Agricultura Tropical, Cali-Columbia. Observations for nodulation and plant growth, recorded after eight weeks of growth, revealed effective nodulation and symbiosis with the two outside strains only (table 1).

Table 1 *Effect of Rhizobium phaseoli inoculation of Phaseolus var. French bean on the root nodulation and dry wt of shoot at the 8 week stage (mean of 10 pots, each containing 2 plants)*

Treatment	Number of nodules	Dry wt. of shoot (g)
Control-uninoculated	0.6	3.6
Rhizobium-VPKAS-Inoculated	0.7	4.1
Rhizobium CIAT 166-Inoculated	43.4	8.3
Rhizobium CIAT 255-Inoculated	12.0	5.0

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1. Verdcourt, B., *Kew Bull.*, 1970, **24**, 507.
2. Gaur, Y. D. and Sen, A. N., *New Phytol.*, 1979, **83**, 745.
3. Lange, R. T., In *Symbiosis* Vol. 1, *Association of Microorganisms Plants and Marine Organisms*, ed. S. M. Henry, Academic Press, New York, 1966, p. 99.

COPPER GRANULES IN THE HEPATOPANCREAS OF THE SNAIL, *CRYPTOZONA LIGULATA*

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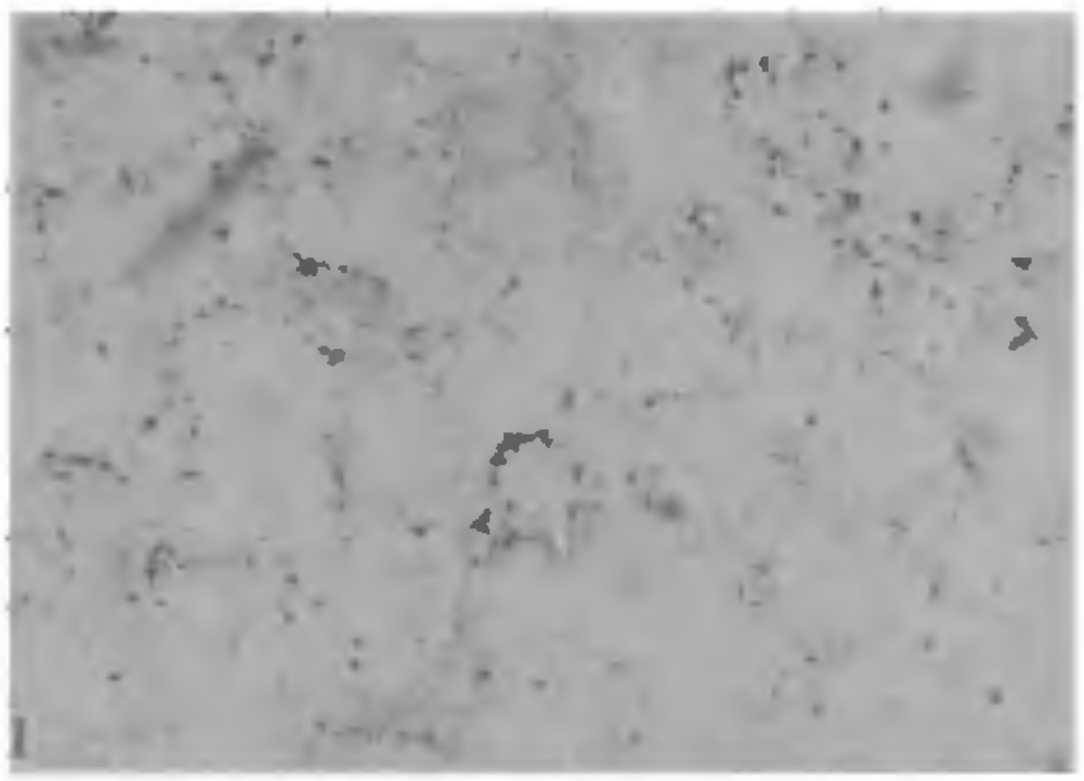
THE body fluids of molluscs consist of a copper containing respiratory protein called the haemocyanin[1,3]. The variation in the haemocyanin content in the blood during molt cycle and season has been reported in a number of Crustaceans[4,5]. The levels of copper in the blood of *C. ligulata* are reported earlier[1] and the present note relates to the influence of aestivation on the fate and the location of the granules of copper in the hepatopancreas of the snails.

