

SHORT CONTRIBUTIONS

THE GASEOUS ENVIRONMENT OF THE POUCH YOUNG OF THE BRUSH-TAILED POSSUM, *TRICHOSURUS VULPECULA* KERR*

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Regular live-trapping by one of us (G.M.D.) during the course of an ecological study of the brush-tailed possum, *Trichosurus vulpecula* Kerr, provided a series of animals, many of which were females with young in the pouch. The opportunity was taken to make a brief study of the gaseous composition of the atmosphere within the pouch and to which the pouch young were exposed.

After parturition the single young crawls to the pouch, enters, and attaches to a teat. At that time the entrance to the pouch is firmly closed by a sphincter muscle and there would appear to be little ventilation of the pouch contents. Later the activity of the growing young and an apparent relaxation of the mouth of the pouch provide for considerable direct exchange between the pouch contents and the outside air.

The conditions within the pouch were determined by introducing a fine mercury-filled plastic tube through which gas samples of approximately 3 ml were withdrawn. These samples were then transferred to a Sleigh gas-analysis apparatus for the determination of carbon dioxide and oxygen. It was impossible to avoid a small dilution of the sample with outside air as the pouch had to be opened slightly to insert the sampling tube; furthermore many females struggled, thus partially ventilating the pouch contents during sampling.

A total of 15 individual females were examined, some of these being trapped on several occasions during the pouch life of a single young. The results (Fig. 1) plotted against the estimated age of the pouch young, determined by tail length (Dunnet 1956), show an increase in carbon dioxide and a reduction of oxygen until about the 70th day. After that the difference from atmospheric air became less pronounced. This trend is reasonable, as in the early stages the increase in body weight of the pouch young will cause a progressive increase in their total respiration. After about 70 days the increasing activity of the pouch young brings about better ventilation of the pouch contents, thus partially compensating for the effects of continuing growth.

The maximum concentration of carbon dioxide found in this study was 5.3 per cent. and was associated with an oxygen concentration of 15.7 per cent., the young being estimated to be 60 days old. Reynolds (1952) reports a maximum concentration of 6 per cent. carbon dioxide present in the pouch of the American opossum, *Didelphis virginiana* Kerr. The two cases are scarcely comparable, however, as the American

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opossum carries up to 12 or more young at one time, whereas *T. vulpecula* usually carries only one. On the other hand the pouch of *Didelphis* appears to be a much more open structure.

The results of the present study suggest that the respiratory reflexes of the pouch young of *Trichosurus* differ from those of many higher mammals in being unaffected by carbon dioxide concentrations and oxygen depletion of moderate values. It was of interest to determine if this immunity was retained in adult life.

A female possum, known to be at least 3 years old, was therefore placed in a sealed glass cage so that its respiration rate could be observed. At first a stream of air was passed through the cage and the animal's respiration rate was measured

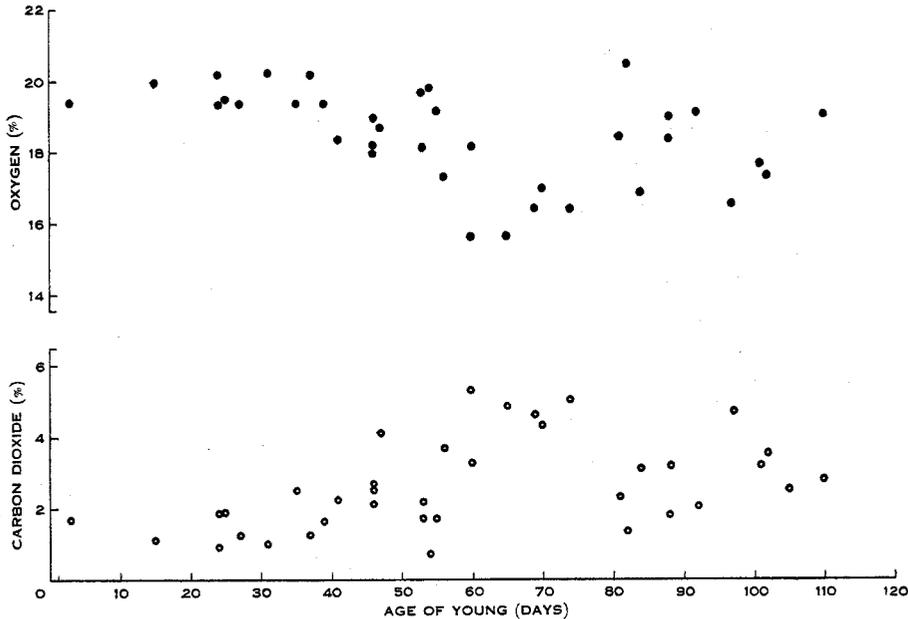


Fig. 1.—Percentages of carbon dioxide and oxygen plotted against age.

(Table 1). During the first half-hour nine counts were made averaging 28.2 respiration cycles per minute. This rate was higher than any subsequent counts, owing probably to the recent handling of the animal. After the lapse of a further hour eight counts were made. These averaged 23.6 respirations per minute, the lowest individual count being 20.

A stream of mixed gases containing 4.9 per cent. carbon dioxide, 15.6 per cent. oxygen and 79.5 per cent. nitrogen was then passed over the animal. During the next 78 minutes respiration counts were made on 18 occasions. At the 13th and 40th minute gas samples were withdrawn from the cage and analysed. The first sample contained 4.0 per cent. carbon dioxide and 16.65 per cent. oxygen, and the second 4.66 per cent. and 16.0 per cent. During the 78 minutes of observations the respiration rate averaged 22.1, the lowest count being 18.5. It seems clear that these concentrations of carbon dioxide did not cause any significant change in the respiration rate.

No data are available on the amount of ventilation of the lungs, as the depth of respiration was not measured. No difference could be detected by observation.

It is apparent that possum pouch young are normally exposed to relatively high concentrations of carbon dioxide in the pouch. No physiological explanation of the necessary adaptations of the respiratory mechanism is offered, but this seems a fruitful field for further research.

TABLE I
RESPIRATION RATE OF ADULT FEMALE BRUSH-TAILED POSSUM IN AIR AND
IN A GAS MIXTURE

Air		Gas Mixture	
Time from Start (min)	Respirations per Minute	Time from Start (min)	Respirations per Minute
4	30	1	25
7	30	5	24
9	28	7	23
12	29	9	24
14	28	11	23.5
19	27	15	22.5
23	29	22	21.5
26	27	25	22.5
30	26	27	23.5
		35	23
90	24.5	37	23
93	24	38	23
95	20	47	19
98	25.5	49	18.5
102	25		
105	25.5	70	20
109	20.5	72	20
112	23	75	21
		78	20

References

- DUNNET, G. M. (1956).—A live-trapping study of the brush-tailed possum, *Trichosurus vulpecula* Kerr (Marsupialia). *C.S.I.R.O. Wildl. Res.* **1**: 1-16.
- REYNOLDS, H. C. (1952).—Studies on reproduction in the opossum (*Didelphis virginiana* Kerr). *Univ. Calif. Publ. Zool.* **52**: 223-84.