale band, the tubercles may be light or dark; lower surface whitish.

Distribution: Very widespread from the north to the south of the State but absent from the higher rainfall area of the South-west. Not known to occur near Perth.

GENUS *Phyllodactylus*

Digits dilated at the tip, with two large plates below; the expanded portion above with scales differing from those covering the basal part, with a row of transverse plates below. Upper surface covered with uniform granular scales. Under surface with larger scales slightly imbricate. Two species are known to occur in Western Australia.

KEY TO SPECIES

Scales granular, smooth, smaller, transverse lamellae under the toes, extend from side to side, larger ... *marmoratus*

Scales faintly keeled, larger, three series of tubercles under the toes, the central series more dilated; size smaller ..... *ocellatus*

Phyllodactylus marmoratus (Gray)
Marbled Gecko

Head oviform, much longer than wide, snout rounded, body rather elongate, limbs normal, the expansion rounded; upper surface covered with uniform granules, largest on the snout, arranged in rings round the tail; abdominal scales larger, smooth, imbricate. Grows to about 5 in.

Colour: Greyish brown or reddish brown above with darker marbling; under surface whitish.

Distribution: Very wide-spread, common in the South-west, ranging as far north as Carnarvon and inland to Kalgoorlie and eastward to South Australia.

Phyllodactylus ocellatus (Gray)
White-spotted Gecko

Head oviform, rather narrower than in the preceding, limbs and body similar; scales on the head and back granular, slightly keeled, larger than in the other species. Larger smooth rounded overlapping scales on the under surface, larger near the vent, arranged in rings around the tail. Grows to about 2 in.

Colour: Greyish brown or olive brown, marbled with darker; a distinct paler dorso-lateral band extending from the snout through the eye to the tail. This may break up into a series of pale spots in which case a pale vertebral stripe may be discernible. The under surface is whitish with a few dark spots.

Distribution: There are specimens in the British Museum from north-west Australia, Champion Bay and Houtman's Abrolhos, but material in the W.A. Museum was obtained at Kojonup, Ongerup and Ravensthorpe.

GENUS *Oedura*

Digits elawed, broad and with a raised terminal joint on whieh is a dise-like expansion with two large plates below, separated by a groove into whieh the elaw ean be withdrawn, the under surfaee of the digits with paired lamellae exeept basally. Upper surfaee eovered with uniform seales.

KEY TO SPECIES

a.—Dorsal seales flat, about as large as the ventrals ..... *marmorata*
aa.–Dorsal seales small, eonvex, granular.
b.—Habit slender, tail eylindrieal .... *rhombifera*
bb.–Habit stout, tail flattened .... *robusta*

Oedura marmorata (Gray)

Head large, much depressed oviform; body elongate, depressed limbs moderate, digits strongly dilated, about as wide as the terminal expansion, four or five divided lamellae followed by several smaller individual ones under the middle toe. Head eovered with uniform flat seales, rostral twiee as wide as high, ten or eleven upper labials, mental triangular, shorter than the adjaeent labials of whieh there are nine or ten. Baek covered with flat, round seales larger than those on the oeeiput, in transverse rows, smaller on the flank, ventrals as large as the dorsals. Males with preanal pores and elusters of enlarged tubereles at the base of the tail. Tail thiek, not eonstrieted at the base, tapering to a point, eovered with rows of squarish scales mueh large than those on the body. Grows to 6 in.

Colour: Head dark speekled with white, body dark brown above with irregular whitish eross-bands enelosing a narrow slightly darker stripe and white spots. Limbs pale brown with white spots. On the tail the eross-bands are more regular and form rings round the appendage. Under surfaee of head and body whitish.

Young examples are banded blaek and white on the body, the bands forming rings round the tail. Head rusty brown with a white band on the upper lip extending baekwards above the ear and forming the white eross-band on the nape. Under surfaee of head and body whitish; limbs rusty brown above.

Distribution: The types were eolleeted at Port Essington by John Gilbert. The speeimens in the W.A. Museum were obtained near Yalgoo and Gullewa.

Oedura rhombifera Gray
Lozenge-spotted Gecko

Head large, oviform, mueh depressed, body elongate, slender, depressed. Limbs moderate, two or three divided lamellae under the fourth toe followed by three or four smaller undivided ones. Rostral reetangular, twiee as wide as high, grooved above, ten or eleven upper and the same number of lower labials; mental angular, not longer than the adjaeent labials whieh are separated

by two or three enlarged granules. Upper surfaee eovered with granules largest on the snout, under surfaee, granular in the gular region, hexagonal, flat and smooth on the abdomen where they are imbrieate. Preanal pores present in the male. Tail slender eylindrieal, covered with rings of squarish or hexagonal sealcs, tapering to a point. Grows to 4 in.

Colour: Pale brown with a zigzag darker brown line on eaeh side, more or less forming a series of pale rhombie spots along the eentre of the back, tail similarly marked; under surfaee whitish.

Distribution: In Western Australia known from the Kimberley Division and La Grange Bay.

Oedura robusta Blnger.

Boulenger's Gecko

Head oviform depressed, snout longer than the distanee from the eye to the ear; rather stout, limbs moderate, digits with basal dilation less than the apieal, three or four divided lamellae under the fourth toe. Upper surfaee eovered with granular seales largest on the snout and tail, rostral almost pentagonal, grooved above about twiee as wide as high, nostril piereed between the rostral, first labial and four nasals the upper two the largest and not in eontaet; separated by two or three granules. Ten or eleven upper and as many lower labials, mental small, triangular, shorter than the first lower labials whieh are separated by an enlarged azygous seale. Under surfaee with small granular scales in the gular region whieh gradually pass into large, flat imbrieate seales on the abdomen. Six to eight preanal pores, a single enlarged tuberele at eaeh side of the base of the tail. Tail depressed, oval in seetion, tapering to a point. The width four and a half to five times in the length. Grows to 5 in.

