

July 1970 could not be made. Further work is in progress.

1. Duursuma, E. K., "The dissolved organic constituents of sea-water," *Chemical Oceanography*, Riley and Skirrow (editors), Academic Press, London and New York, 1965, Chapter 11, p. 433.
2. Hood, D. W., *Chemical Oceanography, Oceanogra, Marine Biol. Ann. Rev.*, Harold Burnes (editor), George Allen & Unwin Ltd., London, 1963, 1, 129.
3. Skopintsev, B. A., *Organic Matter in Sea-Water, Preprints*, Inst. Oceanogra. Congr., Edited by M. Sears, Am. Assoc. Advance of Sci., Washington, 1959, p. 953.
4. Kay, H., "A micro method for the chemical determination of organic carbon in sea-water," *Kieler Meersforsch*, 1963, 10, 26.
5. Tatsumoto, M., Williams, W. T., Prescott, J. M. and Hood, D. W., 'Amino-acid in samples of surface sea-water,' *J. Mar. Res.*, 1961, 19, 89.
6. Belser, W. L., "Bioassay of organic micronutrients in the sea," *Proc. Natl. Acad. Sci. U.S.*, 1959, 45, 1535.
7. Hansen, O. H., Sutcliffe, W. H. Jr. and Sharp, J., "Measurement of deoxyribonucleic acid in the ocean and its ecological significance," *Limnology and Oceanography*, July 1918, 13 (3), 507.
8. Meun, H. C. and Smith, K. C., "A microphosphate method," *Anal. Biochem.*, 1968, 26, 364.
9. Chargraff, E. and Davidson, J. N., *The Nucleic Acid*, Academic Press, New York, 1955, 1.
10. Cantoni, G. L. and Davies, D. R., *Procedures in Nucleic Acid Research*, A Harper International edition, Harper & Rao, New York, 1967, p. 555.

ON SOME INTERSTITIAL FAUNA IN THE MARINE SANDS ON INDIAN COAST

G. CHANDRASEKHARA RAO

Zoological Survey of India, Calcutta-13

AMONG the various groups of interstitial fauna of marine sands, the ostracods are little known due to their meagre representation in the habitat. Likewise information on the psammophilous halacarid fauna is limited, except for the work carried out on European¹ and North American² coasts. The only report of the fauna on Indian coast is that by Chandrasekhara Rao and Ganapati³ on the beach sands of Waltair Coast. During various faunistic surveys undertaken by the Zoological Survey of India, the author had opportunity to study collections of the fauna from different areas on Indian coasts, including the Andamans. The present paper is concerned with two ostracods (Part I), and the salt-water mite *Halacarus anomalus* (Part II).

Part I. On the Occurrence of Two Interstitial Ostracods (Crustacea) on Indian Coast

Among the ostracods encountered, the occurrence of two European species on Indian coast is interesting and the following is a brief report on them.

Sub-order : Podocopa.

Family : Cytheridae.

Sub-family : Microcytherinae.

Genus : *Microcythere* Muller.

Microcythere subterranea Hartmann

Material.—1 ♂ + 3 ♀, Puri (Orissa), 16th December 1966; 1 ♀, Konarak (Orissa), 18th December 1966; 2 ♂ + 7 ♀, Waltair (Andhra), 16th November 1968; 3 ♂ + 8 ♀, Mayabunder (N. Andaman), 29th March 1969; 2 ♀, Cheriatapu (S. Andaman), 6th April 1969; 1 ♂ + 5 ♀, Car Nicobar, 13th March 1969 (all collected by G. C. Rao); 1 ♂, Mangalore (Mysore), 17th December 1966 (collected by A. N. P. Ummerkutty).

Remarks.—Hartmann⁴ described the species from the intertidal sands on French coast of the Mediterranean Sea. Later, Renaud-Debyser⁵ reported the species at Arcachon on the Atlantic coast. This species has now been recorded for the first time on the west coast and Andamans. The specimens collected on Indian coast agree fairly well with the description and figures given by Hartmann. The Indian forms measure 0.18-0.20 mm. in length and 0.06-0.07 mm. in width. The terminal segment of the antennule bears a modified seta, not reported in the type.

