NOTES · AND · NEW TECHNIQUES

THE HIDDEN BEAUTY OF AMBER: NEW LIGHT ON AN OLD SUBJECT

By John I. Koivula

While many aspects of the nature of amber and its organic inclusions have been reported in the literature, virtually nothing has been recorded about the inorganic—mineral, liquid, and gas—inclusions "hidden" amid the better-documented life forms. This article takes a microscopic look at the gas bubbles and crystal forms that also belong to amber's inner world. With the use of polarized light, the author also documents strain centers in the amber, including movements made millions of years ago by animals trapped in the resin.

The gemological literature is filled with a wealth of information on amber and its inclusions. Seemingly countless and exhaustive studies on the subject have been carried out by well-qualified, highly skilled paleozoologists, paleobotanists, and gemologists. Their keen observations have led to the identification of thousands of varieties of flora and fauna as inclusions in amber, and more will undoubtedly be discovered as the search continues. Through the application of infrared spectrophotometry and other sophisticated instrumentation (Langenheim, 1964), the very origins of the amber resin itself are now being studied.

Consequently, when we scan the available literature, it seems that there is very little that remains to be written on the subject of amber. But, to the close and careful observer, amid the often-noted inclusions of flowers and insects a world of hidden beauty unfolds, a microscopic world never before reported in the gemology literature.

This journey into amber's hidden microscopic world begins with a simple spherical void, a bubble. Anyone who has studied amber under the microscope has seen bubbles suspended in its golden depths. But the microscopist's eye is usually drawn away from any bubbles present to the more captivating inclusions of flora and fauna. In fact, if a piece of amber does not contain insects or other fossilized life forms, it is seldom given a second glance with the microscope. This singular fixation on life forms has kept an intriguing portion of amber's inclusion world from the gemological community.

At first glance, except for minor differences in shape, the bubbles found in amber appear to be essentially the same. However, careful study under the microscope reveals that many have unique characteristics. Figure 1 shows a gas bubble distorted by the flow of the resin before it solidified. The bubble plays host to a transparent euhedral crystal of an unknown solid, possibly quartz (Flamini et al., 1975). Figure 2 shows a group of white crystals that appear to adhere to the lower-front inner surface of this somewhat spherical bubble. The crystal group subsequently moved to the inner-back surface of the bubble, revealing it-

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If the readers of this paper have observed any seemingly unusual inclusions in amber, the author would be delighted to hear of them.

Figure 1. Distorted by the flowing motion of its amber host, this bubble is unique in that it contains a well-formed crystal, possibly quartz. Magnified 65×, dark-field illumination.

self as a mobile solid. The photomicrograph of a bubble in figure 3 illustrates a three-phase inclusion in amber. The solid phase consists of tiny brownish-red pollen grains. The largest of these appear to be attached to the inner surface of the bubble, while the smaller grains move around inside the bubble chamber, propelled by heat-convection currents and water vapor. The liquid phase is a droplet of ancient rain or dew. It can be seen easily in various stages of condensation on the inner surface of the gas bubble, the third phase.

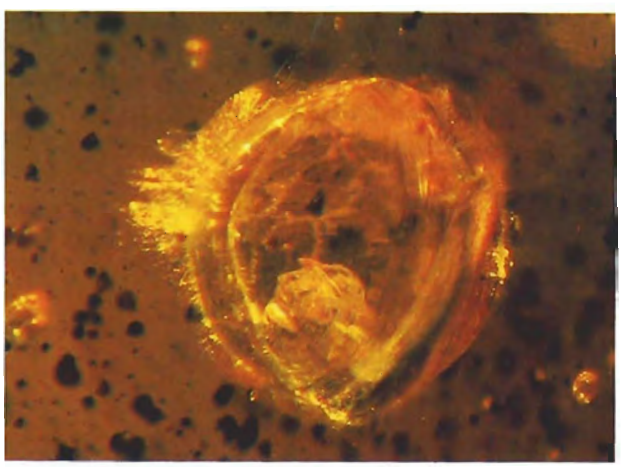

Figure 2. This gas bubble contains a group of whitish crystals that appears to be sticking to the bubble's lower front surface but revealed itself as a mobile solid. Magnified 40×, oblique illumination.