Colour: Light brown with a wide lateral stripe of dark brown from the tip of the snout, through the eye and over the ear to the tip of the tail; there may be a faint more or less ineomplete dark vertebral line from the head to the tip of the tail. Head with irregular markings. Limbs variegated light and dark brown; under side of the body and tail and insides of the limbs whitish.

Distribution: Known in Western Australia from the Eastern Goldfields, Dedari, Northam, Speneer's Brook and Kulin.

GENUS *Oedurella*

Digits free, elawed, dilated, furnished below with two apieal plates separated by a longitudinal groove, with transverse lamellae on the fourth toe, the three distal emarginate in front, extending from side to side, the two proximal smaller, divided. Digits granular above, head, body, and tail above uniformly granular larger on the snout and tail, smallest on the oeeiput, ventral seales similar, beeoming imbrieate on the abdomen. Tail with rings of subequal rounded granules. Pupil vertical.

Oedurella taeniata Lonnb. and Anders.

Head oviform, twice as long as wide, somewhat depressed, ear-opening small, slit-like; body normal, limbs long and slender; digits short, dilated, as wide as the apical expansion; head covered with granular scales largest on the snout; rostral pentagonal, divided by a groove; nostril pierced between the rostral, first labial and three or four nasals, the upper the largest, separated from its fellow by two granules; ten or eleven upper labials, eleven lower, mental small triangular, not larger than the adjacent labials which are separated from one another by two scales. ("The two small prickles at the posterior margin of the eye" present on the type, are missing.) Back covered with uniform, smooth granular scales, laterally the scales are smaller, under surface granular, the granules becoming flatter and imbricate on the abdomen. Tail slightly depressed, about as long as the body. Length about 3 in.

Colour: Whitish in spirits with five brown stripes, the first vertebral stripe extends from the variegated head in the direction of the tail. The broad dorso-lateral stripes extend from the snout through the eye above the ear along the back to the tip of the tail. Fainter lateral stripes commence behind the eye pass over the shoulder along the flank and on to the tail. The limbs appear to be dark but the under surface is whitish. The faint and narrow yellowish stripes referred to in the original description, are absent on the Museum specimen.

Distribution: The type locality is Broome, the only specimen now in the Museum was obtained on the De Grey Station, where other Kimberley forms are also known to occur.

This gecko is very close to *Diplodactylus michaelseni* Werner and when more specimens of both are available may prove to be identical with it.

GENUS *Peropus*

Digits strongly dilated, free at the base, below with undivided or divided transverse lamellae, distal phalanges free, compressed, clawed, raised from within the extremity of the dilation, inner digit clawless. Upper surfaces with granular scales, belly with cycloid imbricated scales. Males with preanal pores. Grows to about 6 in.

One species with three sub-species.

Peropus variegatus (D. & B.)

KEY TO SUB-SPECIES

a.—Digital lamellae undivided ..... *australis*

aa.—Digital lamellae divided.

b.—Upper surface russet brown with transverse rows of silvery and yellowish spots ..... *punctatus*

bb.—Upper surface brown variegated with darker, sometimes dark with light blotches ..... *variegatus*

Peropus variegatus variegatus (Dum. & Bibr.)
Dtella

Head longer than wide, snout longer than the distance from the eye to the ear opening, a depression between the eyes extending on to the snout, ear opening sub-oval, fairly large. Body and limbs moderately elongate, depressed. Digits short, lamellae under the expansion chevron-shaped divided by a median groove. Upper surface chin and throat covered with small granular scales, larger on the snout and abdomen. Rostral quadrangular, much wider than high, with median cleft above, seven to nine upper labials, six to eight lower; mental large, triangular, much larger than the adjacent labials, three pairs of chin shields, the inner much the largest, outer very small, ten to sixteen preanal pores; tail depressed, tapering, upper surface with transverse rows of granular scales, under surface with larger flat scales and a much transversely dilated median row.

Colour: Greyish or brownish variegated with darker, sometimes with distinct white spots or irregular markings. Under surface whitish.

Distribution: Very widespread south of the Kimberley Division reaching the south coast, inland to central and South Australia. Not rare near Perth.

Peropus variegatus australis Gray

This form is very similar to the preceding, the only difference being that the chevron-shaped lamellae under the digital expansion are not divided.

Distribution: The type was collected at Port Essington. As far as is known its range in Western Australia is restricted to the Kimberley Division.

Peropus variegatus punctatus Fry
Spotted Dtella

This Dtella differs from the typical form in its colouration only, having the normal divided lamellae under the digital expansion.

Colour: The original description states: "Upper surface russet brown, lighter on the snout with transverse rows of silvery and yellowish spots. The spots are more abundant on the limbs. Black spots may be distributed all over the dorsal surface or they may be confined to two rows, one on each side of the vertebral column, between the rows of lighter spots. Sometimes two faint streaks of brown on the loreal region, the upper continuing behind the eye to above the ear-opening". Spirit specimens in the W.A. Museum are all paler, the background being vinaceous buff or avellaneous (Ridgway).

Distribution: The type locality is Strelley River; other records are La Grange Bay, Lyndon River, Dalgaranga Station, and the Yalgoo district.

(Part 2 will deal with the Genus *Diplodactylus*)

NEW SPECIES OF TOXIC PLANTS FROM WESTERN AUSTRALIA

By C. A. GARDNER, State Herbarium, Perth.

This paper contains descriptions of plants toxic to stock which have remained undescribed until now, including a new variety of *Gastrolobium spinosum*, also toxic to sheep. *Gastrolobium propinquum* has for many years been mistaken for Champion Bay poison (*G. oxylobioides*), and *G. tomentosum*, a little-known species, has been confused with crinkle-leaved poison (*G. villosum*).