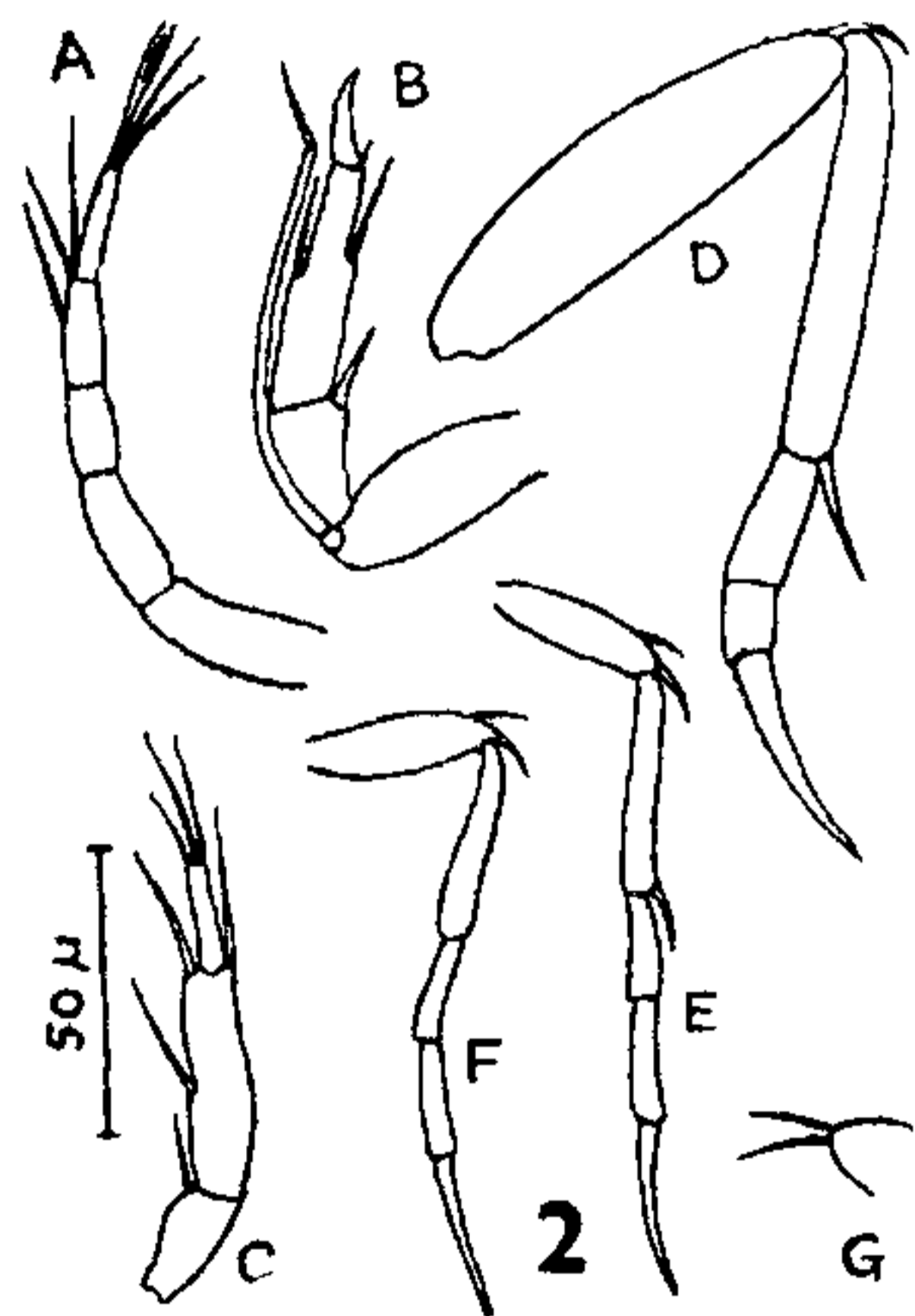
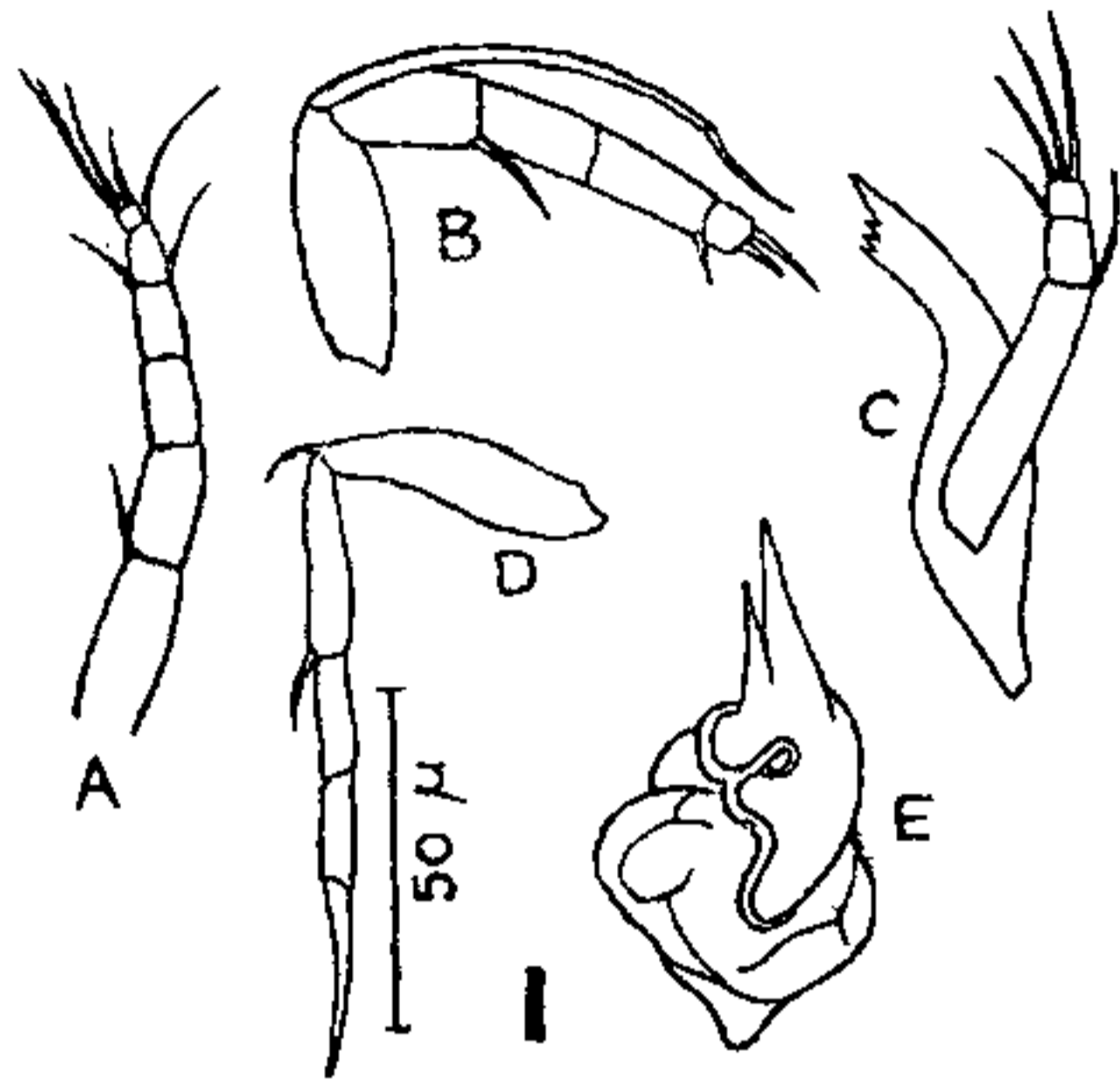
Sub-family : Loxoconchinae.

