solvent and σ is a constant ($k_{(aq)} = k_{(dry)}$ when $p = 0$). In the present reaction also, a plot of $\log k_2$ against p gives a good straight line (plot B) and thus provides one more experimental verification for the equation proposed earlier. The equation has already been found to be applicable to bromine-addition to methacrylamide[10].

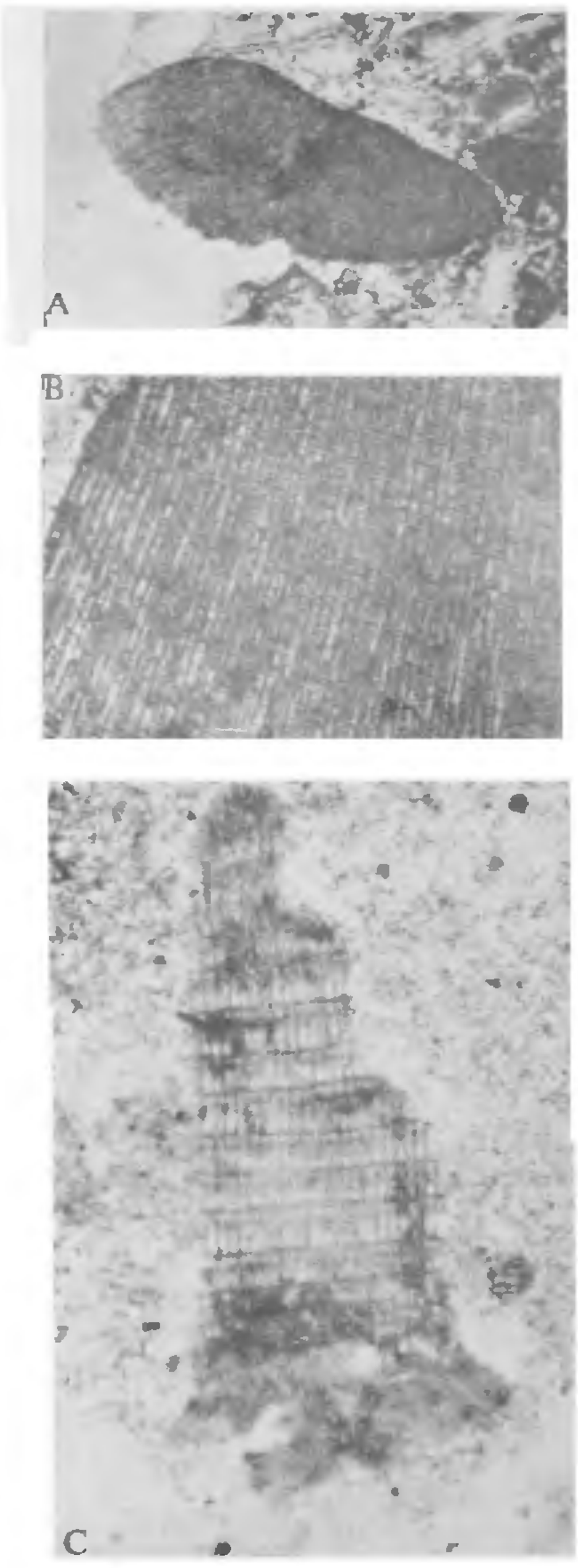
Physical Chemistry Dept., R. M. SUBRAMANIAN.
University of Madras, R. GANESAN.
Madras 600 025. *January* 21, 1978.

1. De la Mare, P. B. D. and Bolton, R., *Electrophilic Additions to Unsaturated Systems*, Elsevier, New York, 1966, p. 75.
2. Subramanian, R. M. and Ganesan, R., *Indian J. Chem.*, 1977, 15 B, 645.
3. Ganesan, R. and Kalachandra, S., *Z. Physik. Chem. (Frankfurt)*, 1970, 72, 269.
4. Seshadri, K. V. and Ganesan, R., *Ibid.*, 1968, 62, 29.
5. Frost, A. A. and Pearson, R. G., *Kinetics and Mechanism*, John Wiley and Sons, New York, 1961, p. 140.
6. Hughes, E. D., *Trans. Faraday Soc.*, 1941, 37, 763.
7. Kirkwood, J. G., *J. Chem. Phys.*, 1934, 2, 351.
8. Laidler, K. J. and Eyring, H., *Ann. N.Y. Acad. Sci.*, 1940, 39, 303.
9. —, *Chemical Kinetics*, McGraw-Hill, New York, 1965, p. 228.
10. Viswanathan, S. and Ganesan, R., *Curr. Sci.*, 1970, 39, 36.

FOSSIL ALGAE *SOLENOPORA* AND *AMPHIROA* FROM THE TRICHINOPOLY CRETACEOUS ROCKS OF SOUTH INDIA

STUDY of fossil algae from the Trichinopoly Cretaceous rocks by Rao and Gowda[1] and Gowda[2,3] has revealed that the genus *Solenopora* ranges beyond Jurassic in time. That its range is upto Danian is shown by the studies made by Rao and Gowda[1] and Keijzer[4]. Further study of the fossil algae from the same has confirmed the wider range of *Solenopora* through its association with *Amphiroa*. The latter genus is known to range from Upper Albian onwards[5]. Newly found *Solenopora–Amphiroa* association in the Trichinopoly Cretaceous region is noticed in the Varagapaudy limestone band that occurs at the base of the Uttatur Group. This band of limestone is one of a series of bands occupying the same stratigraphic position.

