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The preparation of oriented thin sections in micropaleontology: An improved method for revealing the internal morphology of foraminifera and other microfossils

ABSTRACT

The use of a slow-setting, glass-clear plastic as an embedding medium provides accurate control over the orientation of a specimen and at the same time permits observation and photographing of morphological structures during sectioning. The technique is especially useful for very small specimens and has been applied successfully to both fossil and Recent foraminifera.

INTRODUCTION

The external morphology of fossil foraminifera, although in many cases well preserved, is not sufficient for the precise identification of a specimen. Moreover, there are certain groups of foraminifera, the precise identification of which depends on recognition of internal structures as revealed by sectioning. Previous methods of sectioning (Dunbar and Hembest, 1942; Douglass, 1960, 1965; Honjo, 1960; Hofker, 1965) are not entirely satisfactory for several reasons.

First, they involve the embedding of the specimen in Canada Balsam or Lakeside-70 cements, both of which set too quickly to permit accurate orientation of the specimen. In consequence, it is necessary to reheat the embedding medium repeatedly in order to manipulate the fossil. However, reheating induces brittleness in the cement and commonly results in a darkening as well.

Second and more important, previous methods involve the grinding of the specimen with abrasive powders on glass plates. This commonly results in a chipping of the fragile structures, and particles of grit invariably become embedded in the sample.

These problems are overcome by the embedding of the specimen in a slow-setting, glass-clear polyester resin and the use of carborundum papers for grinding. The procedure involves preparation of a section about 60 μ thick on a microscope slide, followed by careful thinning to 30 μ or less, if required. Photomicrographs can be taken at intervals to record the internal morphology, but the section must be polished before each such photograph is taken in order to reveal clearly the fine details of the structure. Because the technique is destructive, it is further recommended that a photograph of the specimen also be taken before it is embedded.

PROCEDURE

A cubic mounting block about 2 cm. on edge is first prepared in clear polyester resin (Polylite No. 61–209). A suitable disposable mold for casting the resin may be readily fabricated from aluminium foil by forming it around the end of a wooden rod or similar object (Zeidler, 1972). When the block has set, a small hole (or series of holes) is drilled into one surface to accommodate the specimen (or series of specimens) so that, when in position, it lies just below the surface.

The specimen is placed in the hole, which is then filled with more polyester resin. Accurate placement of the specimen necessitates

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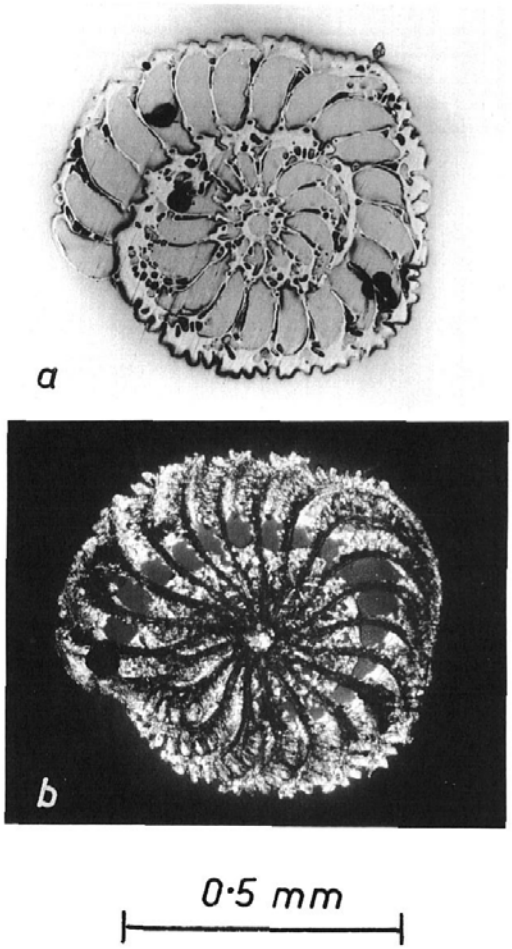

