Response to Comment on "30,000-Year-Old Wild Flax Fibers"

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Bergfjord *et al*. express doubts regarding our identification of flax fibers on the basis of the morphology of their internal layers. The authors use microphotographs and descriptions of the outer layers of fibers as arguments for their claims. Morphology and structure of the outer and inner parts of fibers are radically different, however, rendering their reservations misplaced.

We reported the identification of wild flax fibers based on the morphology of the internal layers of the fibers, which were exposed due to the chemical treatment applied in palynological sample preparation (*1*). The morphology of the internal layers is considerably different from the structure of the outer layers of the flax fibers. This is substantiated through a series of laboratory experiments that tested recent plant material of different taxons. Exposure of the internal structure of modern flax fibers was achieved by subjecting the fibers to damage procedures analogous to the treatment of palynological samples in which chemically active substances such as potassium hydroxide, acetic anhydrite, sulphuric acid, and others were employed.

Following this procedure, we identified the taxonomic characteristics of various basts. These characteristics are missing in the outer layers of fibers, yet can be consistently used for identification of fossilized plant fibers. We noticed in the case of flax that each fiber consists of multiple segments of equal length. The segments are clearly visible and are distinctly separated from each other by deep linear grooves. The fibers' surface is not smooth but rather linear. The end of the short fiber segments is always straight, as if cut across. These features were observed during the study of more than a thousand modern flax samples, as well as several thousand ancient fibers uncovered by archaeological investigations.

During the next step of our analysis (*1*), we compared the internal structure of the flax fibers with the internal structure of other plant fibers, including nettle, hemp, and cotton—species most commonly used for textile production. The comparison demonstrated clear differences in the morphology of the inner layers of each of the plants, as visible in Fig. 1. In nettle fibers, the segments are of uneven length and lack deep grooves with straight borders. The internal structure of hemp is generally not segmented. Also, the surface morphology is different, and fiber extremities are not straight. Thus, our results are in accordance with the opinion that the internal structure of fibers (similarly to other vegetative or generative parts of plants) is a reliable criterion for their taxonomic identification (*2*, *3*).

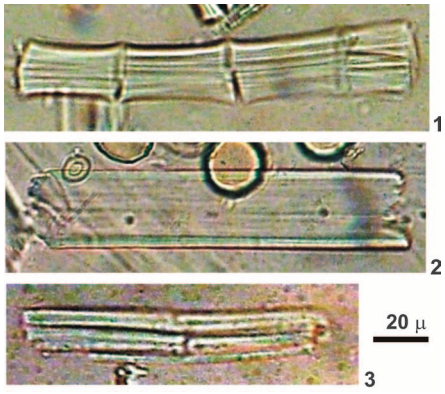

Fig. 1. Modern fibers from the collections of the Institute of Paleobiology, National Museum of Georgia. 1, flax; 2, hemp; 3, nettle. The photos were taken using light microscope E. Leitz (Wetzlar).

We cannot agree with the conclusion of Bergfjord *et al*. (*4*) that light microscopy does not allow the identification of various bast fibers. The research history of bast fibers demonstrates the opposite. Light microscopy has revealed time and again the essential characteristic traits of fiber morphology and allowed plant identification (*5*–*11*). The use of different methods, such as DNA analysis, x-ray microdiffraction, and polarization microscopy is undoubtedly suitable for the verification of bast fibers. But so is the identification of plant fibers as palynomorphs, demonstrated through numerous laboratory experiments comparing modern and archaeological samples (*12*).

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