Genus : *Microloxoconcha* Hartmann.

Microloxoconcha compressa Hartmann

Material.—2 ♂ + 5 ♀, Waltair (Andhra), 16th November 1968; 2 ♂ + 7 ♀, Mayabunder

(N. Andaman), 29th March 1969; 3 ♀, Rangat Bay (M. Andaman), 24th March 1969; 2 ♂ + 6 ♀, Car Nicobar, 13th March 1969 (all collected by G. C. Rao); 4 ♀, Mangalore (Mysore), 17th December 1966 (collected by A. N. P. Ummerkutty).



FIGS. 1-2. Fig. 1. *Microcythere subterranea* Hartmann. A, Antennule; B, Antenna; C, Mandible; D, Walking leg; E, Penis. Fig. 2. *Microloxocncha compressa* Hartmann. A, Antennule; B, Antenna; C, Mandibular palp; D, First leg; E, Second leg; F, Third leg; G, Caudal furca.

Remarks.—Hartmann⁴ described this species also from the intertidal sands on French coast of the Mediterranean Sea. The ostracod, which was not reported later, has now been recorded for the first time on the west coast and Andamans. The present material is strikingly similar to the description and figures given by Hartmann. The Indian specimens measure 0.26-0.27 mm. in length and 0.10-0.11 mm. in width. Characteristic appendages of the species are shown in Fig. 2. A pointed tubercle on the

dorsal surface of the second segment of the mandibular palp, described for Mediterranean specimens, is not observed in the local forms.