It is an established fact that the physical bodies of all animal life are composed primarily of water. When insects or other fauna are trapped in amber, their internal organs deteriorate, leaving behind the fossilized exoskeleton. Transparent, gem-quality amber is not porous, so any organic

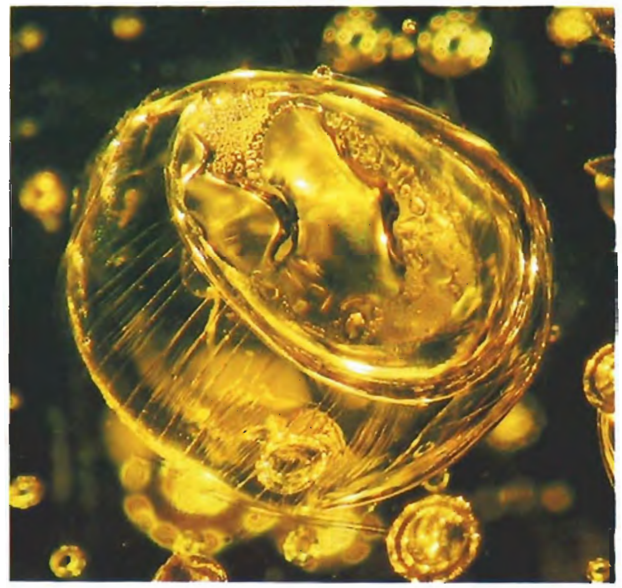

Figure 3. The solid phase of this three-phase inclusion in amber consists of microscopic pollen grains, some of which stick to the inner surface of the void while others fly around. The liquid phase, seen here in various stages of condensation on the inner surface of the gas bubble, is possibly a droplet of ancient rain or dew. Magnified 40×, dark-field illumination.

body fluids trapped within the insect's remains are left behind in the exoskeletal void. If the exoskeletal shell is thin enough to allow the passage of light, then a small mobile gas bubble often can be observed rolling about inside the fauna host. In figure 4, we see one of these mobile bubbles trapped in the abdomen of an ant. Occasionally, small fragments of the exoskeleton will float with the bubble, creating a three-phase inclusion.

The application of polarized light to the study of amber reveals further heretofore hidden details. The spherical voids shown in the first photo in figure 5 house two-phase, liquid and gas, inclusions with a mobile gas phase in each. Under polarized light, framed by bright interference colors, these inclusions show themselves as strain centers in the amber. A close-up of a strain-center

Figure 4. The internal organs of this ant in amber have deteriorated, and only the body fluids remain in the exoskeleton. A bubble of abdominal gas can be seen floating about. Magnified 30×, dark-field illumination.

liquid-and-gas two-phase inclusion shows tiny liquid droplets that have condensed in the gas phase as a result of temperature-change and vapor-pressure alteration.

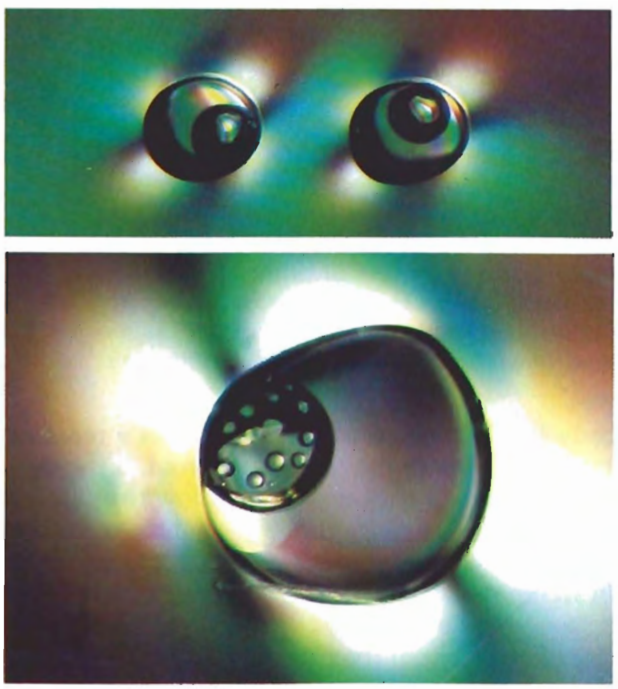

Figure 5. The bubbles in the top photomicrograph house two-phase, liquid and gas, inclusions with mobile gas phases. Under polarized light, these inclusions show themselves to be strain centers in the amber. Magnified 35×. Higher magnification reveals tiny liquid droplets that have condensed in the gas phase as a result of vapor-pressure alteration. Magnified 60×.

Figure 6. The death dance of three tiny bees. The final life movements of arthropods are often traced in amber, but only under polarized light do these final death throes become visible as vivid strain colors. Magnified 10×.

Polarized light may also disclose "hidden" details in amber's fauna inclusions that often remain invisible when other methods of illumination, such as dark field, are used. If insects or other fauna are trapped alive by the resin, their final life movements—as they attempted to escape—are visible under polarized light in the form of vivid strain colors surrounding their bodies and legs. Figure 6 illustrates the death dance of three small bees.

A case of not seeing the forest for the trees. It is obvious that there is more to amber than has previously met the gemologist's eye. These newly recorded facts only add to the unique nature of amber as a gem material.

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