ons. In the second type (2%) two or three radicles each enclosed by a cupule emerge and grow normally (figure 12). But only the earlier emerged embryo develops into a plant. Very rarely two seedlings emerge and survive. In the third type (1%) plumule emerges when radicle is 1-1.5 cm long. It grows faster producing miniature leaves while the radicle remained 3 cm long (figure 13).

Schmidt observed no sclerenchyma in the pericarp except the macrosclereids of epidermis. But isolated patches of fibres and brachysclereids have been observed in the ground tissue of the pericarp in the current investigation. Also, protoxylem lacunae observed by Rost and Simper could not be found in the present material. It is probable that they might have mistaken enlarged protoxylem vessel elements for protoxylem lacunae. A significant observation of the present investigation is the presence of vascular tissue in seed coat, which is a primitive feature found in Gymnosperms and rarely in Angiosperms. Roth recognised coleorhiza as a part of suspensor or hypocotyle. The hypocotyledonary cupule partially enclosing the radicle is hence comparable to coleorhiza. The cupule is absent elsewhere in Dicotyledons. The abnormal germination of the embryo after breaking the cotyledons is probably due to the elongation of suspensor pushing embryo deep into the seed. In this process the orientation of embryo in relation to the polarity of the seed is disturbed resulting in abnormal placement and hence germination.

The authors are thankful to Prof. K. S. Rao for encouragement and facilities.

4 December 1981

1. Schmidt, R., In La Jojoba, Memorias de la II Conferencia Internacional Sobre, Baja California, Mexico, 1976, p. 143.

2. Rost, T. L. and Simper, A. D., In La Jojoba, Memorias de la II Conferencia Internacional Sobre, Baja California, Mexico, 1976, p. 135.


LYTIC PHAGES FOR BACILLUS THURINGIENSIS IN THE LOCALITY AROUND CALCUTTA

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The use of Bacillus thuringiensis as an insect pathogen is widely accepted. There are many reports on the presence of phage of B. thuringiensis. As phage infection may transform B. thuringiensis which is apparently non-pathogenic to mammalian pathogenic variety, we tried to survey the locality around Calcutta for the presence of the phage. But due to the presence of some spreading type chloroform resistant sporulating bacteria in the locality, we were unable to determine phage titer by conventional method. In the present communication we report the phage population in the locality around Calcutta by using a tetracycline and streptomycin resistant strain (developed in this laboratory) of B. thuringiensis ATCC 13366.

A strain B. thuringiensis TC Sm resistant to 100 µg of streptomycin and 20 µg of tetracycline, and pathogenic to Bombyx mori developed in this laboratory from B. thuringiensis ATCC 13366 was used in the present work. Samples including soils from garden field, river/canal and municipal dumping ground were collected at random. Besides, water and mud from the river and the canals were also taken as samples. In 50 ml sterile stopped tube, 20 g of soil/mud were brought to 30 ml level by adding sterile water. The tube was vigorously shaken for 30 min and 15 ml suspension were centrifuged at 2000 r.p.m. for 10 min. From the resulting supernatant, 10 ml were treated with 0.5 ml chloroform, 200 µg tetracycline and 1000 µg of streptomycin. The above preparation in 7.5 ml (such high volume was necessary as the phage count was low) portions were mixed with 0.5 ml of B. thuringiensis TC Sm spore suspension and 2.0 ml of molten and temperate agar medium-1 (4 times concentrated and contained 4% agar). This was distributed as seed layer over agar plates containing 25 ml of medium-1 supplemented with tetracycline and streptomycin in the above stated concentrations. Plates were incubated and the plaque count was made after 16 hr.

For the determination of phage titer altogether 108 soil samples collected from the locality around Calcutta were examined. The result (table 1) shows that the highest titer was found in the river/canal side soil or water or mud and a good number of samples were phage-positive in the above mentioned site. In all samples the plaques were round and clear with sharp margin. But the diameter was variable. By noting the diameter, three typical plaques were purified by the conventional method. They were designated as P-1, P-2 and P-3. Although their plaque sizes were found variable under different cultural conditions, the relative plaque size was constant.

For cross infectivity studies with these three phages, the bacteria used were Bacillus subtilis NCTC 8236, B. subtilis ATCC 6633, B. cereus NCTC 10320, B. cereus mycoides sub sp. ATCC 11778, B. pumilus NCTC 8241 and 50 isolated sporulating soil Bacillus. Besides these, B. thuringiensis ATCC 13366 and its mutants (developed in this laboratory): NSm (resistant to 3000
**Table 1**

<table>
<thead>
<tr>
<th>Isolation site</th>
<th>No. of Samples screened</th>
<th>No. of Samples containing phage</th>
<th>No. of phage in 100 g or ml positive samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden soil</td>
<td>32</td>
<td>6</td>
<td>20–40</td>
</tr>
<tr>
<td>River/canal side soil or water or mud</td>
<td>32</td>
<td>18</td>
<td>≈0–200</td>
</tr>
<tr>
<td>Field soil</td>
<td>34</td>
<td>4</td>
<td>20–40</td>
</tr>
<tr>
<td>Municipal dumping ground</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCOVERY OF ENDOXYTHIIRD FORAMINIFERS FROM THE BEDDED MALDEOTA PHOSPHORITE, GARHWAL HIMALAYA

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Endothyrid foraminifers are being recorded from the rock phosphates of Mussoorie–Dehradun Sector, Garhwal Himalaya. The occurrence of endothyrids from the Transitionary Limestone unit, intervening between the Upper Krol and the Phosphorite horizon, from Maldeota, Dehradun has been earlier reported. The present samples yielding foraminifers were collected from the Phosphorite (Surkhet) mine, Maldeota, Dehradun. The samples were collected from the phosphorite overlying the Krol Limestone (Sample No. 1a), from the Chert–Phosphorite (Sample No. 1), from the level in phosphorite rich in chert (Sample No. 2) and from the Chert–main ore contact (Sample No. 3). The samples (Nos. 1–3) have yielded relatively few foraminiferal remains. The sample of phosphorite sampled near the adit one (No. 4) has yielded a rich and diverse assemblage of endothyrid foraminifera. The main ore body (Nos. 4–6) contains rich assemblages of foraminifera. Sample (Nos. 4 and 5) contain mainly *Endothyra* spp., *Nodosinella* spp., *Paraendothyra* sp., *Globivalvalina bulloides* and *Tetraataxis conica*. In Sample No. 6 taken from the upper middle part of the ore body, a few members of the family Tournayellidae also appear.

The foraminifer assemblage recorded from Phosphorite includes, *Endothyra* spp. (figures 1–3) *Nodosinella digitata* Brady, 1876, (figure 4), *N. Nodosariformis* (Cushman and Waters), 1828, (figure 5), *Tetraataxis conica* Ehrenberg, 1854, (figures 8, 9, 11, 12), *Paraendothyra* sp. (figure 10) and *Globivalvalina bulloides* Brady, 1875, (figures 2, 13). The members of the family Tournayellidae are commonly present in the upper-middle part of the ore body and are represented by *Tournayella* sp. (figure 7) and *Glosmospiroides* sp. (figure 6). This assemblage is characteristic of Carboniferous–Permian age.

The discovery of endothyrid foraminifers from the phosphorites of Garhwal Himalaya is significant for the geology of the region since, these foraminifers are reliable indices of the geological age. The occurrence is significant because only the endothyrid group of foraminifers is present along with skelatal blue green algae, preserved in phosphorite. Such an association indicates restricted basin with low salinity.