Archaeology & History in Lebanon Issue Eighteen : Autumn 2003, p. 62-69.

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Identification of the Wood used in the Construction of the "Sunken Room" at Sidon.

During the 2002 excavations in Sidon, the charred remains of a substantial piece of timber were discovered in a building of which only the underground room, commonly called "The Sunken Room", has survived. The remains appeared to be those of a beam supporting the roof. According to the available calibrated radio-carbon dates the beams were grown c. 1390-1120 BC (seep. 15).

Historical texts often refer to the cedars of Lebanon and their use as building materials (see for example several papers in *Archaeology and History in Lebanon*, Volume 14, such as Hepper, 2001; Briquel-Chatonnet, 2001; and Bikai, 2001). There can be few firmer associations of a nation with a tree than the association of Lebanon with its eponymous cedar, *Cedrus libani* (Talhouk *et al.*, 2001). The discovery of a substantial piece of ancient charred timber *in situ* among the remains of the ancient port city of Sidon thus became cause of some excitement. In discussing the use of cedar to build Solomon's Temple in Jerusalem, Hepper also notes that the woodcutters of Sidon were famed for their skill (Hepper 2001, 4). It was thus of considerable interest to establish whether this discovery of a roof timber in a 13th century BC archaeological context might provide a physical example to support the textual references indicating the use of cedar in building.

With understandable anticipation a small sample of the carbonized wood was removed from the beam for microscopic analysis at the Archaeobotany and Palaeoecology laboratory of the Institute of Archaeology, University College London, in order to identify the species of wood used to create the beam. It was hoped that the process of heating in an inadequate supply of oxygen, which transforms wood into inert carbon (charcoal) and so renders it resistant to fungal and microbial attack, might have preserved the wood microstructure sufficiently to allow the identification of the tree species based on the specimen's anatomical features. Some indication of the types of diagnostic microstructural features used in identifying wood and charcoal are given in Cartwright (2001), together with specific details on the microstructure of the cedar of Lebanon.