The two new species and the new variety have been figured in colour, and are to be included in the forthcoming book, *The Toxic Plants of Western Australia*.

Gastrolobium propinquum C. A. Gardn. sp. nov.

Frutex erectus, ramulis patentibus, subangularibus, sparse sericeo-puberulis; stipulis setaceis, erectis, petiolo brevissimo non excedentibus neque spinescentibus; foliis ternis, lanceolatis, spinoso-mucronatis, utrinque attenuatis, glabris, tenuiter reticulatis; racemis axillaribus terminalibusque, folia superantibus; calyce sparse sericeo, labio superiore obtuso bifido; ovario stipitato, villoso.

In distr. Irwin in lutosis glareosis subhumidis, fl. m. Septem. **Gardner** 12233 (Typus); prope White Peak in glareosis lapidosis, fl. m. Septem. **Gardner** 8558; Isseka leg. **H. W. Jones.**

Frutex facie fere **G. oxylobioides**, ramis rigidis, erectis, dense foliosis, ramulisque angulatis pube sparsis, appressem cinerea vel albida internodiis ca. 12 mm. longis vel brevioribus; stipulae setaceae, 2-3 mm. longae, erectae, nigrae. Folia ternatim verticillata, rigide coriacea, lacte viridia vel glauca, cum petiolo (3 mm.) 2.5-3.8 cm. longa, subcomplicata, acuta vel mucronata, mucronulo pungenti, recto, 1-2 mm. longo, fusco, nervo medio crassiusculo, venis pinnatis, interstitiis reticulatione densa, juniorum pagina utrinque cano-pubescentia, demum glabra. Racemi circiter 5-7 cm. longi, remote triflori. Pedicelli in ternis orti, bractae lanceolatae. Calyx campanulatus pubi breviter adpressus albido-subsericeus, 3 mm. longus, semiquinquelido bilabiatus, lobis obtusis, labii superioris alte connati. Corolla calyci vix duplo longior, vexillo suborbiculare, aurantiaceo, carina obtusissima purpurea; ovarium longiuscule villosum. Legumen ignotum.

This shrub, which may be known in the vernacular as Hutt River poison, attains a height of two feet with whorled, erect or spreading branches and a dark-coloured bark; the branchlets are angled, the angles being formed by the continuance of the leaf-stalk along the branch below its insertion, thus continuing as ribs. The leaves are mostly in threes, usually one and half to two inches in length, narrowly lance-shaped and somewhat folded lengthwise. The leaves have slender stalks and taper somewhat abruptly at both ends, with a fine pungent point at the apex. The stipules are fine and black in colour, but break up as the leaf matures. In colour the leaves vary from an olivaceous green to a blue-green (glaucous) colour.

The flowers are in long slender racemes much exceeding the uppermost leaves, and are mostly at the ends of the branches, but are additionally found in the upper leaf axils, not crowded, and rather well spaced. The calyx is less than a quarter of an inch in length on a slender stalk, and very sparsely hairy with appressed

white hairs. The corolla is orange-yellow in colour and about as long again as the calyx.

Hutt River poison grows along the Hutt River in clay or silty-clay soil, but we have it also from White Peak and from Isseka. The White Peak form has bluish leaves while the form from the Hutt River has olivaceous green leaves.

The plant has been confused with Champion Bay poison which it closely resembles when not in flower, especially in its leaf arrangement, leaf-shape and colour, but it is a taller more branched shrub, and when in flower can easily be distinguished from Champion Bay poison by its much smaller flower, the calyx with a sparse clothing of hairs, the racemes with more numerous flowers and the larger acute, entire chestnut-brown bracts which are longer than the calyx.

Gastrolobium tomentosum C. A. Gardn. sp. nov.

Ramis tomentosis, stipulis angusto-lanceolatis, petiolo subaequantibus deciduis; foliis oppositis, orbicularibus, passim late-ovatis, utrinque obtusis vel subtruncatis, minute mucronatis, margine obsolete crenulatis undulatisque, supra reticulatis et virescentibus, glabris, subtus cum pedunculis calycibusque molliter tomentosis; racemis terminalibus, subsessilibus, foliis superantibus, dense multifloris, pedicellis calyce brevioribus; bracteis villosis, ovato-lanceolatis, acutis, concavis alyci brevioribus, caducis, ovario longiuscule stipitato, villoso.

In distr. Darling ad Dardadine prope Williams, in collibus glareosis, fl. m. Oct. M. W. H. Moore (Typus); prope Narrogin, M. Martin. Species distinctissima. Frutex decumbens, rami recti, onuste ramulosi. Stipulae tenerae, fuscentes. Folia rigide coriacea, 2-2.3 cm. longa et plerumque vix angustior. Racemi subsessiles, juniores foliis excedentibus, densiflori. Vexillum auriantiacum, carina alaeque purpurae. Legumen ignotum.

This plant, which may be known as woolly poison, occurs in the Dardadine district about twelve miles southward from Williams, and in the Narrogin district. It has only recently been received as a reputed toxic plant, and has not been officially tested. It has probably previously been confused with crinkle-leaved poison, but may be distinguished from that poison by its stiff erect stems and branches, much smaller racemes, and leaves which are densely white felted on the lower surface, but dark green above. The stipules are much smaller, and the hairs of the inflorescence are densely silky and short — quite unlike the long spreading hairs of crinkle-leaved poison. It is also related to runner poison, but the latter can always be distinguished by its flat rather large but thin cottony stipules, its prostrate habit, and its quite flat leaves with a finely reticulated network of thick veins, the small spaces between which are like pits in the lower surface of the leaf.

