graph pen recorder using an isometric myograph attached by a fine thread to a longitudinal tracheal trunk. The recordings suggest that the maximum number of such pulsatile movements is 22 to 25 per minute (Fig. 1) in an individual taken out of water

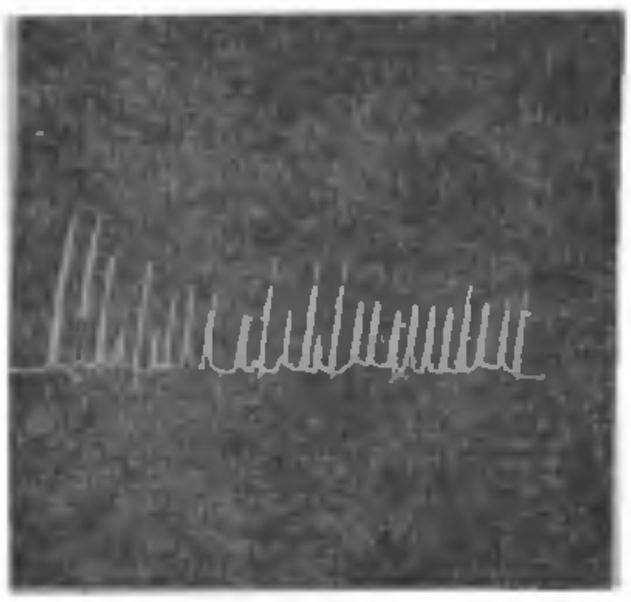

FIG. 1. An extract from a recording of the tracheal pulsations of *Mixophilus indicus* The time for the recording shown in the figure is one minute.

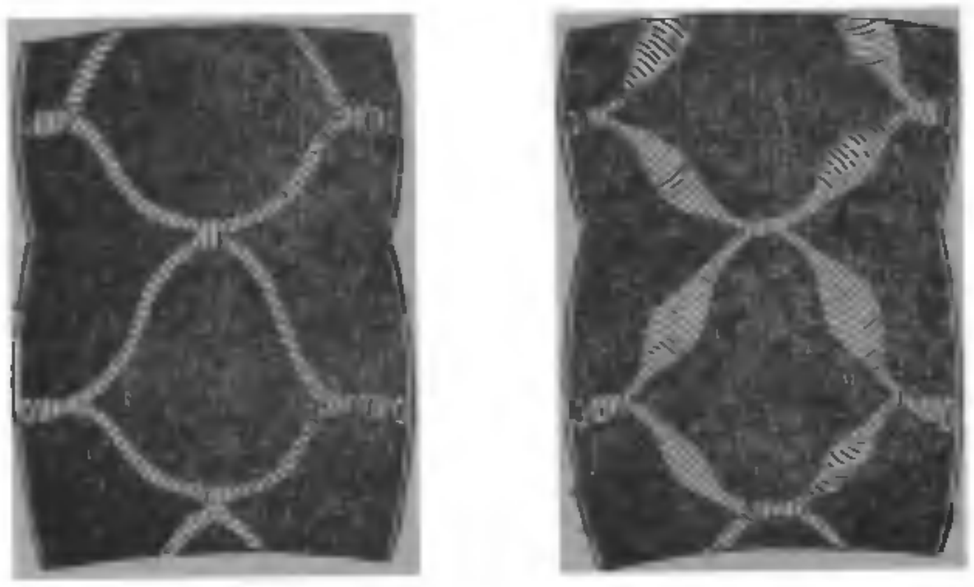

FIG. 2. Tracheal trunks in two segments of the centipedes (semi-diagrammatic). A, *Himantarium samuelraji*; B, *Mixophilus indicus*.

after submergence for a period of 3 days. If the period of immersion in water is shortened, the rate of pulsatile movements of the tracheal trunks is also lowered. During normal respiration in an individual which is not previously subjected to submergence in water, the rate of tracheal pulsation is only 3 to 5 per minute.

An attempt was made to find out whether such tracheal pulsations are of common occurrence in typical terrestrial centipedes also. For this purpose, a number of alive geophilid centipedes of the species *Himantarium samuelraji*, collected from Alagar Koil forest region, were dissected and their tracheal trunks examined as described above. In none of the 10 centipedes examined were the tracheal pulsations observed.

