PHOSPHORUS CONCENTRATION DURING RED-WATER PHENOMENON IN THE NEAR SHORE WATERS OF PORTO NOVO (S. INDIA)

AN interesting feature of phytoplankton which is of much significance in the economy of the sea is the appearance of "blooms". The blooming of the alga *Trichodesmium erythræum* (Ehr.), which has a red colouring matter as well as green causes the so-called red-water phenomenon. Similar coloured plants of various other species may also bloom suddenly and give rise to "red-water phenomenon".

The red-water phenomenon has been reported from several seas and is often associated with mass mortality of fish and other marine organisms. In Indian waters the occurrence of this phenomenon due to *Trichodesmium* has been observed chiefly on the west coast and Gulf of Mannar. Chidambaram *et al.* (1944)[3] observed the active swarming of *Trichodesmium erythræum* (Ehr.) in Pamban area. Chacko and Mahadevan (1956)[2] reported the occurrence of red-water bloom of *Trichodesmium erythræum* (Ehr.) in the Gulf of Mannar during the months of April, May, July, October and November. According to Chacko these blooms lasted for 3 to 7 days and were accompanied by heavy mortality of some marine animals. Chacko (1942)[1] also reported mass mortality in a fish pond near Krusadai Island due to *Trichodesmium erythræum* (Ehr.). On the west coast of India, in Cochin, Prakash and Sarma (1964)[5] reported red water during November 1963. Prabhu and Ramamurthy (1965)[6] recorded swarming of *Trichodesmium* during March 1965 on the Mangalore coast.

We have so far no precise analysis of the casual factors whose interplay might result in the red-water phenomenon These blooms depend evidently on the simultaneous presence of several factors, of which an abundant supply of nutrients is one. None of the authors mentioned above studied the changes in the concentration of any of the nutrients during the *Trichodesmium* bloom. On the Florida coast, during the red-water phenomena, due to the bloom of *Gymnodinium*, the total phosporus content of sea-water was found to increase from 2½ to 10 times the maximum normally expected in sea-water (Ketchum and Keen, 1948).[4]

The present note records the occurrence of red-water phenomenon in Porto Novo waters resulting from a bloom of a *Trichodesmium*, which lasted for eleven days, from 7th March to 19th March 1965. The bloom was very striking. It stretched for about 6 metres in width and extended for about 12 miles in length in the 7 to 10 fathoms line. No mortality of fish or other organisms was associated with this bloom. The changes in the total phosphate and inorganic phosphate in sea-water during the bloom are shown in Table I.

TABLE I

Date in March 1965	Total P μ gm. at p/l.	Inorganic P μgm. at p/l.	*Trichodesmium* cells per ml.	Settling volume of plankton in c.c.	Salinity S‰	Temperature °C.
3	0·7	0·4	Traces	..	33·32	23·10
4	0·8	0·2	,,	..	33·05	24·31
5	1·0	0·2	,,	..	33·41	23·95
7	1·5	Nil	192	125	33·75	24·51
8	6·4	Nil	215	170	33·60	24·48
9	11·4	Nil	346	250	33·45	24·60
10	11·5	Nil	412	270	33·81	24·67
11	10·8	Nil	396	220	33·92	24·59
12	9·7	Nil	358	185	33·68	24·53
14	8·4	Nil	321	145	33·52	24·74
16	7·1	Nil	297	130	33·45	24·72
17	4·5	Nil	262	115	33·27	24·68
19	1·4	0·3	Traces	..	33·48	24·22
20	1·2	0·3	,,	..	33·50	23·85
21	0·8	0·35	,,	..	33·50	23·80

It will be observed that, from 3rd March to 5th March, when only traces of *Trichodesmium* were present, the inorganic phosphate in sea-water declined from 0·4 to 0·2 μgm. at p/l. and the total phosphate increased gradually. Subsequently, with a rapid increase in *Trichodesmium* population the inorganic phosphate disappeared and the total phosphate in sea-water showed a corresponding increase. The bloom disappeared after 17th March, only traces of *Trichodesmium* cells being present. With the disappearance of bloom, the total phosphate in sea-water declined considerably and inorganic phosphate appeared.

