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The Unique Diversity of Electron and Confocal Imaging Applications in a Natural History Museum Setting

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Large public science institutions such as the American Museum of Natural History (AMNH) generally have two faces: the public exhibit halls and the "behind-the-scenes" research effort. The collective expertise of the curatorial staff ultimately contributes to the scientific content of the public exhibits. For the most part, however, day-to-day scientific research at AMNH is conducted as it would be in any conventional academic institution.

The AMNH Core Imaging Facility is a shared resource that maintains a state-of-the-art cold field-emission scanning electron microscope (FE-SEM) equipped for energy dispersive x-ray microanalysis (EDS) and cathodoluminescence spectroscopy (CLS; late 2002). The facility also houses a confocal laser scanning microscope (CLSM) and an image-processing lab where we maintain a number of 3-D reconstruction software packages, multiplatform (Windows NT/2000, Mac OS, and SGI/IRIX) computers, and peripheral devices such as a publication quality digital printer and a large format printer.

The imaging and microanalytical environment at AMNH is unique because applications come from the many diverse disciplines pursued in a natural history museum setting.[1] Broadly, these areas of research include anthropology, biological sciences, and geological sciences. Specifically, typical sample types examined include fossil bone and ammonites (paleontology); skulls, bone and teeth from extant vertebrate species (vertebrate zoology); mollusk shells, pearls, insects, and spiders (invertebrate zoology); meteorites and magmas (earth and planetary sciences); and pigments, metals, and hairs from cultural artifacts (anthropology).

Examples of typical confocal and electron imaging applications are shown in Figs. 1– 6. Figs. 1 and 2 are front and back views of the genitalia of a male mosquito (Family Culicidae). These images are 3-D reconstructions from 2-D confocal image stacks. The data were collected on a Zeiss 510 CLSM at 512 x 512 image resolution and reconstructed using Bitplane Surpass surface rendering software. Fig. 3 shows a close-up view of several types of sensory structures found on a wasp antenna (*Dolichovespula sylvestris*). This specimen is part of the permanent insect collection and was imaged uncoated at 1 kV accelerating voltage, 7 μA emission current. A fractured cross-section of the nacreous material making up the outer layers of a cultured freshwater pearl is shown in Fig. 4. This image became part of the public exhibition entitled "Pearls".[2] Fig. 5 is an image of part of a pigment fragment removed from a Zapotec urn. The rod-like structure of these crystals (palygorskite) and the absence of Cu and Co (data not shown) helped identify this material as Maya Blue, an unusual pigment used throughout Mesoamerica.[3,4] Fig. 6 is a backscattered electron (BSE) image of a porphyritic olivine chondrule within a thin section of the Allende meteorite. Chondritic meteorites represent one of the oldest (~4.6 billion years) forms of undifferentiated material available for laboratory study.[5] All electron images were collected on an Hitachi S-4700 cold FE-SEM.

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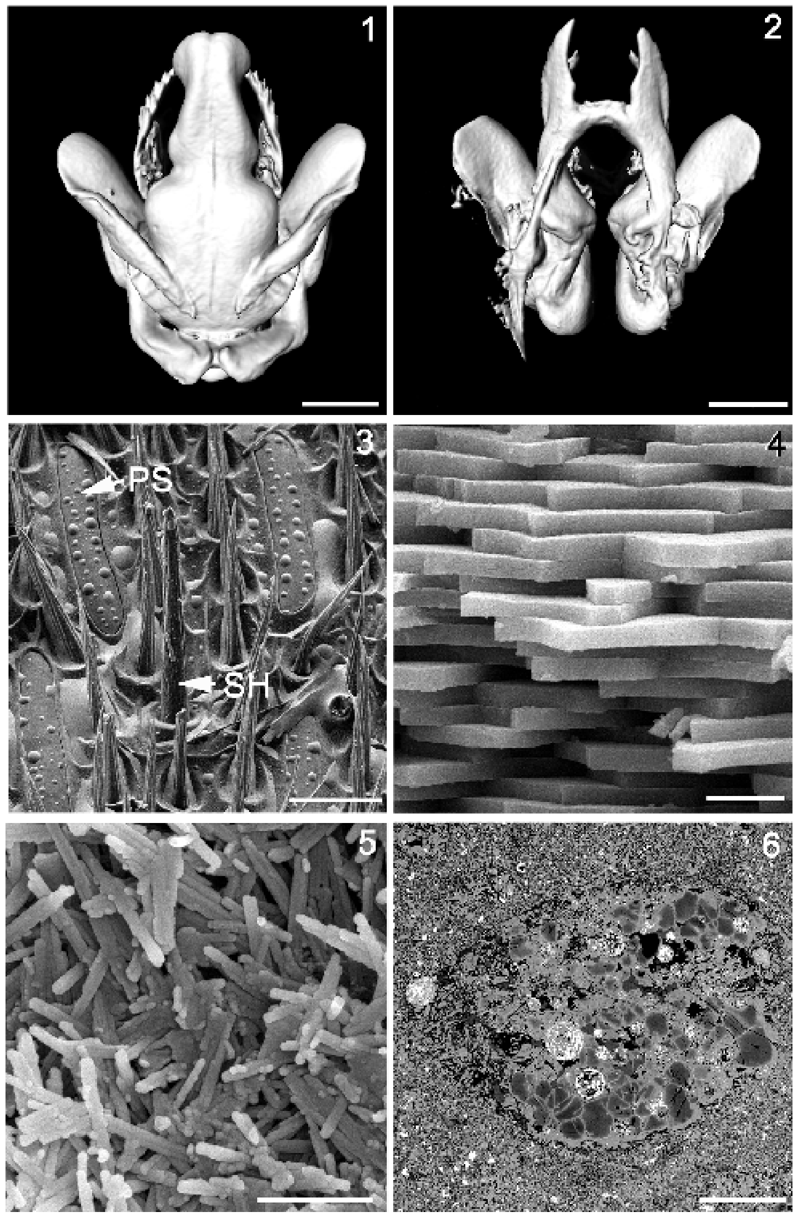

Figs. 1 and 2: 3-D reconstructions of male mosquito genitalia. Bars = 50 µm. Fig. 3: Wasp antennal sensory structures (PS = placoid sensillum, SH = sensory hair). Bar = 10 µm. Fig. 4: Fracture surface of cultured freshwater pearl. Bar = 2 µm. Fig. 5: Palygorskite crystals in Maya Blue pigment. Bar = 1 µm. Fig. 6: BSE image of Allende meteorite chondrule. Bar = 100 µm.

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