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OBSERVATIONS ON THE TEMPERATURE TOLERANCE OF LIZARDS IN THE CENTRAL NAMIB DESERT, SOUTH WEST AFRICA

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During February 1959, Professor R. C. Stebbins (of the University of California) assisted by the writer, did some determinations on the heat tolerance of lizards in the Kalahari National Park. The results of these investigations have been published by Stebbins (1961). In comparison with the coastal Namib, the Kalahari is a relatively mild and inactive desert, supporting a considerable amount of vegetation, although characterised by an absence of surface water. In view of the more severe conditions prevailing in the Namib desert, it seemed that some determinations on the heat tolerance of lizards from this region would be of interest. The Namib desert proper is a strip of moving sand, fringing the Atlantic coast of South West Africa and varying in width from a few miles in the north to about 100 in the south. The wide sand area terminates abruptly at the Kuiseb

River (at about the latitude of Walvis Bay) and on its north bank the dunes give way to extensive gravel plains, stretching inland from the narrow coastal sand strip. Rainfall over the whole area is low, seldom more than 5 inches per annum, although the development of nightly fogs, rising from the cold Benguella current, results in considerable precipitation of dew. Although the periodic rainfall allows the rapid growth of annual plants, larger vegetation is mostly restricted to the water courses, which make their way westward from the interior to the coast.

Perhaps the most characteristic elements of the reptile fauna of the Namib desert are the nocturnal and diurnal geckos, together with sand lizards of the family Lacertidae. Many of these show a preference for the sandy areas although a variety of species make use of the gravel plains as well. The sand lizards are exclusively diurnal and can be seen in the open during the hottest hours of the day. At such times the sand surface is clearly too hot for any lizard to remain upon and although the reptiles traverse it, they are completely dependent on the shade provided by vegetation or on the cooler depths of the subsurface sand. In view of the fact that it would be fatal for a lizard to remain exposed to full sun, even for a short while, on a normal day, it is interesting to know what temperature can be tolerated by the various lizards before the first signs of heat shock are exhibited. It was also planned to compare the heat tolerance of the robust-looking sand lizards and day geckos, with that of the nocturnal geckos which are so delicate in appearance.

In assessing the temperature which can be tolerated by a lizard, the most useful determination appears to be the Critical Maximum (Cowles and Bogert, 1944; Bogert, 1959).

This is the body temperature at which the first sign of heat shock or rigor is exhibited, usually taking the form of a loss of co-ordination between the limbs, impaired locomotion, followed by paralysis spreading inward from the extremities. Should the lizard be maintained at its Critical Maximum temperature for even a brief period, death will ensue. In all the determinations recorded below however, the lizards were cooled rapidly immediately the first signs of heat shock became apparent and all recovered completely.

Experimental procedure was briefly as follows: in each case the test was done on a recently caught individual and using a fast-registering rectal thermometer the lizard's body temperature was measured at the start of the test. Its temperature was then slowly raised, over a period of 10 to 15 minutes, until the Critical Maximum was reached. This can be done by tethering the lizard on the sand in full sun, but in the present instance cloudy and windy weather made this impracticable and an artificial heat source was employed. As each lizard was being warmed up, its body temperature was measured at the first signs of panting and again at the onset of loss of limb co-ordination. The animal was then rapidly cooled by being placed in the wind and sprinkled with cold water; in each case its activity was normal again within about 60 seconds. The tests were done on 3 species of nocturnal gecko (*Ptenopus garrulus, Ptenopus carpi* and *Palmatogecko rangei*); one species of diurnal gecko (*Rhoptropus afer*) and 3 species of diurnal lacertid (*Aporosaura anchietae, Meroles suborbitalis* and *Meroles cuneirostris*). Results are tabulated below:

Species	*Starting Temp.*	*Panting Starts*			*Critical Maximum*		
	Deg. C.	Deg. C.	Deg. F	Mean	Deg. C	Deg. F	Mean
Ptenopus garrulus	36.5	38.5	101.3		44.1	111.4	
	33.0	39.7	103.5		45.5	113.9	
	33.2	38.6	101.5	37.4	44.2	111.6	44.2
	18.5	37.2	99.0	99.4	43.6	110.5	111.6
	19.0	35.0	95.0		44.0	111.2	
	26.0	35.5	95.8		43.8	110.8	
Ptenopus carpi	31.3	33.5	92.3		42.7	108.9	
	30.5	33.9	93.0		42.4	108.3	
	29.5	38.2	100.8	34.8	43.5	110.3	42.7
	28.5	37.0	98.6	94.6	42.5	108.5	108.8
	28.6	31.0	87.8		43.0	109.4	
	29.5	35.0	95.0		42.0	107.6	
Palmatogecko rangei	30.9	32.0	89.6		43.0	109.4	
	32.8	37.7	99.9	36.2	43.5	110.3	43.5
	34.8	37.7	99.9	97.2	43.8	110.8	110.3
	35.2	37.5	99.5		43.6	110.5	
Rhoptropus afer	23.9	42.5	108.5		43.8	110.8	
	34.4	41.4	106.5	42.0	43.5	110.3	43.9
	35.0	42.0	107.6	107.6	43.9	111.0	111.0
	28.2	42.2	108.0		44.4	111.9	
Aporosaura anchietae	34.2	42.9	109.2		44.5	112.1	
	30.8	42.6	108.7	42.2	46.0	114.8	45.1
	31.4	41.0	105.8	107.9	44.7	112.5	113.1
Meroles suborbitalis	36.0	41.1	106.0		43.8	110.8	
	35.0	40.8	105.4	40.8	44.1	111.4	44.0
	33.5	40.6	105.1	105.5	44.0	111.2	111.1
Meroles cuneirostris	34.2	39.5	103.1		45.2	113.4	
	29.5	41.2	106.2		44.7	112.5	
	35.5	41.3	106.3	40.7	45.5	113.9	45.4
	35.0	39.5	103.1	105.3	46.3	115.3	113.8
	33.4	41.6	106.9		45.7	114.3	
	34.0	41.1	106.0		45.2	113.4	