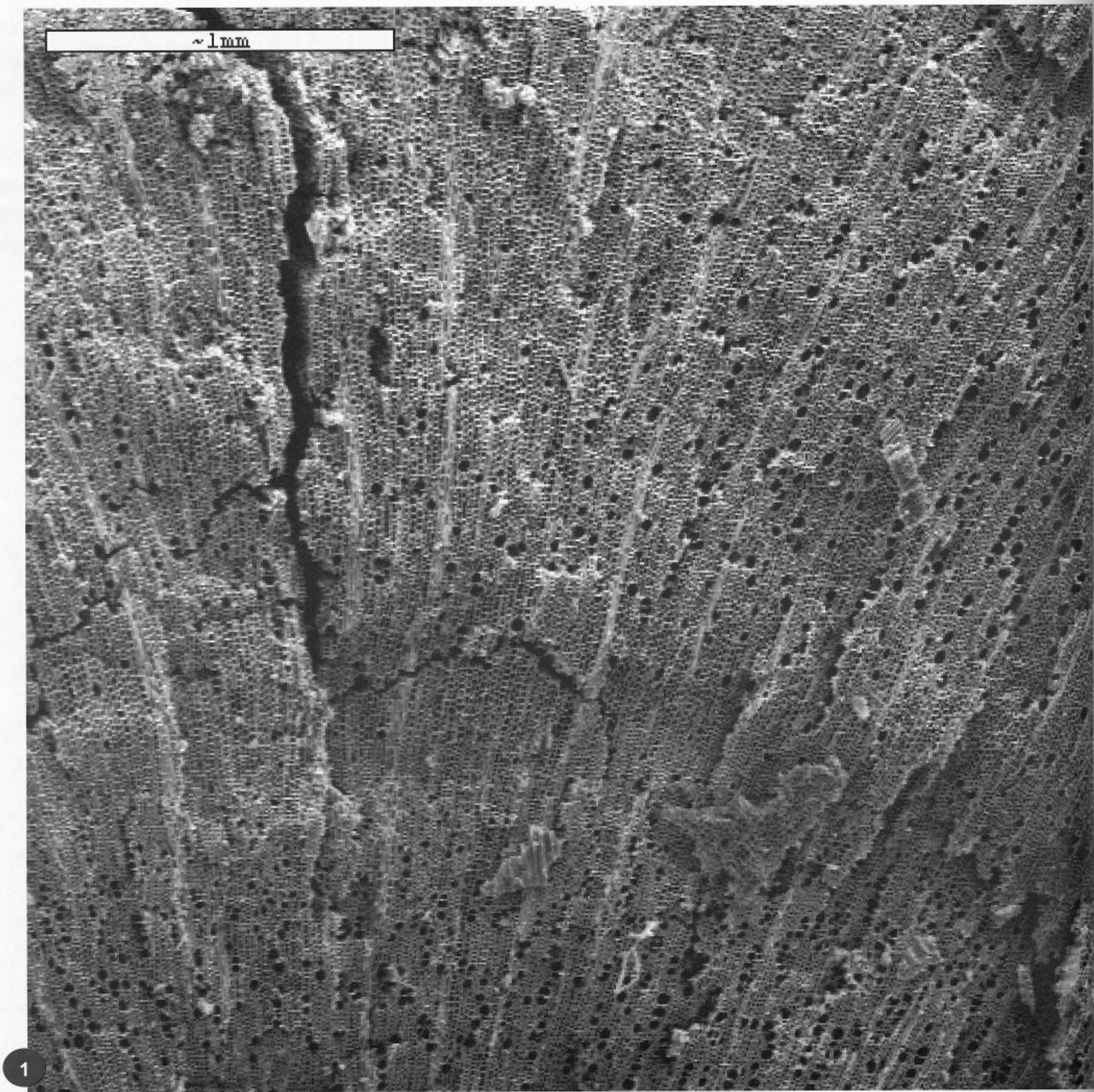
Although the charcoal specimen was very fragmented, its microstructure was preserved remarkably well. It was apparent that the wood had burned in a reductive environment (i.e. lacking free oxygen). The good preservation of the microstructure in the charcoal implies quite a slow burning process. The charcoal resulting from the pyrolysis (thermal breakdown) of the wood tissues cannot be burnt away unless there is enough oxygen available for it to react with. If free oxygen is present at a temperature above about 500°C, the carbonized wood (charcoal) reacts with oxygen producing gaseous carbon monoxide or carbon dioxide and leaving only ash, the inorganic by-product of charcoal combustion. Further details about the process of combustion and the chemical reactions occurring during the burning of wood can be found in Beall (1972) and Drysdale (1999, pp11-13 & 182-190).

Photographs taken by using a scanning electron microscope at the Institute of Archaeology (plates 1-6) show the microstructure of the carbonized wood specimen. The photographs (see p. 64-69) show the three anatomical planes (transverse, radial longitudinal and tangential longitudinal). Examination of the three different planes is necessary to reveal in a three-dimensional perspective the various anatomical features of the complex structure of the wood. The detailed description of the anatomical structure of the examined specimen is presented in the captions to the figures, while the paragraph below seeks to clarify some relevant points for the non-specialist reader.