Ecological Notes.—Although the present knowledge of the geographical distribution of interstitial Ostracoda is still incomplete due to lack of sufficient data from other parts of the world, the occurrence of the two European species on Indian coast throws considerable light on the ubiquitous nature of the fauna and shows their tolerance to diverse environmental factors. During the investigation on Waltair coast, it was found that both the species occur in the same biotope throughout the year in small numbers. In most of the beaches studied, the forms inhabit medium sands 5-40 cm. below surface near half-tide level. The texture of the sands ranged from 200 μ to 500 μ in mean diameter. The organic detritus appeared rich in some of the finer substrates. The temperature in the habitat varied from 24° C. to 29° C., while the salinity of interstitial water ranged between 24‰ and 33‰. The sands are associated with low values of dissolved oxygen compared with adjacent seawater.

Of the two species, *Microcythere subterranea* is smaller in size and perfectly adapted for life in minute interstices between sand grains. The species is agile and keeps always rapidly walking over the surfaces of sand grains. It is highly thigmotactic and firmly adheres to the substrate even to slightest disturbance in the habitat. The ostracods are omnivorous, feeding on fine particles of detritus, bacteria and smaller protozoans. The two species are often found to occur in company, as has been reported in the Mediterranean habitat also (see Hartmann⁴).

Part II. Occurrence of the Salt-Water Mite *Halacarus anomalus* Trouessart in the Intertidal Sands on Indian Coast

Halacaridæ or the salt-water mites form one of the constituent groups of marine interstitial community inhabiting intertidal sands. Of the species encountered, the mite *Halacarus anomalus* Trouessart (Fig. 3) was common in the collections, presenting some interesting features in its structure, habits and distribution.

Material.—1 ♂ + 13 ♀, Puri, 15th December 1966; 2 ♀, Konarak, 18th December 1966; 9 ♀, Waltair, 16th November 1968; 1 ♂ + 14 ♀, Mayabunder, 29th March 1969, 3 ♀,

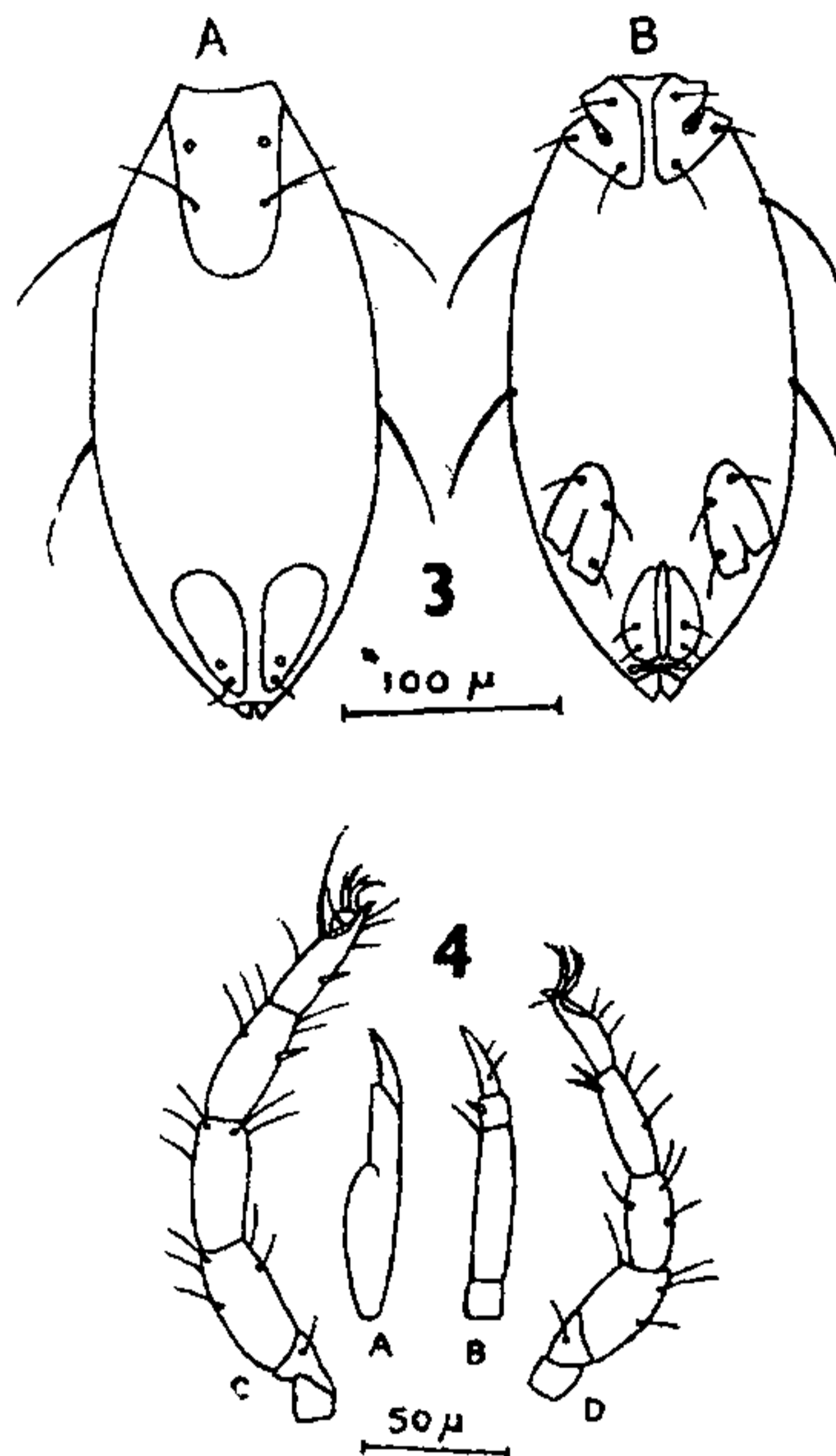
Rangat Bay, 24th March 1969; 3 ♀, Cheriatapu, 6th April 1969; 6 ♀, Car Nicobar, 11th March 1969 (all collected by G. C. Rao); 2 ♀, Coondapur, 31st December 1966 (collected by A. N. P. Ummerkutty).

