The identification of plant fibres from shipwreck Aanloop Molengat

Interne Rapportage Project Aanloop Molengat

Otto Brinkkemper & Ineke Joosten
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Otto Brinkkemper & Ineke Joosten
e-mail: o.brinkkemper@cultureeefgoed.nl

Introduction

The inventory of the ship wreck Aanloop Molengat included objects made of plant fibres that were used in the bales with cattle hides. Findnr. AM-033 consists of dark brown, loosely packed material with a leaf-like appearance. This material was woven into mats (see Fig. 1). Findnr. AM-1/2.01.2.1 West 10.2 is a knot in loosely-twisted fibrous plant material (see Fig. 2). This type of material is used to bind two hides together and to stitch skinning cuts.

Fig. 1. Piece of woven mat used to pack a bale of hides.
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Plant seeds and fruits are in general identifiable by means of their overall morphology, but the identification of vegetative plant material such as leaves and stems requires detailed anatomical information. Especially the outermost cell layer (epidermis), where the plant is in contact with the external atmosphere, contains crucial information for identification of leaves and stems. These criteria include the form of the cell walls, the presence of appendages (hairs, prickles) and the presence (in leaves, especially on the lower, adaxial side, not exposed to direct sunlight) or absence (in most stems) of stomata. These stomata are pores in the epidermis that allow for exchange of oxygen and carbon dioxide. The stomata can be opened or closed and regulate the transport of oxygen to the chlorophyll where photosynthesis takes place. Especially the shape of subsidiary cells is of diagnostic importance. Besides, epidermes of grasses often have silica cells, with distinct shapes and significance for identification (see Fig. 3, see also Brinkkemper & Van der Heijden 1999).
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Fig. 3. Epidermis of grass (Sugar cane) in surface view. Left: epidermis of adaxial (lower) side of leaf with stomata, right: epidermis of stem with cork cells and silica cells (after Esau 1960, p. 66).

Material and methods

Both specimens were first studied by means of a Zeiss Axioskop stereomicroscope (enlargement up to 70x) and an Olympus incident light microscope (enlargement up to 400x). With this study, it proved impossible to obtain useful identification criteria for the material. Subsequently, both were studied by Scanning Electron Microscopy (SEM; JEOL JSM5910LV) at the Cultural Heritage Agency (RCE) in Amsterdam. Dr. Ineke Joosten kindly acted as SEM operator. Backscatter electron (BE) images of the material were taken in a low vacuum (30 Pa) environment. The material was studied without gold- or carbon-coating. For the identification of the archaeological material, stems of recent plants of fox-sedge (*Carex otrubae*), bulrush (*Schoenoplectus lacustris*) and soft rush (*Juncus effuses*) and leaf sheaths of cotton grass (*Eriophorum vaginatum*) were studied by means of SEM as well.

Results and discussion

The material of AM-033 yielded a uniform cell pattern of rectangular cells, measuring c. 50 x 25 µm. No stomata or silica cells could be observed (see Fig. 4).
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Fig. 4. Backscattered electron (BE) image of cell pattern found on AM-033.

Since stomata are often absent in stems, at least in grasses, and the material did not yield any trace of silica cells that occur in all grasses, reference material of several other monocotyledon plants was examined (see Fig. 5-7).

Fig. 5. Stem epidermis of bulrush (Schoenoplectus lacustris). Costal zone with stomata indicated by red arrow.
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Fig. 6. BE image of stem epidermis of false fox-sedge (*Carex otrubae*). Costal zone with stomata indicated by red arrow.

Fig. 7. BE image of stem epidermis of soft rush (*Juncus effuses*). Costal zone with stomata indicated by red arrow.

All these three stems yielded rows of stomata in the so-called costal zone, overlying the vessels in the stem. Apparently, the sample AM-033 does not contain any of these epidermes.
Since the material macroscopically resembles worn leaf sheaths of cotton grass, recent material of this species was studied by SEM as well (Fig. 8).

Leaf sheaths of cotton grass are naturally worn in the living plant. This is clearly illustrated in Fig. 8, where parts of the epidermis are torn and show the underlying layer of spongy, parenchymatous cell tissue. Parenchyma is the primary tissue of higher plants, composed of thin-walled cells and forming the greater part of leaves, roots, the pulp of fruit, and the pith of stems. These parenchymatous cells strongly resemble the shape of the cells found in AM-033, although they are twice as small in the specimen of cotton grass studied here. Parenchymatous tissue occurs in all plants and is much less diagnostic than epidermal tissue. Notwithstanding the inspection of three pieces of AM-033, no remains of the more diagnostic epidermal cells could be found. Seemingly, the epidermis layer has been fully eroded, making the underlying parenchyma visible. The unrewarding conclusion must be that the material of AM-033 cannot be identified microscopically. Macroscopically, it is more like the leaf sheaths of cotton grass than like the stem of any of the monocotyledons studied, but the fossil material is coarser. The parenchyma cells are also coarser in the fossil material.

The SEM photograph of the finer material of AM-½.01.2.1 is depicted in Fig. 9.
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Unfortunately, this material neither showed clear remains of epidermal tissue, but instead showed layers of parenchymatous cells as well. The cells measure c. 50 x 15 μm, comparable in length to those in AM-33, twice as long as the recent cotton grass. They are somewhat smaller in width than those in AM-33. Is it unclear whether these subtle differences point to different species, different plant parts within a species, or might even be of the same part of the same species.

Conclusions

The botanical fibres studied from Aanloop Molengat lacked epidermal remains. As a result, no diagnostic cell patterns were available for identification. The parenchymatous cells visible in the archaeological material resemble those observed below the epidermal cells of cotton grass, but they are larger in both archaeological specimens. The cell patterns in both differ somewhat in width. It is not clear if this points to a difference is species, plant part, or not.

References