

- GILBERT, P. A. 1939. Field notes from New South Wales. *Emu* 39: 107-10.
- GRANT, J. M. 1937. Whence come the Goldfinches? *Aust. Cage Birds* 1: 15.
- HALL, R. 1907. *The Useful Birds of Southern Australia*. Melbourne: Lothian.
- HARRISON, L. 1923. Notes on the Zoology of New South Wales. Guide Book, Pan Pac. Sci. Congr. 1923.
- HARTRIDGE, F., B. CLARK and N. W. GANE. 1976. Bird pests in orchards. Proc. Conf. Agric. For. Wildl.: Conflict or Coexistence? University of New England.
- HINDWOOD, K. A. 1948. A communal roost of the Indian Myna. *Emu* 47: 315-7.
- , and A. R. McGill. 1958. *The Birds of Sydney (County of Cumberland)*, New South Wales. Sydney: R. zool. Soc. NSW.
- LANE, S. G. 1964. First arrivals at Lane Cove and North Ryde, New South Wales. *Emu* 64: 47.
- LEACH, J. A. 1911. *An Australian Bird Book*. Melbourne: Whitcombe & Tombs.
- LUCAS, A. H. S., and W. H. LE SOUËF. 1911. *The Birds of Australia*. Melbourne: Whitcombe & Tombs.
- McGILL, A. R. 1960. A Handlist of the Birds of New South Wales, Sydney: Fauna Protn Panel.
- . 1961. Recent ornithological records in New South Wales. *Proc. R. zool. Soc. NSW* 1958-9: 35-47.
- MAYR, E. 1964. The nature of colonization of birds. In *Genetics of Colonizing Species*. H. G. Baker and G. L. Stebbins (Eds). New York: Academic Press.
- MOEDD, A. 1975. Diet of nestling Starlings and Mynas at Havelock North, Hawke's Bay. *Notornis* 22: 291-4.
- MORRIS, A. K. 1975. The birds at Gosford, Wyong and Newcastle (County of Northumberland). *Aust. Birds* 9: 37-76.
- NORTH, A. J. 1914. *Handbook for New South Wales*. Br. Ass. Adv. Sci.
- PETERS, D. 1970. Indian Mynas in Queanbeyan. *Canberra Bird Notes* 8: 13.
- ROGERS, A. 1972. N.S.W. Bird Report for 1971. *Birds (J. NSW Fld Orn. Club)* 6: 77-99.
- SEFTON, A. 1962. Additions to the birds recorded from the Illawarra district. *Emu* 62: 184-7.
- TARR, H. E. 1950. Foreign birds in Australia. *Emu* 49: 189-98.
- VAN GESSEL, F., and T. KENDALL, 1972. A checklist of the birds of Kooragan Island, Hunter nat. Hist. 4: 194-215.
- WILSON, P. R. 1973. The ecology of the Common Myna (*Acridotheres tristis* L.) in Hawke's Bay. Ph.D. thesis, Vict. Univ. Wellington.
- WOODS, A. 1974. *Pest control: a survey*. Sydney: McGraw Hill.

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29 December 1977.

OSTEOLOGICAL DIFFERENCES IN THE LEG BONES OF TWO FORMS OF ANHINGA

Darters of the genus *Anhinga* were originally regarded as four species: *A. anhinga* in North and South America, *A. rufa* in Africa, *A. melanogaster* in Asia and *A. novaehollandiae* in Australasia. More recently they have sometimes been treated as two species (*A. anhinga* being kept separate) or merged in a single species because they appear similar and behave similarly, the differences in colour and pattern of plumage being regarded as subspecific characters. During examination of skeletons of these birds for identification of fossil material, some apparently consistent differences in osteology have been found in the tarsometatarsi. Two skeletons of *A. anhinga*, one of *novaehollandiae*, one of *rufo* and three of *melanogaster* were examined.

The flattened proximal end of the tarsometatarsus has two shallow hollows, the cotylae, which articulate with the tibiotarsus, and on the posterior side a projecting block of bone, the hypotarsus, which supports the tendons where they pass over the back of the leg-joint. The shape of the hypotarsus and the pattern of tendinal canals that form holes or grooves in it are usually sufficiently consistent to permit identification to the level of family and often to genus (Harrison 1974).

Two types of tarsometatarsus were apparent in *Anhinga* (Fig. 1). On both types a small groove is present at the posterior edge on the external side and towards the centre a larger canal occurs, the open posterior edge of which is closed by two thin cartilaginous sheets in the live bird. In Type A (Fig. 1) the main calcaneal ridge of the hypotarsus appears stoutly rectangular in proximal view with two canals, one anterior to the other and the more anterior one on a level with the single external canal. The angle between the calcaneal ridge and the posterior edge of the internal cotyla is sharp and the external cotyla is anteroposteriorly long.