During the peak period of the bloom, inorganic phosphate was entirely absent in the sea-water. As the total phosphate increased the inorganic declined and disappeared, when the total phosphate declined later the inorganic phosphate reappeared. It may not be unreasonable to infer that the appearance of the bloom has involved the utilization of inorganic phosphate and its conversion to organic form. The reappearance of inorganic phosphate with the disappearance of the bloom may be due to non-utilization of organic phosphate.

We may consider whether a terrigenous contamination could have contributed to this *Trichodesmium* bloom. During the bloom the

salinity of the water remained constant and there was no evidence of the dilution of the sea-water due to fresh-water drainage from land. The possibility of water-borne contamination from land sources being the cause of increase in total phosphate must therefore be excluded.

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A RARE RECORD OF *LETHACOTYLE* (MONOGENEA), ITS POST-ONCOMIRACIDIAL LARVA WITH OBSERVATION ON DISTRIBUTION

A COLLECTION of marine fishes from Andamans, obtained in February to March 1961, were examined for their parasites and from a single *Caranx sexfasciatus* (total length 15·5 cm.) available in that collection, one monogenetic trematode belonging to *Lethacotyle* Manter and Prince,[1] a post-oncomiracidial larva of *Lethacotyle* and fifteen monogenetic trematodes belonging to *Cemocotylella* Price[2] were collected.

There is so far no record of *Lethacotyle* since its first description by Manter and Prince[1] from Fiji in 1953. In view of the absence of clamps in it, Hargis[3] considered this feature as reported by Manter and Prince,[1] though possible, is so unusual that further observations are necessary to confirm this condition. Since the present one is the second record of *Lethacotyle* and it confirms the observation of Manter and Prince, it is of interest to report on the occurrence of the genus.

There is so far no record of the larva of *Lethacotyle* or of its related genera belonging to the family Protomicrocotylidæ (Llewellyn[4] and the post-oncomiracidial larva reported here is the first record to be known in the family.

Lethacotyle recorded from Andamans differs from the one described by Manter and Prince[1] in that the posterior lobed portion of the body being on the left and the distal portion of the vagina on the right side of the worm. These and other differences observed will be included in a redescription of *Lethacotyle* to be published together with the larva elsewhere.

The record of *Lethacotyle* from Andamans is of interest from the point of geographical distribution. Monogenea have direct life-cycle and show high specificity so that it might be expected of them to show the same distribution as their hosts (Dawes[5]; Manter[6]). Though *Caranx sexfasciatus* and its related hosts occur along the coasts of peninsular India, they have yielded monogenea other than *Lethacotyle* (Chauhan[7,8]; Ramalingam[9-11]; Tripathi[12] Unnithan[13-15]).

An intensive examination of *C. sexfasciatus* (total length ranging from 5·2 cm. to 26·5 cm.) netted from inshore and offshore waters around Mandapam over a two-year period did not yield *Lethacotyle*, but yielded *Cemocotylella*. The data obtained from the studies on carangid fishes at Madras show results similar to that obtained at Mandapam with the difference that *Cemocotylella* was found on *C. atropus* and was recorded only once.

Although *Lethacotyle* occurs along with *Cemocotylella* in the same host, the former is confined to fishes from Andamans whereas the latter is more widely distributed and has been recorded from Mandapam and Madras. Thus from the point of distribution, *Lethacotyle* shows a discontinuity. Such discontinuity in distribution is seen even in more successful digenetic trematodes of marine fishes like *Derogenes varicus*. Though this species has been recorded from well over 50 species of fishes all over the world, yet it has not been recorded from fishes of the coast of North Carolina and is absent from surface-water fishes of Tortugas (Dawes[5]). The significance of the restriction of *Lethacotyle* is not clear although it is suggestive that they are more susceptible to unfavourable conditions of the environment than *Cemocotylella*. That this may be so is supported by the observation of Manter,[16] who considers that temperature may be a factor responsible for the discontinuous distribution of *Derogenes varicus* as it may have an effect on the intermediate host or hosts. It is possible that factors such as temperature may operate directly to a greater extent on monogenea than