The method employed for the quantitative estimation of copper in the hepatopancreas of active and four months aestivated snails was that of Barnes and Rothschild[6]. The histochemical localisation of copper in the hepatopancreas was followed by the method of Uzmann[7].

The copper content of the blood reflects the concentration of haemocyanin and it constitutes about 70% of the total blood proteins[1]. The copper levels in the hepatopancreas of active and aestivated snails are 310 $\pm$ 36 and 176 $\pm$ 30 μg/g dry wt of the tissue respectively and there is a significant decrease in the hepatopancreatic copper upon aestivation. The higher values of copper in the hepatopancreas as compared with the



Figures 1 & 2. Density of copper granules in the hepatopancreas of active (**1**) and aestivated (**2**) snails stained with rubeanic acid (× 60)

blood suggest that it accumulates and acts as a storage organ for copper.

The histochemical studies on the hepatopancreas of the Crustaceans revealed that the copper is stored in the form of pseudocrystals distributed all over the gland in an irregular fashion[5]. Whereas in C. *ligulata*, its pattern of distribution is uniform throughout the hepatopancreas (figures 1, 2). The concentration of copper granules in the hepatopancreas of aestivated snails is less than the active snails (figure 2) suggesting its mobilisation into the blood for the synthesis of haemocyanin. The physiological significance of the augmented synthesis of haemocyanin during aestivation such as the storage of oxygen and higher oxygen affinity has been shown in an earlier investigation[1].

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1. Krupanidhi, S., Reddy, V. V., Reddy, V. M. and Naidu, B. P., *Curr. Sci.*, 1977, **46**, 782.
2. Manwell, C., *Arch. Biochem. Biophys.*, 1960, **89**, 194.
3. Lontie, R. and Witters, R. In: *Inorganic biochemistry*, (ed.) G. L. Echiron, Elsevier, Amsterdam, 1973, Chap. 12, 343.
4. Zuckerkandl, E., *Ann. Inst. Oceanogr. Monaca, T.*, 1960, **38**, 1.
5. Djangmah, J. S. and Grove, D. J., *Comp. Biochem. Physiol.*, 1970, **32**, 733.
6. Barnes, H. and Rothschild, L., *J. Exp. Biol.*, 1950, **23**, 123.
7. Uzmann, L. L. C., *Lab. Invest.*, 1956, **5**, 299.