TEXT-FIGURE 1
Final subequatorial section of *Elphidium crispum* (Linné) (see plate 1, figure 8), showing finely preserved structural detail. a, Section viewed under reflected plane polarized light; b, Section viewed between crossed nicols.

working with the aid of a binocular microscope but because the resin sets relatively slowly (about 30 minutes) there is ample time to manipulate the specimen into the required orientation. If faster setting is required clear dental cement (setting time about 5 minutes) can be substituted for the polyester resin when filling the hole. As several specimens can be accommodated in the one surface it may often be useful to embed at least three in different orientations so as to maximize the information obtained during sectioning.

After the specimen has been firmly embedded the faces of the block are ground flat and polished by standard petrographic methods (Zeidler, 1972) so that they are glass-clear. A transparent block is necessary so that the exact position of the specimen can be seen and cutting accurately controlled. The surface of the block containing the specimen is then cemented to a glass microscope slide with the use of Araldite NLC 191 with hardener HY 956. This cement is cold-setting and should be left for at least twelve hours to harden. If it is likely that the section will be required for later study (Kennedy, MS.) a soluble cement should be used instead of the Araldite. Mowolith No. 20 (polyvinyl acetate) is suitable and can be dissolved in acetone. Lakeside-70 which is soluble in alcohol can also be used but is less satisfactory because it is hot-setting.

After the specimen has been cemented to the glass slide the block is trimmed with a diamond cut-off saw which has been graduated to cut sections of various thicknesses by the cutting of quartz slides and a comparison of their interference colors with a standard chart. The block is trimmed so that a section about 60 μ thick remains on the slide above the specimen.

Thinning of the section is carried out by grinding by hand on wet carborundum papers. Coarse grinding is done on 400-grit paper until features of interest are revealed followed by fine grinding on 600-grit paper to remove the largest scratches. Before a photograph is taken, it is necessary to polish the section to remove the remaining scratches. This is done on cloth laps with the use, first, of a slurry of chrome oxide, followed by a final polish with a slurry of magnesium oxide (Zeidler, 1972).

RESULTS

The results obtained with this technique are illustrated in plate 1. Plate 1, figures 1–4, are of an Upper Jurassic specimen of *Alveosepta* sp. from Lebanon, and plate 1, figures 5–8, are of a Recent specimen of *Elphidium crispum* (Linné) from Port Hacking, New South Wales. In contrast to the microfossil, the Recent specimen is hollow and very fragile; it is clear, however, from the finely preserved details of the carbonate tests (text-figure 1) that, with care, satisfactory sections can be prepared from such specimens.

CONCLUSIONS

The technique described is applicable to both fossilized and Recent microorganisms of various sizes and has the following advantages over previous methods:

1. The use of a glass-clear mounting medium permits constant observation of the specimen during embedding and grinding procedures, and the slow-cooling of the polyester resin allows time for the specimen to be accurately manipulated into the required orientation.

2. The use of carborundum papers for grinding overcomes problems of the chipping of the specimen and embedding of abrasive grit in it. This, coupled with the

preparation of a highly polished surface prior to photography, enables fine structural details to be recorded.