In Type B the calcaneal ridge tapers more. The two canals are larger and irregular in shape. The anterior of the two is more posteriorly sited in relation to the single external canal than in Type A and the more posterior of the two canals borders the side of the hypotarsus and either opens into it laterally and is closed in the living bird with cartilage or is closed at the side with a thin sheet of bone. The general effect compared with Type A is as though the whole canal arrangement had been twisted towards the external side. In Type B the angle between the hypotarsus and the posterior edge of the internal

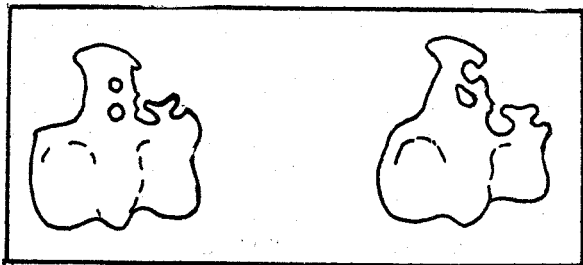


Figure 1. Proximal views of the left tarsometatarsi of anhingas. Type A on left, Type B on right. The anterior side is at the base of the figure, the external side to the right.

cotyla is more gradual and the external cotyla is short.

On the main tarsometatarsal shaft the abductor digiti IV muscle runs alongside the external edge of the shaft on the posterior side and in Type A is a larger deeper groove, more deeply incised into the shaft, and in Type B is shallower and less conspicuous. On the anterior surface the extensor hallucis longus muscle curves across the internal side of the shaft to the hind toe. On Type A it does so near the proximal end, creating a hollow in the edge of the bone about one-quarter to one-third along the shaft. On Type B it crosses lower down, nearly halfway down the shaft.

These differences in positions of tendons and muscles on the leg suggest some difference in the functioning of the foot but observation of live birds would be desirable to confirm this. Similar osteological variation in a related family, the gannets and boobies Sulidae, may help to provide a clue. In this family the difference is between two genera (Fig. 2). In species of the genus *Sula* the hypotarsus has two external canals like those of *Anhinga* but the inner one is closed. The stout calcaneal ridge has a single large canal piercing it, set slightly towards its external side. In *Morus* both canals are shifted towards the external side, the calcaneal ridge

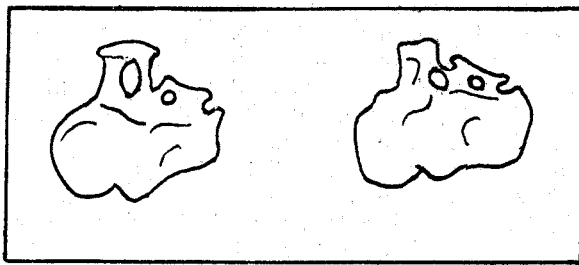


Figure 2. Proximal views of the left tarsometatarsi of *Sula* sp on left, *Morus bassanus* on right.

canal being reduced in size and at the external side of the ridge. There is some difference in the use of the foot in these species because species of *Morus* come to land mostly on large flat ledges and rocky stacks but some species of *Sula* frequently perch on branches and thick twigs.

An examination of the skeletons of different forms of *Anhinga* did not reveal comparable differences in other bones. The differences in the tarsometatarsi are not of the type that occurs between the two sexes, and Owre (1967) found no differences of this type in the samples of both sexes of *A. anhinga* that he studied. Type A tarsometatarsus was found only in the American form *anhinga* and Type B was common to *novaehollandiae*, *rufa* and *melanogaster*. These differences suggest that the last three are more closely related to each other than to *anhinga* and that they have diverged more recently. It would support the treatment of the two types as separate species, in which case *Anhinga melanogaster* Pennant 1769 is the oldest and valid name for the Old World species.

REFERENCES

- HARRISON, C. J. O. 1976. The tendinal canals of the hypotarsi as a taxonomic character of water birds. *Bull. Br. Orn. Club* 96: 82-88.
OWRE, O. T., 1967. Adaptations for locomotion and feeding in the Anhinga and the Double-crested Cormorant. *AOU Orn. Monogr.* 6: 1-138.

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16 January 1978.

AVOIDANCE OF TOXINS BY THE GALAH *CACATUA ROSEICAPILLA*

Interest has recently increased about what cues birds use to distinguish toxic from nontoxic ingestibles (Brett *et al.* 1976; Brower *et al.* 1968; Czaplicki *et al.* 1976; Martin *et al.* 1977; Rothschild 1967; Wilcoxon *et al.* 1971) although the problem has a long history (Wallace 1867; Poulton 1887). Unfortunately

we know of no studies dealing with any native Australian bird. In November 1977 we had an opportunity to observe the behaviour of the Galah *Cacatua roseicapilla* to toxic substances. Circumstances prevented a thorough examination of all relevant issues but we believe that our observations