EUDORINA PLUSICOCCA G. M. SMITH— A NEW RECORD FOR INDIA

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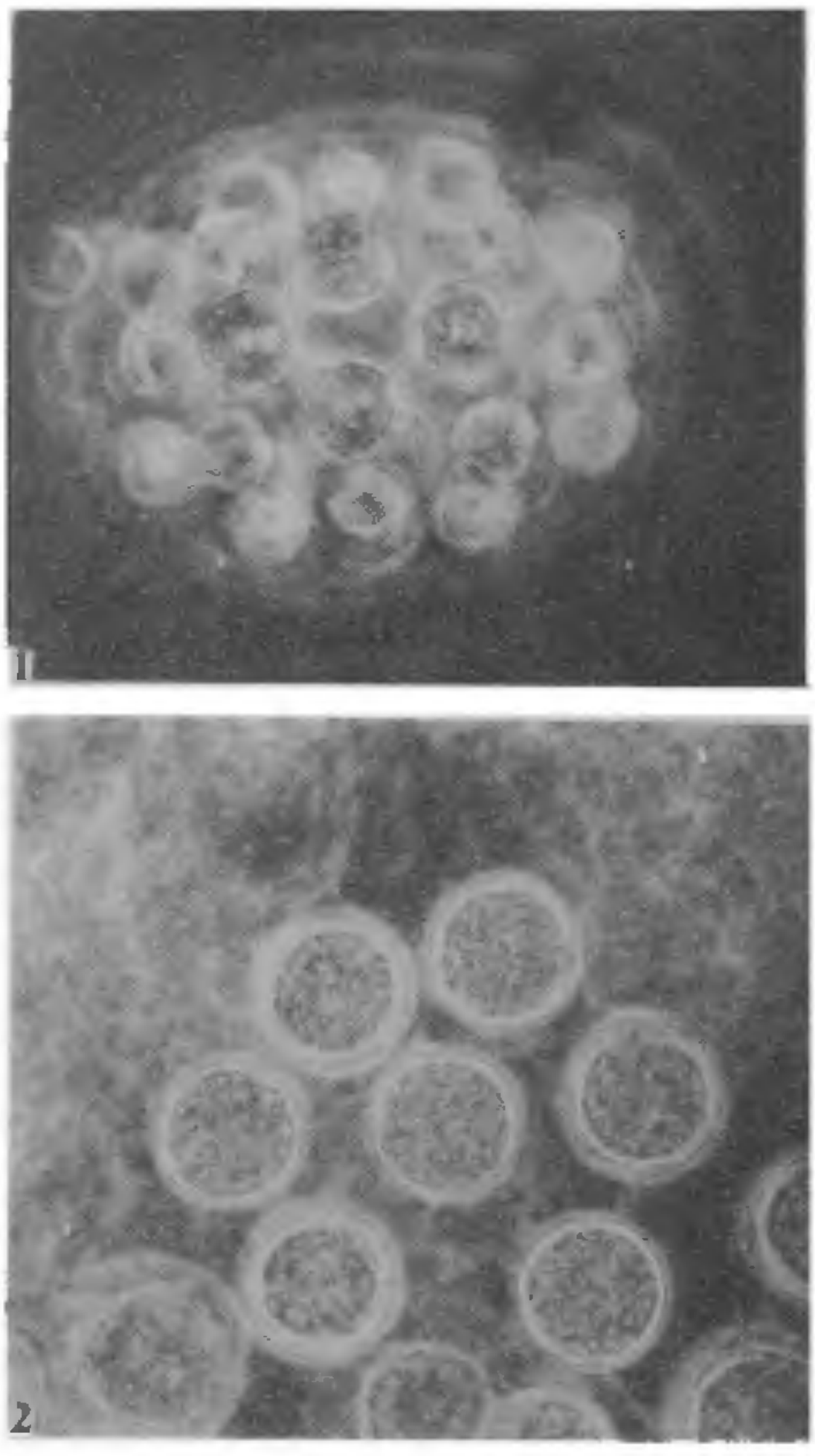
FIVE species of *Eudorina* Ehr. *viz. E. elegans* Ehr., *E. indica* Iyengar, *E. illinoisensis* (Kofoid) Pascher, *E. charkowiensis* (Kors.) Pascher and *E. carteri* Smith are reported so far from India[2]. During the study of Volvocales of Gujarat, the authors collected *E. plusicocca* G. M. Smith from road-side ditches. The entire collection showed aplanospore formation in the colonies.

Systematic account:

Eudorina plusicocca G. M. Smith (figures 1 & 2)

Colony ellipsoidal, 84–100 μm long and 67–86.5 μm broad, with double layered gelatinous envelope; 32-celled with cells in distinct tiers of 4, 8, 8, 8 and 4 cells in each; all cells equal in size, spherical or sub-spherical, 14.8–15.6 μm in diameter; chloroplast cup shaped with



Figures 1 & 2. *Eudorina plusicocca* G. M. Smith. 1. Showing the nature of colony, 2. Part of the colony showing aplanospores (× 642)