The generic identity of *Solenopora* (Figs. A and B) is based on the characteristic irregular arrangement of transverse septa. Similarly the genus *Amphiroa* (Fig. C) is recognised by the larger cells alternating with the smaller cells in the vertical direction. Both genera occur in detached form, as seen in thin sections of the rock.



FIGS. A–C. Figs. A and B. *Solenopora* sp., A × 25; B × 50. Fig. C. *Amphiroa* sp., × 100.

The present discovery of *Solenopora–Amphiroa* association in the Trichinopoly Cretaceous rocks confirms the author's earlier conclusion[3] that the stratigraphic distribution of fossil algae in the Trichinopoly Creataceous is not of so much value in fixing the age as much as in interpreting the paleoecology of those sediments. It is of interest to recall here that the genus *Corallina* which is known to be restricted to Tertiary everywhere else is found[6] in the Callapaudy limestone band which occurs, like Varagapaudy band, at the base of the Utatur Group. This occurrence of *Corallina* also corroborates the conclusion referred to earlier in regard to the stratigraphic range of fossil algae in the Trichinopoly Creataceous succession.

Department of Geology, S. SAMBE GOWDA.
Central College,
Bangalore 560 001,
December 26, 1977.

1. Rao, L. R. and Gowda, S. S., *Curr. Sci.*, 1954, **23**, 177.
2. Gowda, S. S., *Fossil Algae Found in India, Burma and Pakistan*, University of Mysore, 1954.
3. —, *Curr. Sci.*, 1976, **45**, 91.
4. Keijzer, F. G., *Geogr. Geol. Meded.*, 1945, **2**, 6.
5. Conti, S., *Pubblicazioni. Inst. Geol. Universita, Genova, Ser. A, Paleontologia*, 1950, **4**, 132.
6. Gowda, S. S., *The Foraminifera of South Indian Cretaceous-Eocene*, University of Basle., 1964.

RESPONSE OF *RHIZOBIUM* CULTURE INOCULATION, ZINC AND MOLYBDENUM APPLICATION ON RHIZOSPHERE AND PHYLLOSPHERE MICROBIAL POPULATION OF SOYABEAN (*GLYCINE MAX* MERILL)

CLARK AND PAUL[4] have summarised various factors like plant species, growth stages and soil or plant treatments that affect rhizosphere or phyllosphere microbial populations. Several workers (Lochhead and Rouatt[9]; Sundararao and Venkatraman[12]; Rangaswami[11]; Emmimath and Rangaswami[6]; Bagyaraj and Rangaswami[13]; and Egeratt[7]) have reported that fertilizers, herbicides, insecticides, fungicides and antibiotics influence the quality and quantity of the rhizosphere microbial populations. In view of this a trial in randomized block design with eight treatments including zinc and molybdenum application separately and combined, and with and without *Rhizobium* culture as seed inoculant was conducted with Soyabean var, to note the influence of the treatments on total bacteria, *Azotobacter* and *Rhizobium* in the rhizosphere and phyllosphere at Allahabad Agricultural Institute. Soil was applied with zinc in the form of zinc sulphate and molybdenum in the form of ammonium molybdate. *Rhizobium* sp. was applied as seed inoculant. Field was managed as described in our earlier paper (Tripathi and Edward[14]).

Phyllosphere and rhizosphere study was done at flowering stage according to the methods adopted by Prasad and Edward[10], and Agnihothrudu[2], respectively. The former is a modified method of Dickenson[5]. Total bacteria, *Rhizobium* and *Azotobacter* were enumerated in Thornton's agar (Allen[1]) and yeast extract mannitol agar (Allen[1]) and Base medium 77 (Allen[1]), respectively. *Rhizobium* was identified as per the method described by Vincent[15].

Rhizosphere.—Soyabean inoculated with *Rhizobium* registered higher population of total bacteria as compared to uninoculated control irrespective of trace element treatment. Similar findings have also been reported by Tripathi[13] with *Azotobacter* inoculated wheat. Application of trace elements (zinc and molybdenum) separately or combined decreased total bacterial population, irrespective of whether culture was inoculated or not. Molybdenum when applied along with *Rhizobium* culture had the most depressing effect on total bacterial population whereas zinc had the most depressing effect on total bacterial populations among the uninoculated series. Under culture inoculated condition, molybdenum treatment antagonized the stimuatory effect of zinc on total bacterial population of zinc and molybdenum treated culture plants. Under uninoculated treatments, on the other hand, application of zinc antagonised the stimulatory effect of molybdenum on total bacterial population under zinc and molybdenum combined treatment (Table I). Rangaswami[11] stated that the trace elements suppressed the growth of pathogenic or parasitic forms of microorganisms in the rhizosphere.

Contrary to the findings on total bacteria in rhizosphere, *Azotobacter* and *Rhizobium* recorded an increased population with culture inoculation treatment over uninoculated control. The application of zinc or molybdenum separately or combined recorded increased population of *Rhizobium* and *Azotobacter* in both culture inoculated or uninoculated series over their respective controls without trace-element application. That the nitrogen fixing micro-organisms require higher amounts of zinc and molybdenum has been recognized by Waksman[16].

Phyllosphere.—Phyllosphere, in general, recorded reduced population of total bacteria and *Azotobacter* and increased population of *Rhizobium* in culture inoculated soyabeans over uninoculated controls, irrespective of trace-element treatments. Application of trace-elements remarkably reduced the population of total bacteria and *Azotobacter* whereas significantly increased the population of *Rhizobium* in both inoculated and uninoculated series over treatments without trace-element controls. Amongst the trace element treatments, application of molybdenum whether or