Woolly poison grows to a height of 18 inches to two feet, the principal features which distinguish it are the rounded leaves which are undulate (not flat) dark green above, white-felted underneath, in opposite pairs, small stipules which fall away early, and short raceme of dark-coloured flowers invested with

fine silky hairs. The corolla is relatively small, only slightly exceeding the calyx-lobes. It grows on gravelly rises, flowering in mid-September.

Gastrolobium spinosum Benth. var. *grandiflorum* C. A. Gardn. var. nov.

Ramis glabris, glaucis; foliis orbiculari-reniformibus, spinoso-mucronatis, integerrimis, glaucis; racemis terminalibus, densifloris, calyces amplie glabriusculi, labio superiore lato et breviter bifido; ovario longe stipitato, dense villoso.

Frutex 30 cm. altus, ramis patentibus; stipulae setaceae subspinescentes, demum patentes. Folia circ. 1.5 cm. longa, 2 cm. lata. Racemi 1.5-2 cm. longi; braeteae lanceolatae acuminatae, 5 mm. longae. Calyx 1 cm. longus, laxus, late campanulatus, lobis inferioribus ovatis obtusis, labio superiore lato bifido.

Hab. in distr. Irwin interiore prope Latham, in arenosis apertis, fl. m. Oct. Gardner sine no. (1934).

This variety appears to be the most toxic of all the varieties of *G. spinosum*. It has accounted for heavy losses in stock, especially sheep, in the Latham and Dalwallinu districts. It grows on open sand plain country, and is a low shrub with widely spreading, almost horizontal branches and large orange-red blossoms. The leaf is almost kidney-shaped or broadly heart-shaped, and deeply indented at the base. Pale green in colour, it is not very thick, but is rigid and the apex is somewhat abruptly narrowed into a slender but rigid spine. The flowers are almost twice the size of those of the other forms and varieties of prickly poison. It has been received also from near Mingenew, and from between Mollerin and Beacon, as well as from Kalannie.

NESTING SEASONS OF WESTERN AUSTRALIAN BIRDS—A FURTHER CONTRIBUTION

By A. H. ROBINSON, Coolup.

In the previous issue of this journal (p. 149) I. C. Carnaby has analysed his records since 1926 of the nesting of Western Australian birds. I have maintained comparable records during the same periods and over similar areas. In view of the interest now being shown in the incidence of breeding seasons and the factors controlling them I feel it an opportune time to publish a series of my records showing how closely they conform to Carnaby's data.

In 1921 and 1922 my records for Claremont, near Perth (Lat. 32° S.) were made over an area bounded by Cottesloe, Claremont, Floreat Park, Herdsman's Lake, Searborough and the ocean. For the most part this area was in its natural state. The present-day settlements of Graylands, Floreat Park and City Beach were unknown and Herdsman's Lake was in the process of being drained. There was only one house at Perry's Lakes (now portion of Floreat Park), a relic of the days when the lime kilns were

worked. This was inhabited and some of the area round the lakes was used for grazing cattle. The reed-beds in the lakes were not extensive and water-fowl did not nest in any numbers.

Butler's Swamp (Claremont) at this time was noted for its bird life. It had extensive reed-beds and the paper-barks were still alive (cf. *W.A. Naturalist,* vol. 2, 1950, p. 152) and afforded nesting sites for many birds which did not breed in the reed-beds. Included among these was the Restless Flycatcher.

The records made in 1921 and 1922 were mostly confined to weekends and school holidays. At this time the only Magpie Larks in this area were at Herdsman's Lake and there were many other breeding species within this area which are not recorded on my 1921-22 lists. Black-faced Wood-Swallows bred on the Seaview Golf Links at Cottesloe and from there back to the sanitary depot at North Cottesloe. The Australian Bittern was still breeding in Butler's Swamp.

Between 1923 and 1934 I was in the North-West. From 1923 to 1927 I made records at The Peake Station (Wyloo) (Lat. 23° S.) and from 1927 intermittent records on Ullawarra, near the same latitude. In 1933 and 1934 these records were made more comprehensive.

In setting out these records I have followed Carnaby's method for easier comparison with his paper. The map included by him is also applicable to this paper.

It will be noted that in North Western Australia, where the rainfall is very indefinite and mostly confined to the monsoonal season, many species have two breeding seasons. They nest as a result of the monsoonal rains in the summer and if the season is favourable with winter rains they nest again in the spring (August-September). But there is a decided dropping off in the number of breeding birds during mid-winter (May, June and July). This could be caused by the fact that the gonads need a certain period of recuperation or regeneration between each breeding cycle and the low temperatures of winter are unpropitious.

Magpie Larks and Yellow-tailed Thornbills have been known to start building in May at Coolup in the South-west, but did not continue and the nests remained unattended until August. The cause of this temporary break-down on nesting operations appears to have been the cold wet conditions of mid-winter. It is possible, of course, that the spring breeding in the North-west of those species which have a double breeding season is confined to individuals which were unsuccessful with their summer broods but we also have the fact that over a period of years odd records of many species may be obtained in mid-winter, particularly among seed-eating birds.

