

VERTICAL DISTRIBUTION OF VITAMIN B₁₂ IN THE SEA

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A considerable seasonal variation in the vitamin B₁₂ concentration in oceanic surface water has been demonstrated by Cowey (1956).

The present investigation was undertaken to examine any variation with depth.

The samples were taken in the Bay of Biscay during cruises of the R.V. 'Sarsia' in May and June 1956 and May 1957. Stations sampled were:

Station A:	47° 30' N.,	7° 18' W.
Station C:	46° 30' N.,	8° 00' W.
Station 15:	48° 25' N.,	9° 57' W.
Station 16:	48° 24' N.,	10° 00' W.
Station 17:	48° 24' N.,	9° 53' W.
Station 19:	47° 47' N.,	9° 18' W.

The water was collected in a Nansen Pettersson bottle and in Nansen reversing bottles, then filtered through Whatman No. 3 filter-paper, preserved and assayed by the *Euglena* method as already described (Daisley, 1958). The 1956 samples were assayed twice each and the mean values are given in Table 1; the 1957 samples were assayed once only.

In addition, some of the 1956 samples, which were larger (but consequently fewer) than the 1957 samples, were also assayed by the Cowey (1956) procedure as a check on the accuracy of the *Euglena* method.

The results are given in Table 1. For the depth calculations and oxygen measurements we are indebted to Dr L. H. N. Cooper and Mr F. A. J. Armstrong of the Plymouth Marine Laboratory. They calculated the oxygen saturation values by reference to the tables of Truesdale, Downing & Lowden (1955).

The 1956 results indicated an inverse relationship between the vitamin B₁₂ concentration and the oxygen concentration, suggesting that perhaps the vitamin was being synthesized in association with respiratory activity by organisms in these waters. The more detailed 1957 survey showed, however, that although the vitamin B₁₂ concentration is in general highest at intermediate depths (*ca.* 200-2000 m) and the oxygen concentration reaches its minimum values within this region, the inverse relationship between them is not a close one.

* Grant-aided by the Development Fund.

TABLE 1. VERTICAL DISTRIBUTION OF VITAMIN B₁₂ IN THE SEA

Date station and sounding	Depth (to nearest 10 m) (m)	Oxygen concentration (ml./l.)	Oxygen saturation (%)	Vitamin B ₁₂	
				Daisley's method (<i>E. gracilis</i> z) (mµg/l.)	Cowey's method (<i>Lb. leich- mannii</i>) (mµg/l.)
28 May 1956 C 4710 m	100	5.74	97.4	0.8	0.7
	500	4.92	81.9	2.1	—
	880	4.20	68.8	2.2	—
	990	4.40	71.3	4.6	4.2
	2110	5.51	77.1	3.0	—
29 May 1956 C 4710 m	0	—	—	0.6	—
20 June 1956 A 1260 m	20	6.44	113.4	0.6	0.4
22 June 1956 C 4710 m	4040	4.82	65.0	0.5	0.5
23 June 1956 A 1260 m	600	—	—	2.5	1.7
	1190	4.52	71.1	1.1	1.5
5 May 1957 15 590 m	220	5.76	97.0	0.3	—
	310	5.61	94.3	1.9	—
	400	5.31	88.8	1.9	—
	490	5.15	85.8	1.9	—
	580	4.93	81.5	1.7	—
5 May 1957 16 2620 m	1270	4.93	74.9	1.0	—
	1360	5.03	75.2	2.6	—
	1450	5.20	76.9	5.0	—
	1540	5.31	78.1	5.0	—
	1630	5.09	—	2.0	—
5 May 1957 17 2100 m	400	5.41	90.6	1.5	—
	490	5.05	83.9	1.7	—
	590	4.82	78.6	3.8	—
	690	4.83	78.7	3.5	—
	790	4.81	78.0	2.8	—
	860	4.48	72.7	2.4	—
	950	4.55	72.9	2.3	—
	1050	4.61	73.4	1.6	—
	1140	4.72	74.2	1.0	—
	1240	4.90	75.3	1.6	—
6 May 1957 19 3900 m	0	—	—	0.3	—
	190	5.72	96.5	2.0	—
	370	5.22	87.1	4.0	—
	560	4.82	80.1	1.6	—
	770	4.47	—	0.2	—
	970	4.26	68.5	1.5	—
	1170	4.61	71.4	3.9	—
	1560	5.77	82.4	1.6	—
	1980	5.74	80.3	1.0	—
	2980	5.44	74.3	0.8	—
	3580	5.38	72.7	—	—
3600	5.26	71.1	0.4	—	

Dr Cooper intends to publish later other hydrographic data relating to this sampling programme; these other data do not, however, display any correlations with the pattern of vitamin B₁₂ distribution.

No samples, even those from the greatest depths, were entirely lacking in vitamin B₁₂; the possibility must be considered, however, that the small amounts of vitamin B₁₂ recorded in the deepest samples may derive from adsorptive contamination of the bottles as they passed down through the vitamin-rich regions. A means of avoiding any such possible source of experimental error will be sought.

When this present work was completed, we found a recent report of a survey of vitamin B₁₂ concentration in the sea near Japan; here also a considerable variation with depth had been found, but no samples were from below 1200 m (Kashiwada, Kakimoto, Morita, Kanazawa & Kawagoe, 1957).

No conclusion can as yet be drawn regarding the cause of the variation in vitamin B₁₂ concentration; possible contributory factors may be water movements, bacterial activity, consumption of the vitamin by the inhabitants of the illuminated zone and sinking of such organisms and their disintegration at lower levels.

We are grateful to the Director and staff of the Marine Biological Association for facilities and advice and especially to Dr L. H. N. Cooper and Mr F. A. J. Armstrong for their help in the collection of samples and for the provision of hydrographic data.

SUMMARY

Sea-water samples were taken from various depths in the Bay of Biscay in May and June of 1956 and 1957.

Low vitamin B₁₂ concentrations were found in the upper illuminated zone and in the greatest depths (mean value for seven samples, 0.57 mμg/l.; standard deviation 0.19 mμg/l.), whereas at intermediate depths (190–2110 metres) the values were generally higher, up to 5.0 mμg/l. in two instances (mean value for 34 samples, 2.26 mμg/l.; standard deviation 1.22 mμg/l.).

Evidently there exists a considerable variation with depth of the vitamin B₁₂ concentration in the sea region sampled at this season. It remains for further research to show what causes this vertical variation to exist, and what influence, if any, it has on life in these waters.

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SUMMARY

Sea-water samples were taken from various depths in the Bay of Biscay in May and June of 1956 and 1957. Low vitamin B₁₂ concentrations were found in the upper illuminated zone and in the greatest depths. Mean values for these samples, 0.77 and 1.1 standard deviation 0.19 mg/l., whereas at intermediate depths (100-1100 metres) the values were generally higher up to 7.0 mg/l. in two instances (mean value for 24 samples 2.10 mg/l.; standard deviation 1.13 mg/l.).

Evidence is given that a considerable variation with depth of the vitamin B₁₂ concentration in the sea region sampled at this season. It remains for further research to show what causes this vertical variation to arise, and whether, if not, it has an effect on life in these waters.