

Evaporative water losses of some Australian parrots.—Study of species representing five orders (Galliformes, Columbiformes, Strigiformes, Caprimulgiformes, and Passeriformes) indicates that weight-relative evaporative water loss by birds at moderate temperatures (*ca.* 25° C) varies inversely with body size and, at least in species weighing less than 150 g, exceeds metabolic production of water (G. A. Bartholomew and W. R. Dawson, *Physiol. Zoöl.*, 26: 162–166, 1953). Subsequent measurements of additional species in these orders (summarized by G. A. Bartholomew and T. J. Cade, *Auk*, 80: 504–539, 1963) confirm these findings. It is now appropriate to extend observations of evaporative losses to other orders. Consequently, I took advantage of opportunities to perform some simultaneous measurements of evaporative water losses and metabolic rates of several Australian parrots.

Two Bourke Parrots (*Neophema bourkii*), a Rock Parrot (*N. petrophila*), a Cockatiel (*Nymphicus hollandicus*), and a “Twenty-eight” Parrot (*Platycercus zonarius*) were studied. Considerable variation exists among these species in ecological preferences, according to D. L. Serventy and H. M. Whittell (*Birds of Western Australia*, Perth, Paterson Brokensha Pty. Ltd., 1962, third edit.) and N. W. Cayley (*What bird is that?* Sydney, Angus and Robertson, 1959, third edit.). The Bourke Parrot is an inland species that frequents acacia scrub and is noted for its habit of visiting watering places after dark or before dawn. The Rock Parrot is a coastal form resident on offshore islands and mainland dunes and rocks from the Great Australian Bight to Shark Bay in Western Australia. The Cockatiel is generally distributed through the interior of Australia in riparian woodland and open country dotted with scrub vegetation. The Twenty-eight Parrot occurs north to the Pilbara District in Western Australia and its range extends eastward into central and South Australia. In Western Australia it is plentiful in both the southwestern forests and in more open areas inland and farther north.

Evaporative water loss and metabolic rate were determined gravimetrically, the latter as CO₂ production, using an open circuit system similar to that described by Bartholomew and Dawson (*op. cit.*). Dry, CO₂-free air was supplied to the bird as it rested in the chamber portion of this system in the dark. The animal was allowed at least an hour to adjust to the chamber, and longer if activity was detected. Measurements were not begun until the animal had been absolutely quiet for at least 30 minutes. Evaporative water loss and metabolic rate were determined by measuring the increase in weight of two drying tubes and two CO₂-absorbent tubes (these also contained a drying agent to capture any water produced in the reaction of CO₂ with the absorbent) placed in that order in the outflow line from the chamber for a precisely timed interval of at least 20 minutes. Water vapor was absorbed with a mixture of anhydrous CaCl₂ and indicating Drierite (anhydrous CaSO₄), and CO₂ with Ascarite (sodium hydrate asbestos). All tube weighings were performed to a mg on a Mettler analytical balance of appropriate sensitivity. Air flow through the system was held constant at approximately 360 cc/min for the Bourke and Rock parrots, at 400 cc/min for the Cockatiel, and at 450 cc/min for the Twenty-eight Parrot. With these flows, the rates of water loss observed in the experiments produced chamber relative humidities averaging approximately 25 per cent. The mean rates of evaporative water loss at 25° C, based on at least two trials for each bird, and the corresponding mean metabolic rates are summarized for the four species of parrots in Table 1.