TABLE 1 — NESTING RECORDS FROM CLAREMONT, 1921

Yellow-tailed Thornbill	July 16; Aug. 23, 25.
Western Yellow Robin	July 31; August 25.
Scarlet Robin	Aug. 7, 8.
Western Silver-eye	Aug. 8.
Western Shrike-Thrush	Aug. 17.
Gilbert Whistler (?)	Aug. 20.
Little Wattle-bird	Aug. 20.
Red Wattle-bird	Aug. 20, 21.
Welcome Swallow	Aug. 21.
Golden Bronze Cuckoo	Aug. 23, 25.
Spinebill	Aug. 23.
Black Duck	Aug. 25.
Grey Butcher-bird	Aug. 26.
Singing Honeyeater	Aug. 29.
Willie Wagtail	Sept. 4; Dec. 14.
Western Magpie	Sept. 7.
Brown Honeyeater	Sept. 7.
Western Warbler	Sept. 10.
Rufous Whistler	Sept. 10, 19.
New Holland Honeyeater	Sept. 10, 13.
Raven	Sept. 18.
Reed Warbler	Oct. 10.
Swamphen	Oct. 29.
Grey Teal	Nov. 5.
Whistling Eagle	Nov. 5.
Red-tipped Diamond Bird	Nov. 5; Dec. 11.
Red-capped Dotterel	Nov. 12.
Sacred Kingfisher	Nov. 12.
Bee-eater	Nov. 16.
Little Bittern	Nov. 19.
Tree-Martin	Dec. 11.

TABLE 2 — NESTING RECORDS FROM CLAREMONT, 1922

Western Yellow Robin	July 23.
Whistling Eagle	July 23.
Yellow-tailed Thornbill	July 29; Aug. 5, 13, 20, 25, 25, 25, 28; Sept. 15, 22.
Scarlet Robin	Aug. 5, 6, 13.
Little Wattle-bird	Aug. 5, 19.
New Holland Honeyeater	Aug. 12, 28.
Raven	Aug. 19, 19.
Singing Honeyeater	Aug. 19, 19; Sept. 15.
Narrow-billed Bronze Cuckoo	Aug. 20, 25; Sept. 15, 22; Nov. 20.
Welcome Swallow	Aug. 23, 30.
Brown Honeyeater	Aug. 28.
Western Silver-eye	Aug. 28, 28; Sept. 15, 18, 23, 23.
Mountain Duck	Aug. 31.
Western Magpie	Sept. 9.
Tawny Frogmouth	Sept. 14.
Willie Wagtail	Sept. 15, 30; Nov. 11, 11, 12, 13, 18.
Pallid Cuckoo	Sept. 15.
Spinebill	Sept. 18.
Kookaburra	Sept. 23.
Splendid Blue Wren	Sept. 23.
Grey Butcher-bird	Sept. 23.
Restless Flycatcher	Nov. 11.
Sacred Kingfisher	Nov. 12, 19.
Little Grass-bird	Nov. 18.
Reed Warbler	Nov. 18.
Swamphen	Nov. 12, 18, 18.
Western Warbler	Nov. 18.
Bee-eater	Nov. 21; Dec. 21, 21.

As a preliminary to Table 3 the following general remarks may be made concerning the season and the breeding behaviour of the birds. During February and March, 1933, there was a fall of 10 inches of rain, and abundant feed was available to stock by the end of March. On April 2 Budgerygahs were looking for nesting sites. On April 9 migrating flocks of White-fronted Honeyeaters were noted feeding on the flowers of the mistletoe and wax-bush, and odd birds remained until early August. Banded Plovers were commonly seen since the first rains. In early August Masked Wood-Swallows were breaking up flocks preparatory to nesting, which was first noted on September 9. On August 24 at the bower of a Spotted Bower-bird green pods and berries were being placed. On September 11 Bee-eaters were tunnelling.

The records between September 23 and October 30 were made on a trip from Ullawarra to Onslow down the Ashburton River.

TABLE 3 — NESTING RECORDS FROM ULLAWARRA STATION, 1933 *

Magpie Lark	March . . .; April (young); Sept. . . ., 28; Dec. 15.
Owlet Nightjar	March 8 (young); April 8, 23; Aug. 9.
Crested Bell-bird	March 13, 13, 21; April 8, 24, 27; Aug. 11; Sept. 4, 4, 8, 18.
Redthroat	March 16; July 28.
Variegated Wren	March 19, 19.
Rufous Song-Lark	March 19, 23.
Yellow-throated Miner	March 20; April 23; May 31; Aug. 7; Sept. 13.
White-plumed Honeyeater	March 20; April 2; Sept. 30.
Wedgebill	March 20, 21, 21, 21, 23, 31, 31, 31, 31.
Black-faced Wood-Swallow	March 20, 21, 22; April 19; Sept. 13, 18, 23; Nov. 15 (young); Dec. 16.
Crimson Chat	March 26; April 19, 21, 21; Sept. 9, 9.
Australian Pipit	March 26; April 22; Aug. 9, 15; Sept. 8, 13, 16.
Brown Song-Lark	March 23; April 4, 18.
Crested Pigeon	March 28, April 23, 24; Aug. 3; Nov. 16.
Brown Honeyeater	March 28.
Little Quail	March 29; April 4, 4.
Rufous Whistler	March 30; April 26; Aug. 24.
Western Shrike-Thrush	March 30; April 2, 4.
White-winged Triller	March 31; Sept. 27, 28.
White-winged Wren	March 31.
Weero (Cockatiel)	April 2, 4.
Spiny-cheeked Honeyeater	April 4, 4, 19, 23, 29, 31; Sept. 11.
White-browed Babbler	April 7, 12, 12, 26.
Zebra Finch	April 19, 23, 23, 26, 27, 27, 27.
Painted Finch	April 19; Sept. 27.
Australian Dotterel	April 19.
Diamond Dove	April 22.
Ground Cuckoo-Shrike	April 23.
Little Crow	April 24, 24; Aug. 4.
Budgerygah	April 23; June 4 (young); Sept. 10.
Star Finch	April 27.
Red-browed Pardalote	April 27, 27; Sept. 4, 20.
Peaceful Dove	April 28.
Black-faced Cuckoo-Shrike	April 28; Aug. 9, 21; Sept. 10.
Cinnamon Quail-Thrush	May 21.
Emu	June 9.
Australian Crow	June 25; July 2, 28.