Remarks.—Except for some minor variations, the specimens on Indian coast conform to the description of the species given by Andre.⁶ The European specimens are known to reach 600 μ in length including rostrum, while the Indian specimens are smaller measuring only 270–290 μ long to the base of capitulum. Ocular plates are absent. Each platelet of the posterodorsal plate is pierced by a pore and bears a seta. Each platelet of the anterior and posterior epimeral plates bears three setae. Genital plate is separate from anal plate and is divided into right and left halves, each bearing two setae. A narrow transverse sclerite separates the genital and anal plates. Measurements of the appendages are as follows (approx.): chelicera 96 μ , palp 108 μ , I leg 260 μ , II leg 186 μ , III leg 172 μ , IV leg 176 μ . Lateral claws of the legs bear an accessory tooth and are non-pectinate. The joints I_5 and I_8 bear a ventral spine each. I_6 bears unidentate median claw and two pairs of parambulacral setae. Bacillum and parabacillum are present on the inner aspect. II_5 has two pairs of pectinate ventral setae. II_6 has a prominent claw fossa and a pair of lateral parambulacral setae. Legs III–IV are similar to II (Fig. 4).

The present study has shown that the species is widely distributed throughout the year, occurring in moderate numbers. In most of the beaches investigated, the species showed preference for substrates with sufficient coarse particle size, ranging from 300 μ to 600 μ in mean diameter. The acarine colonises and thrives at all horizontal and vertical levels of the intertidal zone, indicating its adaptability to diverse physico-chemical conditions of the environment.

The majority of acarines have not shown any specialised modification for progression in interstices and simply crawl over the surface of sand grains with the help of legs. *Halacarus anomalus* is, however, modified in structure to adapt itself to life in minute interstices between sand grains. Its body is cylindrical and the legs are disposed at the extreme ends of body, enabling the mite to move through interstices in any direction with considerable ease.

The form is sluggish and thigmotactic, grasping sand grains when the capillary waters are in motion. The acarine is omnivorous, feeding on detritus, bacteria and other smaller organisms such as protozoans, nematodes, gastrotrichs, ostracods and copepods. The species is gregarious in habits and the occurrence of males to females is about 1:13.



FIGS. 3–4. Fig. 3. *Halacarus anomalus* Trouessart female. A, Body, dorsal view; B, Same, ventral view. Fig. 4. *Halacarus anomalus* Trouessart; A, Chelicera; B, Maxillary palp; C, First leg; D, Second leg.