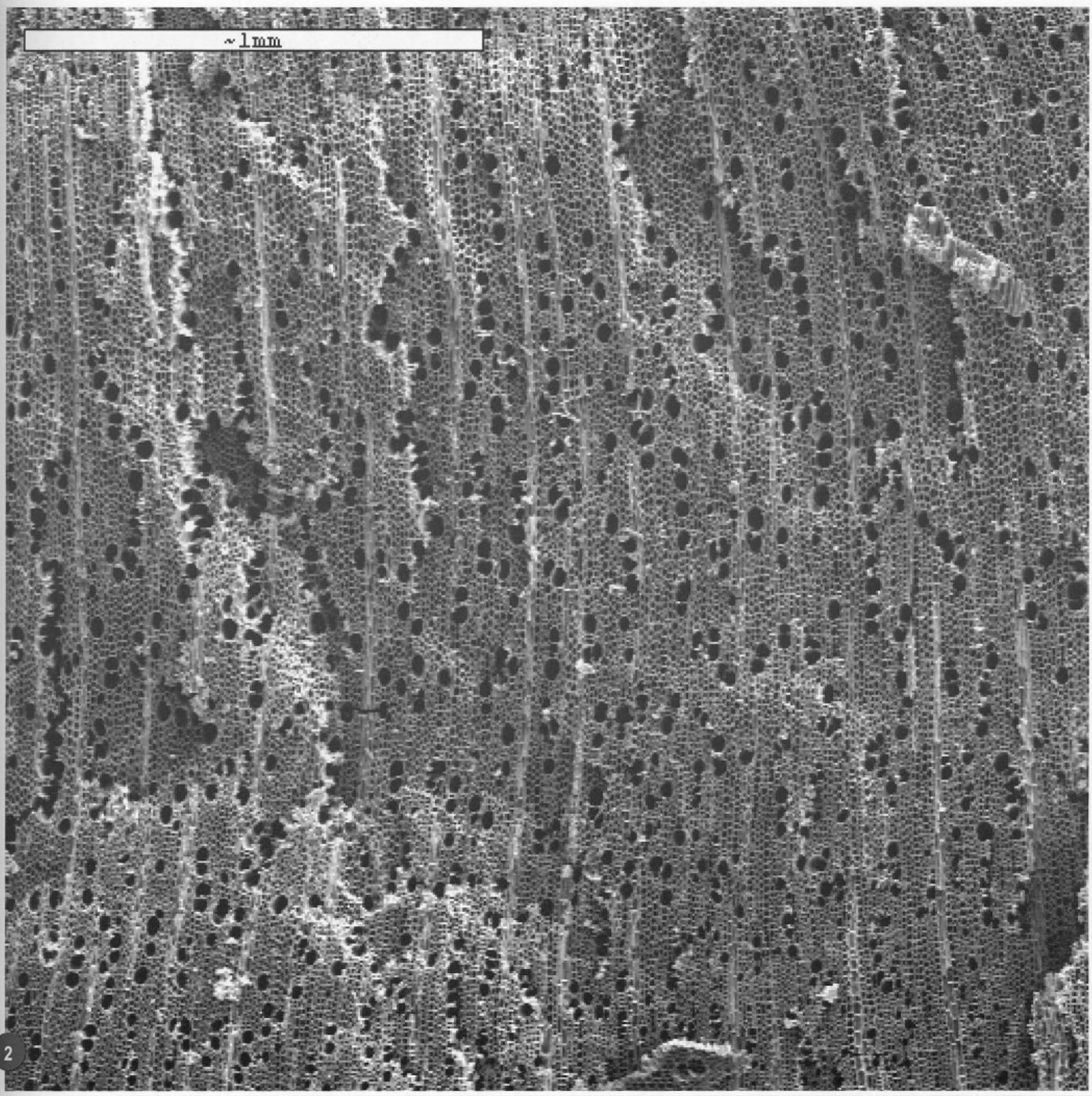
The transverse sections (plates 1-4) are cut across the body of the wood perpendicular to its length. The zone free of large pores spreading in an arc across the lower part of plate 1 indicates the boundary between the annual growth rings (tree rings, composed of ground tissue and pores, representing the vessels). The lines spreading out radially from near the centre of the wood are the rays. The same features, from different perspectives, can be seen in the anatomical planes that follow the axis of the trunk. The section shown in plate 5 is a radial longitudinal section. The photograph shows the face revealed by a split along the length of the wood from the periphery of the trunk or branch towards its centre following the radius of the trunk/branch and at 90 degrees to the transverse section. Plate 6 shows a tangential longitudinal section. This was taken at right angles to the radial longitudinal section and is concentric with the annual rings that were visible in the specimen.

Examination of these anatomical planes and their comparison against reference samples and published descriptions (reference material from the Cecilia A. Western wood reference collection held at the Institute of Archaeology and descriptions available in Fahn *et al.* 1986) of the microstructure of known specimens taken from living trees has shown that the Sidon beam wood belongs to the *Ericaceae* (heath) family and in particular the genus *Arbutus*. This is known in English as the strawberry tree: certainly a far cry from the renowned cedar of Lebanon but a very interesting discovery in its own right.

The two species of strawberry tree, *Arbutus unedo* and *Arbutus andrachne,* are both native to the Eastern Mediterranean but cannot be distinguished on the basis of their wood anatomy. They are evergreen trees and shrubs, growing in *maquis* and forest vegetation, sometimes in association with pine (*Pinus brutia)* and tree-heather (*Erica arborea*) up to an altitude of 300-800 metres above sea level. It is interesting to note that while today the strawberry tree is known as a shrub or small tree, the archaeological evidence shows that specimens of a considerably greater stature, sufficient to provide structural building timber, are likely to have been available in the past.