Tree-Martin	May . . .; April . . .; Aug. 24; Sept. 4, 4, 4, 4, 10, 10.
Black-backed Magpie	June 29; Aug. 9; Sept. 7, 12, 15, 16, 17, 18; Nov. 15 (young).
Red-capped Robin	July (young); Sept. 4.
White-faced Heron	July 28.
Black-eared Cuckoo	July 28.
Galah	Aug. 3, 9.
Twenty-eight Parrot	Aug. 3, 9.
Singing Honeyeater	Aug. 3, 9, 11; Sept. 6, 18; Nov. 1.
Grey Butcher-bird	Aug. 4, 4, 9, 11, 15, 15.
Red-plumed Pigeon	Aug. 7; Nov. 1.
Hooded Robin	Aug. 9.
Pied Butcher-bird	Aug. 9, 15, 24; Sept. 4, 7.
Kestrel	Aug. 9, 31; Sept. 20, 30.
Bustard	Aug. 15.
Red-backed Kinglisher	Aug. 24; Sept. 20.
Little Corella	Sept. 4.
Narrow-billed Bronze Cuckoo	Sept. 4.
Mistletoe Bird	Sept. 4.
Masked Wood-Swallow	Sept. 9 . . ., 18 . . ., 25.
Grey-crowned Babbler	Sept. 10.
Bee-eater	Sept. 11.
Black-capped Sittella	Sept. 11, 18, 23; Nov. 1.
Tawny Frogmouth	Sept. 12.
Wedge-tailed Eagle	Sept. 14 (fully fledged young in nest).
Brown Thornbill	Sept. 19, 19, 20.
Southern Stone-Curlew	Sept. 20.
Blue-winged Kookaburra	Sept. 24, 29.
Little Falcon	Sept. 30.
Whistling Eagle	Oct. 1.
Little Pied Cormorant	Oct. 2 (young).

* The symbol (. . .) in Tables 3 and 4 indicate that several nests were found in the period mentioned but not particularised.

In connection with Table 4, dealing principally with the year 1934, the following information may be given. The season's rain began on December 7, 1933, when 52 points fell, five inches being recorded up to February 10. As at Landor Station, where Carnaby made his observations at the same period, it was a good season, though there was no winter rain.

The first birds to respond to the rain were Black-faced Wood-Swallows and Magpie Larks, which were found nesting on December 15, 1933. On December 24 Red-capped Robins were singing before sun-rise. On January 20 a few White-winged Trillers, flying about in gum trees heavy with blossom, kept up an incessant whistling. The Pallid Cuckoo was singing. Odd Banded Plover had arrived the previous week. By this date Magpie Larks were nesting freely, and by mid-February White-winged Trillers and Wedgebills were also generally nesting. On February 19 the first flocks of Ground Cuckoo-Shrikes were seen. Towards the end of February Emus were very plentiful on the plains in flocks of up to 50 individuals, some with small broods. These must have migrated from elsewhere. On March 19 Red-breasted Babblers were lining nests and on March 23 Brown Honeyeaters were heard singing. On April 1 Song-Larks were recorded as being much more plentiful than hitherto and singing all day long.

I was absent from the area between September-November 8.

TABLE 4 — NESTING RECORDS FROM ULLAWARRA STATION, 1934.

Magpie Lark	Dec. 15 . . .; Jan. 14 . . ., 25, 27; March 24 (young); Aug. 31.
Black-faced Wood-Swallow	Dec. 16; Jan. 14; Feb. 10, 25.
Willie Wagtail	Jan. 19.
White-plumed Honeyeater	Jan. 19; Feb. 8, 16, 16; March 24; Aug. 11.
Black-faced Cuckoo-Shrike	Jan. 19, 29; Feb. 26; March 22; April 1.
Singing Honeyeater	Jan. 19, 20; Feb. 12; March 1, 4, 23, 24.
Crested Bell-bird	Jan. 20; Feb. 4; March 23; April 18.
Western Shrike-Thrush	Feb. 4.
Rufous Whistler	Feb. 5, 10.
Wedgebill	Feb. 8, 8, 8, 16 . . .; March 14, 23, 24; April 8, 18; Aug. 11, 14.
Crested Pigeon	Feb. 10; April 1.
White-winged Triller	Feb. 10 . . .
Owlet Nightjar	Feb. 12.
Banded Plover	Feb. 12.
Common Bronzewing	Feb. 15; March 23.
Peaceful Dove	Feb. 16.
Spiny-cheeked Honeyeater	Feb. 16 . . .; March 22.
Crimson Chat	Feb. 15.
Ground Cuckoo-Shrike	Feb. 25.
Little Crow	March 10, 12, 14, 14, 20, 23.
Grey-crowned Babbler	March 11, 22, 31; April 1, 12, 20; May 8, 13; Aug. 4, 4, 4; Sept. 4.
Yellow-throated Miner	March 14, 17; Aug. 15, 31.
Painted Finch	March 12.
Western Bower-bird	March 12 (two fledglings just left nest).
Hooded Robin	March 12.
Bustard	March 12.
Australian Pipit	March 14; April 23.
Zebra Finch	March 17.
Black-capped Sittella	March 24; April 21.
Tree-Martin	April 12; May 13, 13, 13.
Diamond Dove	April 23, 23, 25; Aug. 13, 14.
White-backed Swallow	April 23, 23.
Cinnamon Quail-Thrush	May 2.
Emu	May 3.
Australian Crow	July 8; Dec. (young).
Grey Butcher-bird	Aug. 13.
Twenty-eight Parrot	Aug. 5.
White-faced Heron	Aug. 31.
Bee-eater	Aug. 31; Dec. (young).
Blue-winged Kookaburra	Dec. (two eggs).