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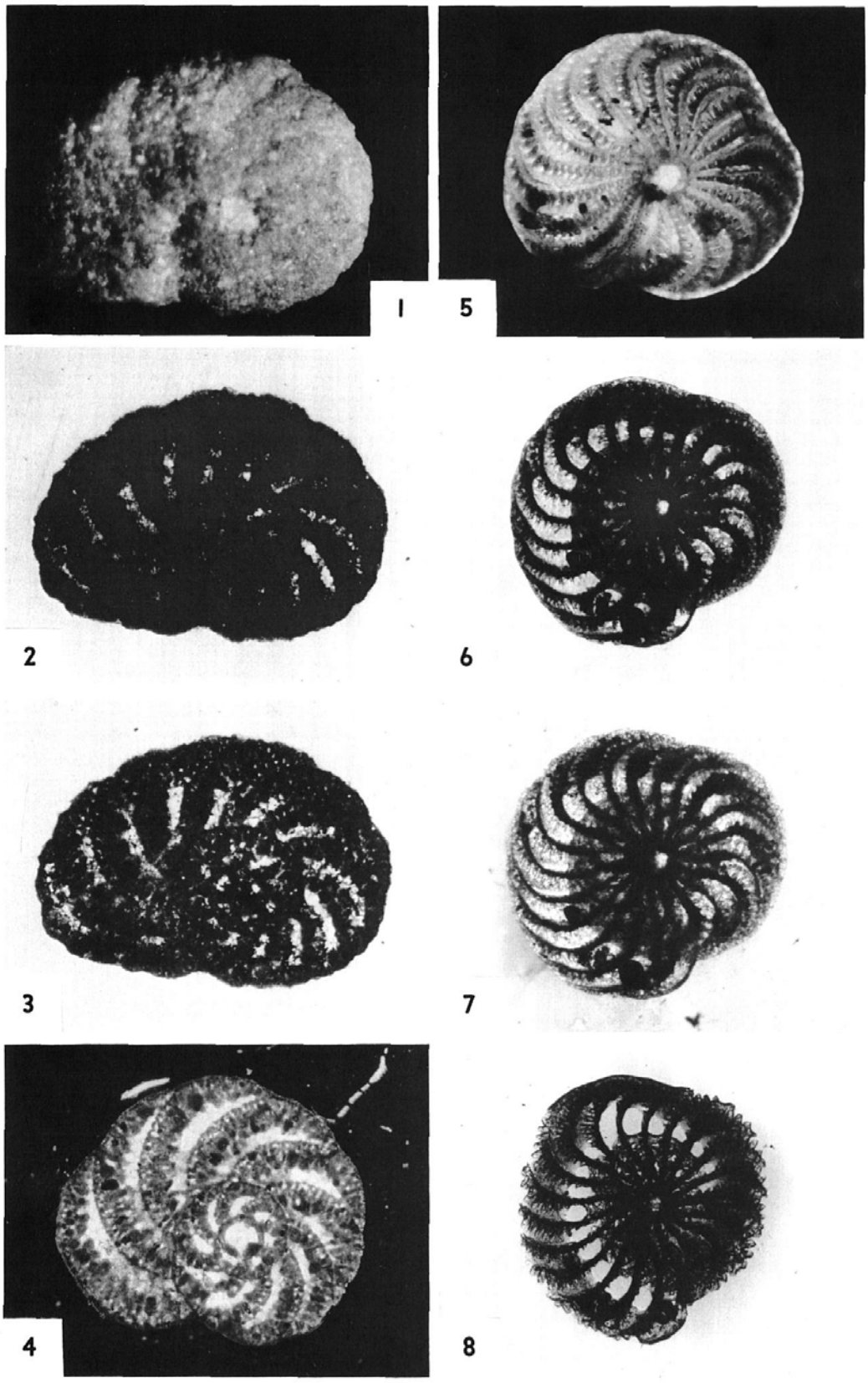
PLATE 1

1–4 Upper Jurassic specimen of *Alveosepta* sp. from Lebanon
1, Prior to embedding; 2, serial photomicrograph of equatorial section (transmitted plane polarized light); 3 equatorial section thinner than shown in 2 (transmitted plane polarized light); 4, final equatorial section, approximately 30 μ thick, suitable for mineralogical identifications.

5–8 Recent specimen of *Elphidium crispum* (Linné) from Port Hacking, New South Wales
5, Prior to embedding; 6, serial photomicrograph of equatorial section (transmitted plane polarized light); 7, equatorial section thinner than shown in 6 (transmitted plane polarized light); 8, final subequatorial section, approximately 30 μ thick, suitable for mineralogical identifications.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