Plates 1-2
Transverse section: Wood diffuse porous, growth rings distinct. Pores mostly angular, solitary, but mainly in short radial multiples (2-4; occasionally more) or clustered, generally numerous.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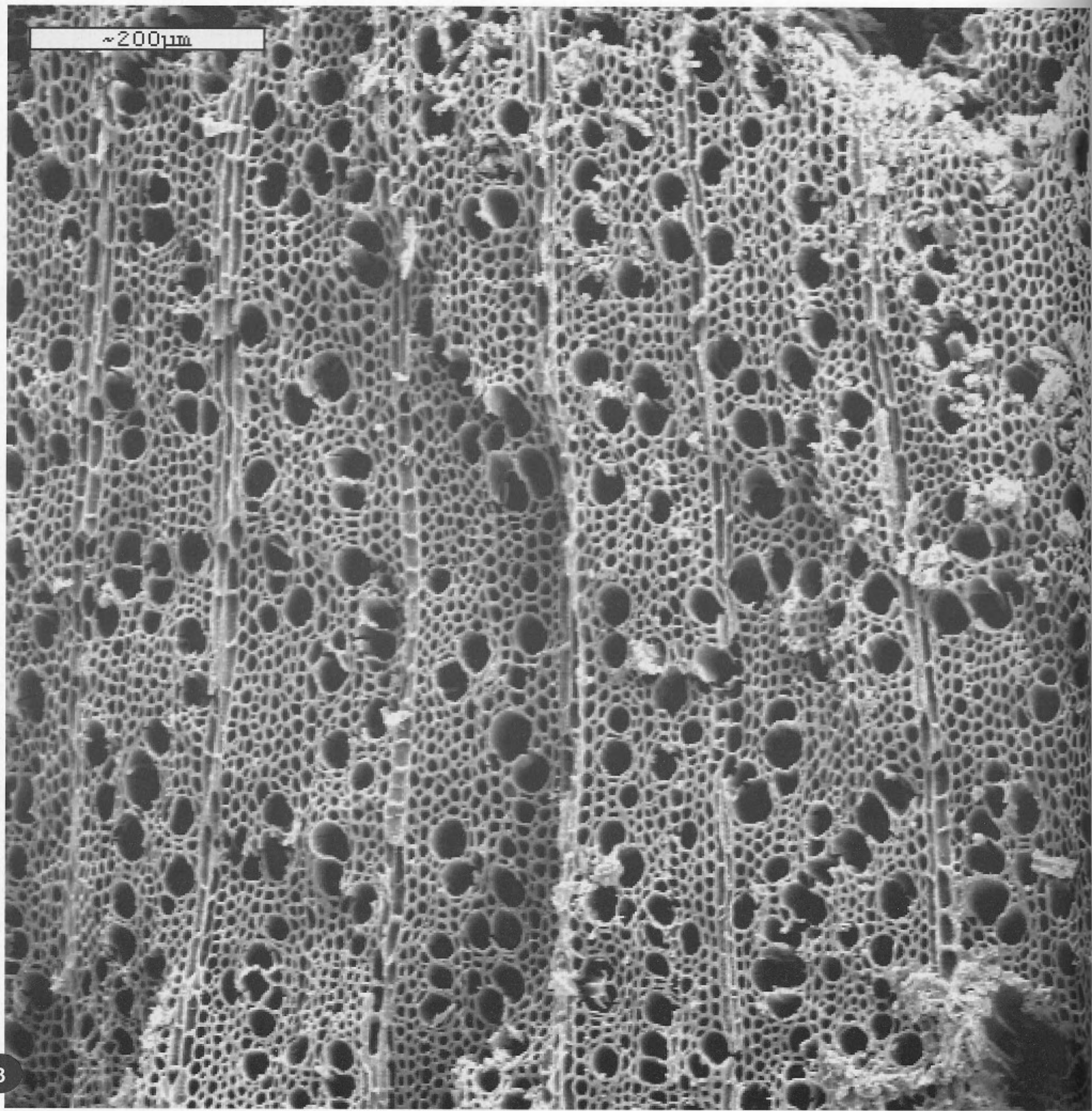

Plates 3-4
Transverse section: Wood diffuse porous, growth rings distinct. Pores mostly angular, solitary, but mainly in short radial multiples (2-4; occasionally more) or clustered, generally numerous.