FROM FIELD AND STUDY

Record of the Silver-grey Petrel from Rottnest.—Together with D. Gillies and E. Lindgren, we found a beach-drifted petrel of grey and white plumage, about half a mile east of Green Island, on the southern shore of Rottnest Island, in December 1954. The specimen had dried out to a mummy and had evidently come ashore during the preceding winter. The colouration (white head, whitish bill, grey back, black wing quills, white tail and under parts) and measurements (culmen, 41 mm., tarsus, 53 mm.) led us to believe the bird was a Silver-grey Petrel or Southern Fulmar (*Fulmarus antarcticus*), which identification was verified by Dr. D. L. Serventy who examined some of the remains. This is the second record for the State and the sixth for Australia.

—E. McCRUM, Bassendean, and P. SLATER, Claremont.

Use by Grey Butcher-bird *(Cractieus torquatus)* **of Wire-Netting as a Vice.**—In November and Deeember, 1953, I noted a young Grey Buteher-bird using wire-netting to assist tearing apart its prey. The method used was to jam the food into the angle caused by two bits of joining wire, thenee dissecting it. Reeently I have noticed probably the same bird aeting similarly.

—P. SLATER, Coonana.

Occurrence of Pectoral Sandpiper (*Erolia melanotus*) **at Reid.**—On Deeember 24, 1954, a Peetoral Sandpiper was observed feeding in a drain at Reid, 400 miles east of Kalgoorlie, 80 miles north of Euela. Identification was based on the faet that the dark throat eolouration was sharply demarcated from the white underparts, the legs were yellow and the bill appeared black over the whole length. In flight the bird gave a eall similar to that of the Budgerygah. Observations were made with Zeiss 7 x 50 Binoetem and Delta 7 x 50 binoculars from five yards.

—E. MeCRUM, Reid, and P. SLATER, Reid.

Occurrence of Western Silvereye (*Zosterops australasiae*) **in Kalgoorlie.**—Since taking up residenee in Kalgoorlie in 1949, I have reeorded the Western Silvereye on numerous oeeasions, usually in assoeiation with the introduced Pepper tree (*Sehinus molle*). It is by no means common; loeal residents eannot reeall having seen it before 1943 or thereabouts, at whieh time seeondary growth was beginning to beeome noticeable in afforested areas. At about the same time, a general influx of honeyeaters was noted. The Silvereye is only noted in the immediate vieinity of Kalgoorlie.

—P. SLATER, Coonana.

The Carab, *Searaphites humeralis*, **at Wembley.**—While eolleeting in the Wembley area on November 27, 1954, I found an inseet whieh proved to be of some interest due to the faet that no previous reeord has been found of its presenee on the mainland of Western Australia. This inseet, a blaek carab, was identified at the W.A. Museum as *Scaraphites humeralis* Castelnau, a speeies generally reeorded only from Rottnest Island. The inseet was found in sandy soil under a log in the eoastal woodland area, south-east of the City Beaeh traffie eirens.

—SHEILA MeCARTHY, South Perth.

Travel of a Banded Little Crow.—On June 1, 1954, the Fisheries Department received for identifieation from Mr. P. Wood, of Kalgoorlie, an immature individual of a Little Crow (*Corvus bennetti*). On the following day it was released at North Perth by Mr. J. Traynor after one of the Department's bands had been plaeed on its leg. The band was returned to us by Mr. C. F. Brewster who had reeovered it from the bird when it was shot on September 22 at a loeality 40 miles east of Narrogin and between Harrismith and Tinkurrin. This is 150 miles south-east from Perth and 250 miles south-west from Kalgoorlie.

—H. B. SHUGG, Fisheries Department, Perth.

Early Migration of Rainbow Bird.—On September 5, 1954, it came under my notice that the Rainbow Bird *(Merops ornatus)* was present in the Bibra Lake district six miles from Fremantle. As this species is a late visitor to the Swan River District, I took particular note of its arrival. On September 5 only one bird was observed in the locality, but one week later four birds were observed.

Usually birds arrive in this district during the first week of October and commence nesting in the last week of the same month.

—W. C. FORD, Fremantle.

Scarlet and Red-capped Robins nesting at Mundijong.—The Scarlet *(Petroeca multicolor)* and Red-capped Robins *(P. goodenovii)* are both quite common in the South-west. Generally speaking, however, the Red-capped species favours the inland districts east of the Darling Range, and the Scarlet Robin is the common form of the forest areas and the Swan coastal plain. An isolated colony of Red-capped Robins on Rottnest Island indicates that the bird was perhaps more widely established along the coastal fringe in earlier times.

In view of the distribution just cited, I was interested to find on December 25, 1954, evidence of both species nesting at Mundijong. A male Red-capped Robin was observed feeding one young bird and a few yards away a pair of Scarlet Robins were noted feeding two offspring. In both instances the young were well able to fly. The white frontal mark on the young Scarlet Robins was very prominent and distinguished them from the young of the Red-capped.

—C. F. H. JENKINS, Department of Agriculture, Perth.

The Quenda in the Riverton Area.—On several occasions between March and May, 1953, whilst clearing swamps by rotary hoeing in Riverton, I noticed what I at first thought were rabbits. It was not until the end of April that the matter was settled with the capture of a live Quenda *(Isoodon obesulus)*, which was handed over to the Department of Zoology of the University. On at least four occasions in different swamps I had noticed the scurrying brown figures, but being used to rabbits I wasn't unduly interested until a mangled body appeared in the hoe debris and which was, as I afterwards learnt, a Quenda. At least six of these animals were sighted in the four swamps. Local residents state that they have noticed them over the past three or four years since building began in the district.

The particular swamps I refer to are located about 1½ miles south-west of the Riverton Bridge over the Canning River, and in the vicinity of Bulls Creek. They are paperbark and Leptospermum swamps, full of water in winter and drying out in summer. The Quenda seemed to be rather partial to swordgrass *(Lepidosperma longitudinale)* areas.