This species has a wide geographical distribution and has been commonly reported on the coasts of Baltic, North Sea, Gulf of Gascogne, Mediterranean and the Atlantic coast of North America. The present records of the halacarid in India are made on the coasts of Orissa, Andhra, Mysore and the Andaman Archipelago. As more intensive surveys of the fauna are carried out at different parts of the world, it is possible that the zoogeographical range of the species will continue to change, revealing a cosmopolitan distribution.

The author is grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta,

for providing necessary facilities to carry out this work.

1. Delamare Deboutteville, C., *Biologie des eaux souterraines littorales et continentales*, Hermann, Paris, 1960, p. 740.
2. Newell, I. M., "A systematic and ecological study of the Halacaridæ of eastern North America," *Bull. Bingham Oceanogr. Coll.*, 1947, 10, 232.
3. Chandrasekhara Rao, G. and Ganapati, P. N., "The interstitial fauna inhabiting the beach sands of Waltair coast," *Proc. natn. Inst. Sci. India* 1968, 34 (2), 82.
4. Hartmann, G., "Ostracodes des eaux souterraines littorales de la Méditerranée et de Majorque," *Vie et Milieu*, 1954, 4 (2), 238.
5. Renaud Debyser, J., "Recherches écologiques sur la faune interstitielle des sables (Basin d'Arcacoon: île de Bimini, Bahamas)," *Ibid.*, 1963, Suppl. 15, p. 157.
6. Andre, M., "Halacariens marins," *Faune de France*, 1946, 46, 152.

ON THE FREE AMINO-ACIDS OF THE HAEMOLYMPH AND REGIONS OF THE ALIMENTARY CANAL OF *EYPREPOCNEMIS ALACRIS ALACRIS* (SERVILLE) (ORTHOPTERA : INSECTA)

M. C. MURALIDHARAN AND T. N. ANANTHAKRISHNAN
Entomology Research Unit, Loyola College, Madras-34

ABSTRACT

The distribution and the relative concentrations of the free amino-acids of the hæmolymph of the late instars and adult females under diverse physiological conditions as well as the free amino-acids of the various regions of the alimentary canal of the V instar and adult females of *Eyprepocnemis alacris alacris* (Serville) are discussed.

CONSIDERABLE information on the free amino-acids of the post-embryonic and adult stages of several insects is available^{4,7} although the free amino-acids of Acridids in particular appear to be confined to the hæmolymph of the nymphs of *Locusta migratoria*,⁶ *Schistocerca gregaria*,² *Anacridium ægyptium*¹ and *Acrida exaltata*.¹¹ Colombo *et al.*³ have also investigated the free amino-acids of the eggs during embryonic development of *Schistocerca gregaria*.

Information relating to the free amino-acids of the various regions of the alimentary canal appears to be lacking in the case of Acridids. Data presented here pertains to the qualitative studies on the distribution of the free amino-acids of the fore, mid and hindgut of the V instar and adult females of *Eyprepocnemis alacris alacris*, as also the free amino-acids of the hæmolymph of the IV, V instars and adult females under three different physiological conditions, *viz.*, females on the '0' day, *i.e.*, immediately after hatching to adult, mature females (12-15 days), as well as the starved females.

Samples of hæmolymph from the hind-femora and abdomen were collected on a Whatman No. 1 filter-paper, dried, kept for 24 hours in 90% ethanol and was concentrated before spotting. Regions of the fore, mid and hindgut,

removed after dissection in distilled water, were separately ground, centrifuged and stored after adding few drops of isopropyl alcohol. Trichloroacetic acid was added before centrifuging so as to precipitate the minor proteins, peptides, etc.

The extracts were spotted on Whatman No. 1 filter-paper and both two-dimensional and circular methods were employed, using in both cases the same solvent (*n*-butanol:acetic acid:water) in the ratio of 4:1:1. After a run of about 10-12 hours at room temperature, the paper was sprayed with 0.2% (W/V) ninhydrin. For the two-dimensional method, phenol:water solvent was also used in the ratio of 3:1. Chromatograms of standard amino-acids were also prepared for comparison and the results tabulated.

The free amino-acid patterns of the hæmolymph from the V instar onwards shows that lysine, histidine, serine, glycine, aspartic acid are present in appreciable concentrations, with a fall in concentration in the starved individuals. Serine has also been reported to be present in the hæmolymph of *Schistocerca gregaria* as in *Eyprepocnemis alacris alacris*, but has not been reported in *Locusta migratoria* and *Anacridium ægyptium*. On the '0' day, a decline in the concentrations of glutamic acid, threonine (absent in *Acrida exaltata*¹¹),