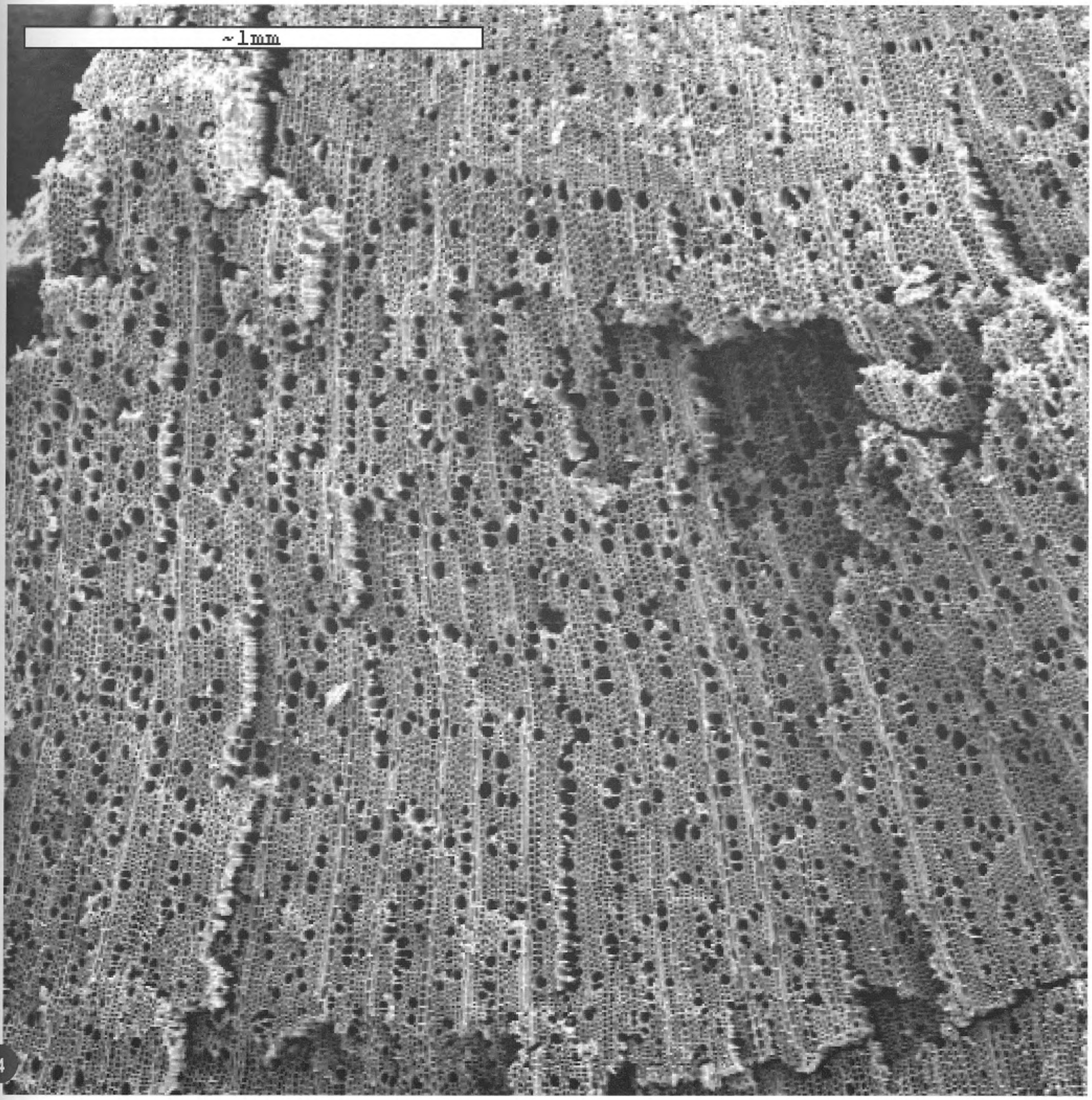
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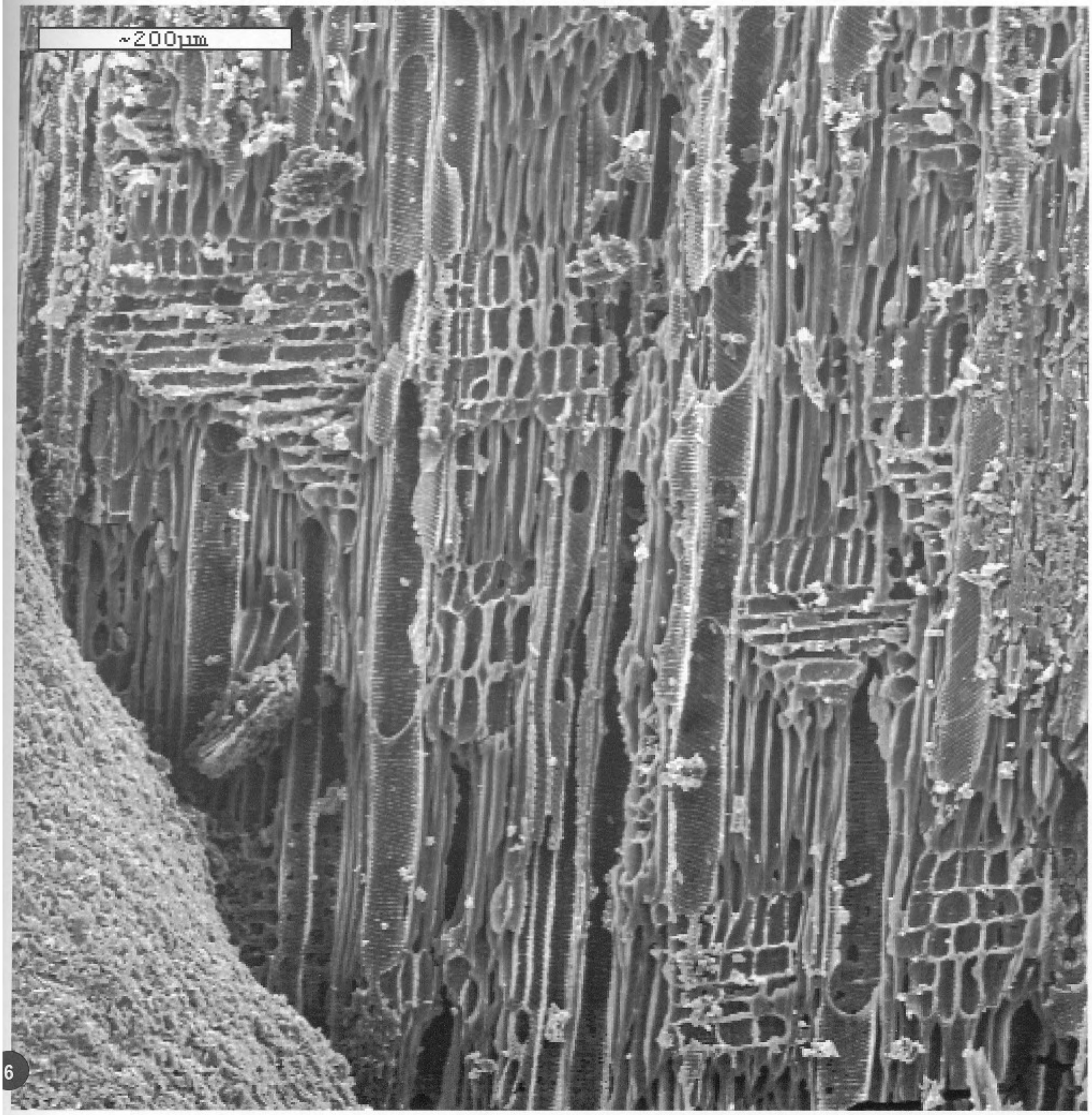
Plate 5
Radial longitudinal section: Perforation plates simple. Rays heterogeneous, with a central part of markedly procumbent cells and one row of upright marginal cells. Inter-vessel pits and vessel-ray pits with slit-like apertures. Fibres with bordered pits and (infrequent) septate fibres present. Conspicuous helical thickenings present on vessel members and fibres.

Plate 6
Tangential longitudinal section : Ray width: bi- to 3(4)-seriate.



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