—R. P. McMILLAN, Cannington.

Frigate-bird at Fremantle.—About noon on May 5, 1951, while a passenger on s.s. *Largs Bay* as she was leaving Fremantle, I saw a Frigate-bird *(Fregata* sp.*)* circling inside the harbour entrance, not far from the ship. Its unmistakeable angular outline, with deeply-forked tail and large pointed wings were clearly seen; the head and bill were buff, and there was a white diamond-shaped patch on the fore-part of the abdomen; the plumage was otherwise black. This description, taken from notes made at the time, makes it clear that the bird was one in immature plumage, but it is not possible to be sure of the species. It is most likely to have been a specimen of the Greater Frigate-bird *(Fregata minor)*, which breeds on Christmas Island in the Indian Ocean.

The only previous record of a Frigate-bird so far south on the coast of Western Australia is of one captured alive in the Swan River on May 4, 1917, after stormy weather. This was identified as a specimen of *F. minor*, and of the form which breeds on Christmas Island (W. B. Alexander, *The Emu*, vol. 17, 1918, p. 238; vol. 20, 1921, p. 161).

From information kindly supplied by the Weather Bureau there does not appear to have been anything abnormal preceding the appearance of the bird here recorded. The fact that both records are in early May suggests that members of this species tend to wander southwards at this time of year.

—A. M. GWYNN, Antarctic Division,
Department of External Affairs, Melbourne.

Gilbert's Note-book on Marsupials.—Respecting Mr. Calaby's comments (*W.A. Nat.*, 4, pp. 147-8) I offer the following solution of the problem concerning the type locality of the western race of the Pig-footed Bandicoot. I premise that "the original label of the specimen seems to have been lost. The present one is in Oldfield Thomas' handwriting, and says 'Boorda, 40 mi. N.E. of Kirltana, W.A.' . . . The skull has the back part broken . . . the ears have what could be shot holes in them . . ." (*Per* T. C. S. Morrison-Scott, British Museum, in a letter to me dated September 28, 1954).

The meaning of the word "boorda" (or "burda"), in the context with which we are concerned, is not clear. In the South-western (Bibbulmun) language it had the meaning of "presently, by and by". It does not appear that it had any other meaning in that language. If, then, it was, in fact, applied to the Pig-footed Bandicoot by South-western aborigines, they must have taken it from another language or dialect, presumably from one spoken by a tribe which inhabited the salt lake country. It is noteworthy that there is in that country a township called Boodaroekin. South of that township, about midway between Merredin and Southern Cross, is the township of Boddalin. In the absence of evidence it seems best to take the meaning of "boorda", for our present purposes, as being that given to it by John Gilbert, i.e. that it means the Pig-footed Bandicoot. It may be concluded that it is not con-

reeted with "burdi" ("Boodie"), the South-western name for a speeies of rat-kangaroo.

"Kirltana" suggests the Tasmanian aborigines, but the eireumstanees, so far as they are known to me, preclude the possibility of an ex-Western Australian origin. "Kirl" and "tana" (I retain, for eonvenienee, Thomas' orthography) are aboriginal words of the Albany dialect, meaning "kylie" (boomerang) and "pierced" or "penetrated" (with an implied 'hit" or "struek") respeetively.

On the basis as stated above, "Boorda kirl tana" would have the meaning of "a kylie struek the Pig-footed Bandicoot", an interpretation whieh is not ineonsistent with the evidenee that I have seen. I have, however, seen no details of the personnel of the expedition whieh got the speeimen and brought it to Gilbert. I ean only eonclude that the words were uttered by a native of the Albany distriet. It seems clear enough that Gilbert did not understand the meaning of "Kirltana". Apparently he did write it on the label, but in sueh a disjointed manner that it eonveyed no meaning. Very likely Thomas surmised that "Kirltana" was a plaee : the label may have eonveyed so mueh to him. And if that be so, then Gilbert must have thought that the "boorda" had been taken at a plaee named "Kirltana" in the "Walyemara" distriet.

"Walye" would appear to be the eastern equivalent of the Perth "walyo" and of the Albany "wahl" ("l" probably liquid), a speeies of Rat-Kangaroo. The Albany word for "hand" was "marr" : further north the word "marhra" (or, loosely, "mara") was used. I eonclude that "Walyema" and "Walyemara" were uttered by natives of Albany and of (say) Perth, respeetively. I eonclude further that "Walyurmouring", "Walyormouring", "Wolyumary", and "Wal-yare-maury" were uttered by natives of the "Walyemara" distriet. The inferenee is that there was at least one native of Albany in the expedition whieh got the speeimen. It is true that Gilbert used "Walyemara", but the "rr" in "marr" would probably have been "rolled" and have had the suggestion of an "h" after it, so the sound eonveyed to Gilbert would have been not unlike "mara", the word used by Perth natives, and one with whieh he was probably familiar.

In "The New Atlas of Australia", dated 1886, published by John Sands, Sydney, "Vietoria County" (W.A.) is deseribed as "situated north of the County of York and south of Glenelg. The Mortlock River and the Toodyay Brook, tributaries of the Swan River, take their rise within it. Toodyay and Bejording . . . are the prineipal settlements . . ." Map No. 5, W.A. Seetion, shows "Walyumouring" in the County as (it seems) a settlement. Thirty-five years ago 718 acres of the "Walyumouring" eountry was set aside as a Reserve for Fauna. Adjoining that Reserve on its north and east boundaries, is what I understand is known loeally as the "Oak Park Reserve", a reserve for water. It is thought that a report on both reserves, from the point of view of the naturalist, made by someone eonversant with loeal eonditions, would be of interest to naturalists.

—F. J. MeNAMARA, Kalamunda.

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