The evaporative water losses of the Bourke and Rock parrots are at the same

TABLE 1
EVAPORATIVE WATER LOSS OF VARIOUS BIRDS AT 25° C

Species	No. of runs	Weight (g)	(a) Evap. H ₂ O loss ¹ (% body wt./day)	Dev. from predicted value ² (per cent)	Metabolic rate			b/a (per cent)
					Mean CO ₂ prod. (mg/hr)	Heat production kcal/day		
						Max.	Min.	
This Study								
<i>Neophema bourkii</i> (2)	3	35.3	7.7 (7.2-9.7)	(-) 3	173	14.2	10.7	4.5
<i>N. petrophila</i> (1)	3	40.7	8.1 (6.3-9.9)	(+) 19	134	11.0	8.3	3.1
<i>Nymphicus hollandicus</i> (1)	3	80.7	4.2 (3.4-5.4)	(+) 11	274	22.4	16.9	3.1
<i>Platycercus zonarius</i> (1)	2	137.0	2.6 (2.5-2.7)	(-) 19	215	17.6	13.3	1.5
Other Studies								
<i>Pipilo erythrophthalmus</i>		35.4	13.3	(+) 68	Bartholomew and Dawson (<i>Physiol. Zool.</i> , 26: 162, 1953)			
<i>P. aberti</i>		38.2	7.7	(+) 5	Bartholomew and Dawson (<i>op. cit.</i>)			
<i>P. fuscus</i>		39.3	6.0	(-) 16	"	"	"	"
<i>Mimus polyglottos</i>		39.6	5.4	(-) 23	"	"	"	"
<i>Richmondia cardinalis</i>		40	6.0	(-) 13	Dawson (<i>Physiol. Zool.</i> , 31: 37, 1958)			
<i>Phalaenoptilus nuttallii</i>		40	8.0	(+) 16	Bartholomew, Hudson, and Howell (Condor, 64: 117, 1962)			
<i>Chordeiles acutipennis</i>		40.2	7.5	(+) 9	Bartholomew and Dawson (<i>op. cit.</i>)			
<i>Lanius ludovicianus</i>		40.8	5.8	(-) 14	"	"	"	"
<i>Toxostoma redivivum</i>		74.7	4.7	(+) 26	"	"	"	"
<i>Zenaidura macroura</i>		118.7	2.5	(-) 24	"	"	"	"
<i>Otus asio</i>		137.8	3.9	(+) 18	"	"	"	"
<i>Lophortyx californicus</i>		147.1	3.5	(+) 24	"	"	"	"

¹ Mean; range in parentheses.

² Predicted values from the curve presented by Bartholomew and Dawson (*op. cit.*).

general level as those of other birds of comparable size and deviate from the curve fitted to data for species of the five orders referred to previously by only (-)3 and (+)19 per cent, respectively (Table 1). That of the Cockatiel is about 90 per cent the rate of the California Thrasher (*Toxostoma redivivum*), the only bird of comparable size on which data are available. The value for this parrot deviates from the curve just referred to by (+)11 per cent (Table 1). The rate of evaporative water loss by the Twenty-eight Parrot is near that by the slightly smaller Mourning Dove (*Zenaidura macroura*), but is only two-thirds and three-fourths those by the Screech Owl (*Otus asio*) and California Quail (*Lophortyx californicus*), respectively. The value for this parrot falls below the curve by 19 per cent (Table 1).

The rates of evaporative water loss of the four parrots deviate by no greater percentages from the curve constructed by Bartholomew and Dawson (*op. cit.*) than do the rates of many of the birds to which it originally pertained (Table 1). Thus it appears to have applicability outside of the five orders which these latter animals represent. This furthers the contention that evaporative water loss of birds generally appears to be independent of taxonomic affinities and habitat (Bartholomew and Cade, *op. cit.*).

The amount of heat production corresponding to the production of a given amount of carbon dioxide varies with the nature of the foodstuff being utilized (see chap. 12 in Brody, *Bioenergetics and growth*, New York, Reinhold, 1945). The smallest value would result from use of carbohydrate (2.57 kcal/g CO₂), and the largest from use of fats (3.41 kcal/g CO₂). Since the nature of the foodstuff used by the parrots is unknown, the maximal and minimal rates of heat production are presented in Table 1.

With the data on CO₂ production it is possible to estimate the rate of metabolic water production. The maximum rate would be provided if the birds were utilizing fats in their metabolism; the fact that such compounds yield less water per calorie than do carbohydrates (0.113 vs. 0.133 g/kcal) is offset in these calculations by the much higher heat production per g of CO₂ linked with utilization of fats. The results indicate that even in the absence of heat stress these parrots account for no more than three-fourths of their evaporative water loss with metabolic production of water. The fact that the proportion accounted for in the Rock Parrot is so small in comparison with those in other species merits further investigation. The results reported here indicate that the Bourke Parrot, the Rock Parrot, the Cockatiel, and the Twenty-eight Parrot are in the same position as birds of other orders in having to supplement their metabolic production of water with water obtained in their food or by drinking.

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