SHORT COMMUNICATIONS

EXAMPLES OF SHELL PREDATION BY PREDATORY GASTROPODS AND PARASITES IN THE MIDDLE EOCENE ROCKS OF KUTCH, GUJARAT

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SOME carnivorous species have the capacity to penetrate and drill holes in the calcareous exosketelons of invertebrates. Interesting observations of such activity were made on the highly calcified oyster shells recovered from the Tertiary rocks of Kutch near Lakhpat, Gujarat (23° 44′ N, 68° 50′ 01″ E). The oyster specimens were collected from a 2-metre-thick exposed section of dirty white monotonous cream and dull yellow foraminiferal limestone. Occurrence of *Nummulites beaumonties, N. pinfoldi, Discocyclina dispansa, Orbulinoides beckmanni*, etc. confirm its Middle Eocene age. Lithological and micropalaeontological evidence indicates littoral to sublittoral shallow marine environment.

Bore hole morphology

Borehole morphology is typically developed on the larger or the left valve of the oyster shells, and includes prominent vertical cylindrical boring and horizontal scratched groove tunnels. The vertical boreholes are found in two size groups. The larger bores have a maximum depth of 0.45 cm and diameter of 0.6 cm, giving a depth/diameter ratio of 0.75. The smaller bores, which are more abundant, have maximum depth of 0.30 cm and diameter <0.1 cm (depth/diameter ratio 3.0). The vertical boreholes have sharp edges, flat and rough bottom, smooth wall and axis of boring at right angles to the shell surface (figure 1).

The horizontal scratched open groove structures are in the plane of the surface of the shell. Very often these structures connect the vertical unfinished boreholes. The maximum length observed of such a groove is 10 cm, with depth 0.35 cm and width about 0.5 cm. The edges of the two parallel sides are sharp, the sides rough-walled, and the bottom broad and irregular.

Borings, interpreted as biogenic sedimentary structures, indicate behavioural patterns of the organisms in direct response to their life functions. The boreholes in oysters reported here indicate two different boring organisms; the behaviour is believed to be predatory in one case and parasitic in the other. Two different organisms are suspected because of the distribution of two different borehole morphologies. A predatory habit is inferred for the vertical cylindrical bores as this morphology shows that the originator, in search of food, attempted to gain entrance into the bivalve oyster shell rather than bore for its domicile. Four facts support the suggestion that the predatory organisms were gastropods—the size of the hole, the presence of more than one hole, preference of the larger, left valve of the oyster shell, and typical vertical drilling as adopted by present-day carnivorous gastropods[1–5].

