XCVI. A NOTE ON THE VITAMIN D CONTENT OF THE STOMACH OIL OF THE AUSTRALASIAN PETREL (*AESTRALATA LESSONI*).

BY JOAN LEIGH LEIGH-CLARE.

From the Department of Experimental Pathology, Lister Institute, London.

(Received May 2nd, 1927.)

THE Australasian petrel (*Australata lessoni*), or mutton bird, flies North from the antarctic regions during the summer months, to the islands of the South Pacific, where mating and breeding take place. Here its staple diet consists of "whale-feed," vast shoals of which are met with throughout the temperate seas of the southern hemisphere.

This "whale-feed," according to G. M. and G. S. Thomson [1923] consists largely of a bright red shrimp, which is a swimming stage in the life-history of the crustacean *Munida gregaria*. Carter and Malcolm [1926] state that this crustacean is also the principal food of the Australasian red cod at this time of the year.

Mutton bird oil is obtained from the stomach of the young petrel, and is commonly believed to be supplied to the young from the stomachs of the parent birds. It is stated by Carter [1921] to consist for the most part of cetyl oleate and other esters of cetyl alcohol. As, however, Carter and Malcolm [1926] found no trace of cetyl alcohol in the oil extracted from "whale-feed," it is obvious that mutton bird oil is not the fatty residue from the digestion of the latter. Its origin is mysterious. Rosenheim and Webster [1927] suggest that it is a special secretion used for oiling the feathers by the agency of the bird's beak. Comparative growth tests have been made on this oil and cod-liver oil by Malcolm [1926] who pronounced it to be "one of the richest known natural sources of vitamin A."

Rosenheim and Webster [1927], however, point out that this statement requires modification, since in his animal tests Malcolm did not give a constant supply of vitamin D. The above-named workers were unable to obtain a supply of mutton bird oil. They therefore examined the stomach oil of the fulmar petrel (*Fulmarus glacialis*) which breeds in enormous numbers in St Kilda, and which corresponds most closely to the antarctic mutton bird. They found that when a constant supply of vitamin D was given throughout the experiment, the vitamin A content was no better than that of a good Newfoundland cod-liver oil.

These workers also demonstrated the presence of vitamin D in the stomach oil of the fulmar petrel, and found that "a dose of 20 mg. gave partial protection, whilst 40 mg. completely protected the animals against rickets."

By the kindness of the African Industries Trade Service, some mutton bird oil was obtained for the following experiments.

Two litters of rats were used. No. 1 was a litter of six white rats weighing 39–50 g., and No. 2 a litter of twelve black-and-white rats, weighing 36–46 g. at the beginning of the experiment. The basal diet given was McCollum's No. 3143 low phosphorus, rickets-producing diet. The doses of mutton bird oil were given daily from the start of the experiment. A series of control animals receiving various doses of a good cod-liver oil was included in order to provide a positive control for the experiment. As will be seen from the table, the doses were given in multiples of five, starting from a daily dose of 0.2 mg. of the petrel oil and culminating in a dose of 120 mg.

Litter No. 2 was killed at the end of 23 days and litter No. 1 at the end of 24 days. To test the condition of the skeletons of the rats, the junctions of the 6th and 7th ribs on the right side were examined histologically, and chemical analyses were made of the leg-bones (femora, tibiae and fibulae). The methods used are described in full in the paper by Chick, Korenchevsky and Roscoe [1926].

In comparing the effect of the two oils, both the chemical and histological analyses indicate that petrel stomach oil has a vitamin D value equal to about 1/5 of that of the cod-liver oil. Doses of the former of 5, 25 and 120 mg. afforded respectively about the same degree of protection as 1, 5 and 25 mg. of the latter. For the rats receiving the above three doses of petrel oil the average value of the A/R ratio (ratio of the mineral ash to the organic matter in the fat-extracted bones) was 0.64, 0.74 and 0.92 respectively; for rats receiving the above-stated cod-liver oil doses, it was 0.59, 0.81 and 0.93. Similarly, the mean values of the percentage of ash contained in the fat-extracted dry bone were 39.1 and 43.8 for animals receiving respectively daily doses of 5 and 25 mg. petrel oil and 39.6 and 44.6 for those receiving cod-liver oil in doses of 1 and 5 mg. respectively (see table).

Rat	Litter	Sex	Oil	Dose (mg.)	A/R	Average	% ash in fat-extracted dry bones	Degree of rickets, from histology of rib junctions
31	1	♀	Petrel	0.2	0.474	0.50	31.75	Severe rickets
37	2	♀	"	0.2	0.632		38.74	
33	1	♀	"	1.0	0.461	0.45	31.55	Severe rickets
39	2	♀	"	1.0	0.443		35.77	
40	2	♂	"	1.0	0.448		38.94	
34	1	♀	"	5.0	0.639	0.64	38.99	Severe rickets
43	2	♀	"	5.0	0.647		39.28	
35	1	♂	"	25.0	0.548	0.74	40.84	Severe rickets
44	2	♀	"	25.0	0.801		44.48	
47	2	♂	"	25.0	0.858	0.92	46.17	Osteoporosis only
48	2	♀	"	120.0	0.920		47.91	
32	1	♀	Cod	1.0	0.535	0.59	34.84	Severe rickets
38	2	♀	"	1.0	0.750		42.86	
41	2	♂	"	1.0	0.486		41.18	
42	2	♀	"	5.0	0.806	0.81	44.62	Slight rickets and osteoporosis
36	1	♂	"	25.0	0.962	0.93	49.03	Osteoporosis only
45	2	♀	"	25.0	0.932		48.23	
46	2	♂	"	25.0	0.904		47.47	

The histology of the rib junctions of animals receiving 5 mg. of petrel oil or 1 mg. of cod-liver oil showed decided rickets. This condition was much modified when the daily doses of the oils were increased to 25 mg. of petrel and 5 mg. of cod-liver oil respectively, and where the daily ration was further increased to 120 mg. of petrel or 25 mg. of cod-liver oil, osteoporosis only was seen.

SUMMARY AND CONCLUSIONS.

The presence of vitamin D in amount equal to about 1/5 of that present in a good cod-liver oil, has been demonstrated in the stomach oil of the Australasian mutton bird (*Australata lessoni*).

How the vitamin D came into the stomach oil is unknown. This oil appears to consist mostly of cetyl esters and therefore not to be the undigested fatty residue from the "whale-feed." However, the fact that the mutton bird feeds on the same crustacean ("whale-feed") as the Australian red cod, seems to suggest that this might be the common source from which both bird and fish draw their supplies of vitamin D.

My thanks are due to Prof. C. J. Martin, Dr Chick and Prof. Korenchevsky, for their kind help and criticism, to the African Industries Trade Service for the sample of petrel oil used in the experiments, to the Medical Research Council for a whole time grant and to the Lister Institute for the hospitality of its laboratories.

REFERENCES.

- Carter (1921). *J. Soc. Chem. Ind.* **40**, 2201.
Carter and Malcolm (1926). *Trans. N. Zealand Inst.* **56**, 647.
Chick, Korenchevsky and Roscoe (1926). *Biochem. J.* **20**, 622.
Malcolm (1926). *Trans. N. Zealand Inst.* **56**, 650.
Rosenheim and Webster (1927). *Biochem. J.* **21**, 111.
Thomson, G. M. and G. S. (1923). *N. Zealand J. Sci. Tech.* **16**, 111.