Another feature discovered was that the longitudinal tracheal trunks in the two centipedes show structural differences. In *Mixophilus indicus* the middle regions of the longitudinal trunks are much swollen resembling the air-sacs found in locusts.[5] But in *Himantariuum samuelraji* all the tracheal trunks are narrow tubes of uniform diameter (Fig. 2). It is suggested, therefore, that the presence of swollen longitudinal tracheal trunks capable of contraction and expansion in *Mixophilus indicus* may be a feature of adaptation in relation to its semi-aquatic mode of life.

A search in the literature for a precedent discloses that a comparable phenomenon was seen by Babak[6] in mosquito larvæ.

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Madras, *February* 20, 1970.

1. Plateau, F., *Arch. Sci. Phys. et Nat.*, 1894, **25**, 132.
2. Sundara Rajulu, G., *Proc. Symp. Est. Biol.*, 1969, p. **1**.
3. Chalande, M. J., *Bull. Soc. Hist. Nat.*, 1887, **20**, 13.
4. Sundara Rajulu, G., *J. Anim. Morph. Physiol.*, 1966, **13**, 114.
5. McCutcheon, F. H., *Ann. Ent. Soc. Amer.*, 1940, **33**, 35.
6. Babak, E., *Int. Rev. Hydrobiol.*, 1912, **5**, 89.

ON THE OCCURRENCE AND DISTRIBUTION OF PHOSPHOBACTERIA IN THE MARINE ENVIRONMENT AT PORTO NOVO

IT is well known that the majority of the phosphates in soil are present as insoluble organic and inorganic phosphates. The phosphorus-cycle in inland natural waters and bottom deposits is known to be a limiting factor in organic production.

Cooper[1] has shown that in the marine environment phosphate liberation from plankton occurred and suggested that this might be brought about by bacteria capable of dissolving phosphate from phosphorus-containing substance in solution. He did not, however, isolate and culture these organisms.

Several reports are available on the role of phosphobacteria in soil.[2,3] But no such work is available for the marine environment either in temperate or tropical regions. The present note reports the definite occurrence

and distribution of phosphobacteria in the marine environment.

The samples were taken from four different zones in the marine environment as shown in Table I. They were taken in sterile glass

TABLE I

Sl. No.	Sample	Locality	Depth	Bacterial population (10^6)	
				Total	Phospho-bacteria
1	Water	Interstitial Open sandy beach	95 cm.	6·53/L	4·96/L
2	Water	Estuary	Surface	6·86/L	5·72/L
3	Water	Neritic	Surface	5·96/L	5·20/L
4	Mud	Sea	10 fathom	7·66/g.	6·96/g.

bottles. Serial dilutions were prepared and plated on special soil-extract apatite agar[4] (the medium containing precipitated calcium phosphate). The media were prepared in sea-water with appropriate salinity. The plates were incubated at room temperature (24 ± 2° C.) for 3 days and observed. Clear solubilization zones around phosphobacteria colonies were seen in all the samples (Fig. 1). The

