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.

Figure 2. Proximal views of the left tarsometatarsi of *Sula* sp on left, *Morus bassanus* on 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
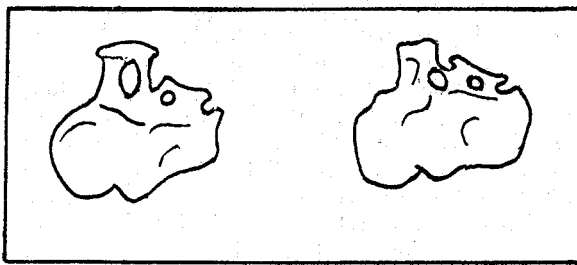
canal being reduced in size and at the external side of the ridge. There is some difference in the use of the foot in these species because species of *Morus* come to land mostly on large flat ledges and rocky stacks but some species of *Sula* frequently perch on branches and thick twigs.

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.

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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

contribute to the literature on birds because there are no data on parrots in this respect. Before this time our own work had been limited to rats, guinea pigs and chickens in standard laboratory settings. We found, in agreement with the literature, that rats definitely rejected toxic substances by taste and smell but that guinea pigs did so by sight and taste. Chickens, however, could not use taste for rejecting food that caused gastro-intestinal distress. We were consequently interested in what cues the Galah would use.

We examined the behaviour of the Galah toward water that was adulterated with red 'Aeroplane'-brand colouring matter and lithium chloride (LiCl), a substance that produces malaise when ingested. To the rat, LiCl tastes much like ordinary nontoxic table-salt (NaCl) and we assumed it would to the Galah as well. Then, after exposing the birds to the pink salty-tasting toxic water we examined their behaviour towards pink, salty and pink-salty non-toxic water.

A total of eleven Galahs, caught in the wild, were housed in an outdoor aviary (5 x 3 x 3 m) in which they could move about freely. They had been housed there for about twelve months before the experiment began. Ten days before the experiment started, the supply of trough-water was turned off and two four-litre white plastic boxes were filled with tap water and placed in the aviary. This was to familiarize the birds with the new source of water.

The plastic boxes were placed under a roof that partly covered the aviary and were therefore protected from direct sunlight and from rain. In addition, another plastic box was filled with the equivalent amount of tap water and placed in a small birdcage in order that the flock could not reach it, thus providing a measure of the amount of water lost by evaporation. This value was subtracted, on a daily basis, from the other containers, permitting the correct water intake by the birds to be measured as well as the relative amount consumed. The amount of unadulterated water drunk each day was about 750 millilitres (350 ml from one container and 400 ml from the other) or approximately 68 millilitres per bird. Although the birds were observed daily, at no time was any bird seen to bathe. The boxes were also checked daily for signs of feathers, fluff or faeces but once again no evidence of bathing was found. See summary in Table I.

On the eleventh day both boxes were filled with a pink-coloured salty-tasting toxic water, formed by adding five millilitres of red colouring matter and forty grams of LiCl to eight litres of tap water. This dosage has proved to be effective in producing malaise in pigeons (Irwin 1976).

During the next twenty-four hours, the birds consumed 650 millilitres from the two containers. Three days on ordinary tap water were allowed for recovery from the LiCl-induced malaise and then preference testing began. The day after consumption of this toxin the birds were lethargic and had a scruffy-feathered appearance. By the next day this had disappeared and they looked and acted normally.

In the first test ordinary tap water was placed in one box and pink water in the other. The box containing the tap water was always chosen randomly. During twenty-four hours the Galahs drank 600 millilitres of the tap water and 200 of the pink. The next day, nontoxic salty water (40 gms NaCl in 8 litres of tap water) was tested against the tap water. This time the Galahs drank 400 millilitres of tap water and 150 millilitres of salty water. The next day, the final test was conducted between pink-salty non-toxic water and the tap water. Again, the Galahs chose the tap water in a ratio of about 3:1 (300 ml of tap water: 100 ml of pink-salty water). This ratio was maintained despite a decrease in the total amount of liquid consumed during the tests.

The fairly constant choice in a ratio of 3:1 indicates that Galahs can learn to avoid toxic substances on the basis certainly of taste and probably colour as well. We are less certain about colour because the reduction in consumption of the coloured water could have been because the vegetable dye had a taste detectable by the Galahs. We do know, however, that guinea pigs, which have a better developed sense of taste, cannot detect red food-colouring at several times the concentration used in this study (Braveman 1974). Using Bob-white Quail *Colinus virginianus*, Wilcoxon (1977) found that they did not respond to yellow vegetable dye at concentrations of twelve millilitres per eight litres, more than double ours.

Some neophobic effect associated with the novel taste and colour rather than the combination of the novel cues with LiCl may have determined the

TABLE I

Water (ml) consumed by Galahs during this study.

Day	Total liquid intake (corrected for evaporation)	Liquids Presented
1-10 (Baseline)	750 (av.)	Plain tap water
11 (Training)	650	H_2O + LiCl + Pink
12-14 (Recovery)	not measured	Plain tap water
15 (Test 1)	800	Tap H_2O (600) v Pink (200)
16 (Test 2)	550	Tap H_2O (400) v Salty (150)
17 (Test 3)	400	Tap H_2O (300) v Pink & Salty (100)

birds' choice. We rejected this interpretation because consumption of the solution adulterated with LiCl was comparable to the consumption of ordinary tap water. Because the pink-salty water adulterated with LiCl administered on the eleventh day was the first that the Galahs experienced, one would expect any neophobia to be at its height on that day rather than on the subsequent days of the test when the cues were repeated and introduced singly. In any case our experience with several thousand chickens confirms Wilcoxon's (1977) observations with Quail that neophobic effects are too modest and shortlived to account for the data, especially given the long exposure to the solutions. We realized that we had no replication and were prevented from using a statistical analysis. However, we considered the effect dramatic enough to be convincing and that the fact that the results suggested interesting questions to be followed up warranted their publication.

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INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

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The following Opinion has been published recently by the International Commission on Zoological Nomenclature (see *Bull. zool. Nom.* 34 [4]:205, 28 February, 1978).

Opinion No.

1101 Conservation of *Geositta peruviana* Lafresnaye, 1847, and *Geositta paytae* Ménégaux & Hellmayr, 1906 (Aves).

The Commission cannot supply separates of Opinions.

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