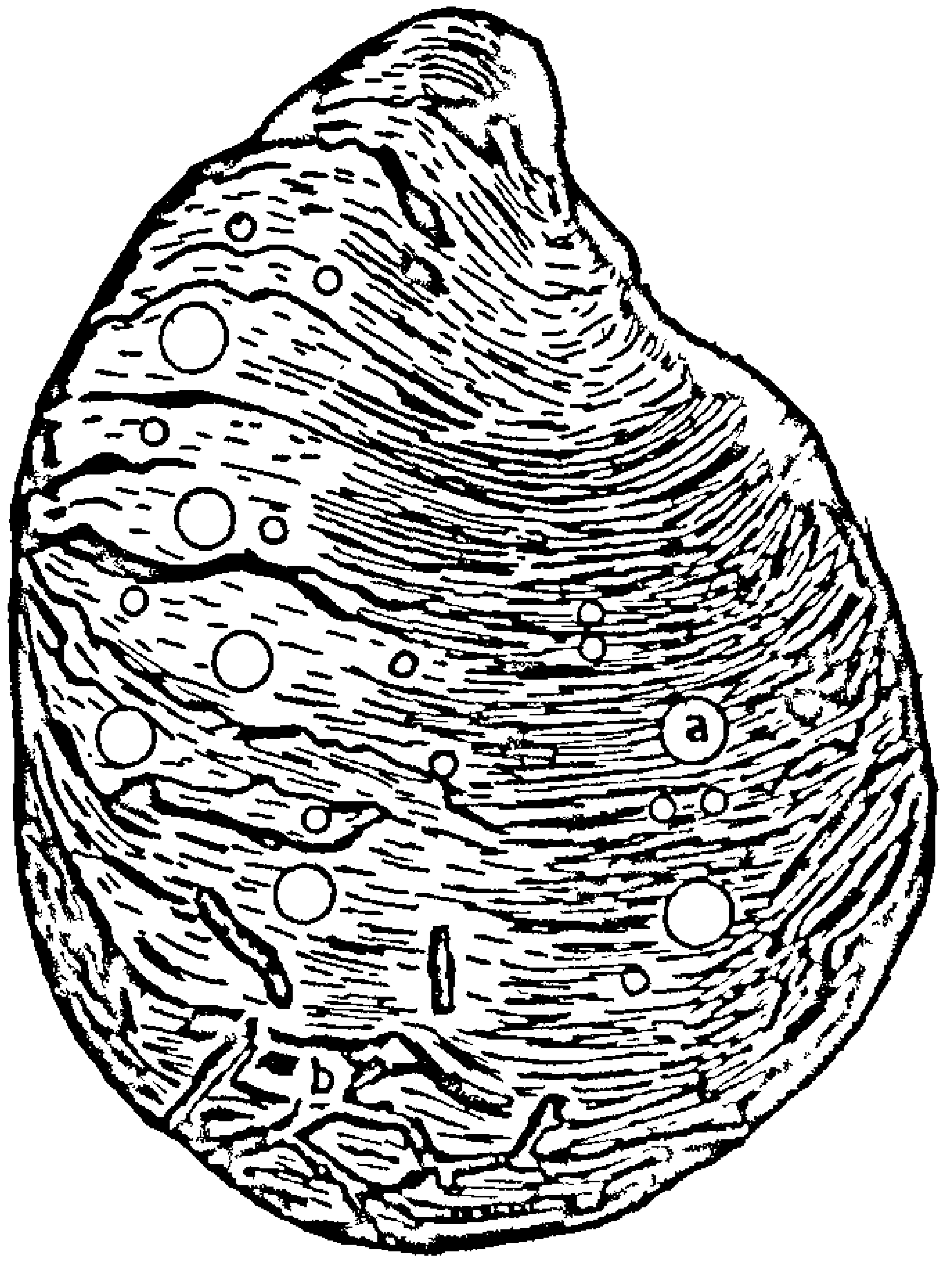

Figure 1. Drawing of oyster shell showing the two types of borings. (a) Vertical cylindrical boring made by predatory gastropods, (b) horizontal tunnels made by parasitic worms.

Cadee[5] distinguishes these gastropods as drillers, chippers and crushers. In the case of our described specimens, we suspect driller gastropods.

According to Keir[6], many snails and parasitic worms have the capacity to excavate tunnels through the shell surface in a short time. The architecture of the tunnels in our specimens rule out the possibility of parasitic gastropods. The preferential location of the tunnels near the posterior end of the oyster shells rather indicates the action of parasitic worms. These worms possibly fed upon the waste brought out through the excurrent siphons and lived a symbiotic life with the oysters. It is further thought that the tunnels were possibly used by the worms as their protective domiciles. Finally it could be argued that the prey (oysters), the predators (gastropods) and the parasitic animals (worms) coexisted in the shallow marine habitat during the Middle Eocene when the limestones in Lakhpat were being deposited.

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ORTHOHYDROXYACETOPHENONE THIOSEMICARBAZONE AS A NEW ANALYTICAL REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF COPPER

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THIOSEMICARBAZONES have been frequently employed as chromogenic reagents for the spectrophotometric determination of inorganic ions and their analytical potentialities have been reviewed[1,2]. Here we describe the synthesis of *o*-hydroxyacetophenone thiosemicarbazone (OHAPTS) and its use as analytical reagent for the determination of copper. Most of the spectrophotometric methods reported in the literature suffer from many disadvantages—low sensitivity, heating, extraction, and tolerance limit of associated ions[3–7]. The proposed method, besides being sensitive, is simple and rapid, requires no heating or extraction, and has the advantage of virtual freedom from interference of many associated foreign ions. The high tolerance limit of zinc in presence of citrate allows the method to be used for the determination of copper in zinc-based alloys and steel samples.

The reagent was prepared by a procedure similar to that of Aydin[8] and Reddy[9] (yield 65%, m.p. 183–186°C). The reagent (0.5232 g) was dissolved in 50 ml of DMF (5×10^{-2} M). Solutions of lower concentration were obtained by dilution with DMF. Stock solution of Cu(II) was prepared by dissolving 2.4969 g of copper sulphate pentahydrate (BDH, AR) and standardized titrimetrically[10]. All chemicals used were of BDH AR grade.

To each of a set of 25 ml volumetric flasks containing 12.5 ml of buffer (acetic acid–sodium acetate) of pH 5.5, 3 ml of DMF, 2 ml of reagent (5×10^{-2} M) and an aliquot of copper(II) solution (5×10^{-4} M) were added and made up with distilled water. The absorbance at 360 nm of each solution was measured against reagent blank. A calibration graph was drawn for the relationship between the amount of copper(II) and the absorbance.

The optimum pH range for maximum colour development was 5.5–8.0. Hence sodium acetate–acetic acid buffer of pH 5.5 was selected for further studies. A five-fold excess of the reagent is sufficient for getting maximum and constant absorbance. The order of addition of constituents (buffer, DMF, metal, reagent) has no effect on the absorbance.

A linear graph is obtained for absorbance vs amount of metal ion in the range 0.42 to 6.6 $\mu g\ ml^{-1}$ of copper(II). The molar absorptivity and Sandell's sensitivity of the method are $9.5\times10^{3}\ l\ mol^{-1}\ cm^{-1}$ and 0.00669 $\mu g\ cm^{-2}$ respectively. The standard deviation for 10 determinations of 64 μg of copper(II) was ± 0.0006. The practical range of determination of copper(II) as envisaged by Ringbom's plot was 0.67 to 3.94 $\mu g\ ml^{-1}$.

Vosburgh and Cooper's[11] method indicates the presence of one complex species in solution. Also Job's and molar ratio and slope ratio methods show the presence of 2:3 (M:L) species. The stability constant of the complex is 6.60×10^{12}.