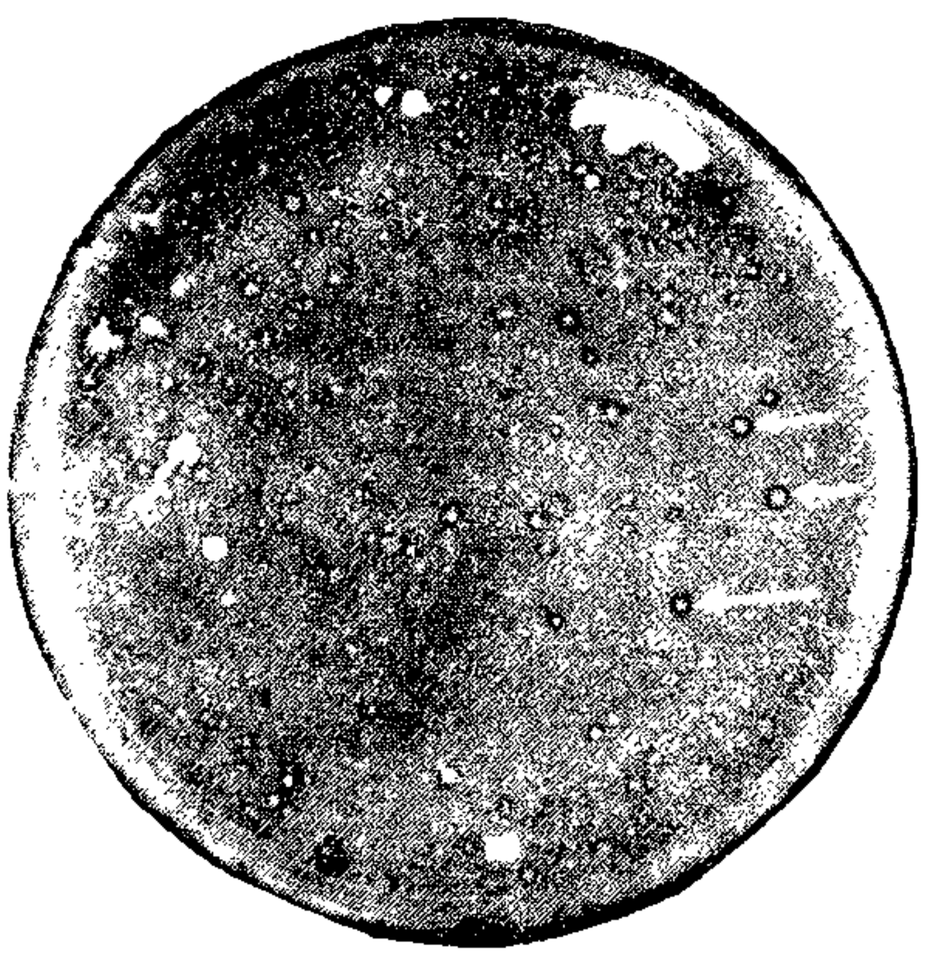

FIG. 1. Phosphobacteria in the interstitial waters. Arrows indicate the phosphobacterial colonies with clear surrounding solubilization zones.

total and phosphate solubilizing colonies were counted and their population was estimated.

From all the four samples, seven morphologically different phosphobacteria were isolated and purified. Five of them can be grouped under *Bacillus* spp. and the remaining two isolates are gram-negative, non-motile, non-spore-forming rods. It is interesting to note that the interstitial water harboured as many as five different groups. The estuarine water and neritic waters and the mud at 10 fathom line showed only three and two groups respectively. The different isolates varied in the degree of their ability to solubilize the inorganic insoluble phosphate as indicated by the clear solubilization zones. In general, *Bacillus* spp. were found to be more potent in their activity than the two gram-negative isolates. The effect of isolates from the neritic waters and the mud at 10 fathom was relatively higher than that of the estuarine and interstitial waters.

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D. CHANDRAMOHAN.

1. Cooper, L. H. N., *J. Mar. Biol. Ass. U. K.*, 1935 *b*, **20**, 197.
2. Sen, A., *Curr. Sci.*, 1957, **26**, 222.
3. Katznelson, H. and Bose, B., *Canad. J. Microbiol.*, 1959, **5**, 79.
4. Sperber, J. L., *Aust. J. Agr. Res.*, 1958, **9**, 777.

PARTIAL LIFE-CYCLE OF A PHYSALOPTERID NEMATODE PARASITIC IN THE STOMACH OF CARNIVORES

NUMEROUS species named under *Physaloptera* Rudolphi, 1819 have been grouped, on the number of uteri—whether two, three, four or many, into four subgenera.[19] Among the species with two uteri in female, *P. præputialis* von Linstow, 1889; *P. brevispiculum* von Linstow, 1906; *P. füelleborni* Mirza and Singh, 1934; and *P. rara* Hall and Wigdor, 1918 have been recorded in our dog, cat, and wild carnivores.[3,4,9,18] Recently, *P. vulpineus* Gupta and Pande, 1963 was described from *Vulpes bengalensis*.[9]

Because of their robust form and the blood-sucking feeding habits, *P. præputialis*, *P. felidis* Ackert, 1936 and *P.* spp. (Ehlers, 1931) are incriminated in ulceration and catarrhal gastritis which, in heavy infections in cat and badger, result in a marked loss of condition.[16]

In spite of their wide prevalence, information on life-cycles and the vectors is comparatively meagre though encysted larval forms have been reported from *Bufo stomaticus*[17]; bob white quail[6]; *Sciurus palmarum*[12]; ruffed grouse[5,6]; *Hemidactylus flaviviridis*[11]; an earwig,