Instructive Micro-replicas from Nail Polish

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The use of nail polish to produce replicas of organic material for further microscope study is described here. The directions are clear and detailed for this unusual technique. The author is in the Department of Zoology at Rutgers.

Micro-replicas are minutely detailed impressions, or casts, of the surface configurations of objects. The preparation of transparent micro-replicas is a technique useful to scientists and one that can be turned to advantage in teaching. It is adaptable to investigations by younger students. Mounted on glass slides for microscopic study, such replicas are unsurpassed for demonstrating the fine surface structure of opaque objects.

Objects painted with suitable solvents may be pressed against plastic cover slips to produce impressions (Lonert, 1960a, 1960b). This can give excellent results and is said to have certain points of superiority to the use of celluloid film or other plastic films softened by heat. However, the flatness of the cover slip limits its usefulness to small areas of subjects that are curved.

I have recently found that beautiful and intricate replicas of surfaces of any contour can be prepared by the use of ordinary colorless nail polish. The surface to be studied is coated with the liquid polish and allowed to dry for several hours. If the film is peeled off too soon, it will be soft and may stretch, distorting the pattern excessively. If the film is allowed to harden too long in a dry atmosphere, it may not be pliable enough to permit moderate flattening without cracking. Some experimentation will be necessary to determine the best thickness of coating and the drying time for the object being studied and the prevailing atmospheric conditions.

Different brands of polish may differ in pliability and in time required for hardening.

A sharp blade, such as a pointed scalpel or a broken portion of razor blade, is used to cut into the film coating around the area desired for study. There is usually no difficulty in stripping the film. The trimmed replica may be lifted off carefully with a corner of the blade or with fine forceps. Trimming replicas of tiny objects is best performed under a dissecting microscope.

Care is required at this stage, since static electricity may cause the fine, lightweight films to cling stubbornly, and a quick breath may blow them away. The replica should be carefully oriented on a clean, dry microscope slide for examination.

With replicas of this type, oblique illumination is not necessary. The lower surface of the film has followed every ridge and valley of the subject, whereas the upper surface has dried smooth and level; hence the film differs markedly in thickness in different areas. These differences cause light passing through the film to be bent to different degrees, so that bold outlines of the surface markings can be seen by transmitted light even though all parts of the replicas are transparent.

These replicas can be used advantageously to study patterns of stomata and epidermal cells on leaves, details of sculpture and pilosity of the exoskeletons of arthropods, and many other subjects. An interested, careful student can prepare excellent replicas and feel that in some cases he may be viewing something that has not been seen before. Enough skill and care are required to present a distinct challenge. Some of the results will be disappointing, but others will more than make up for this.

These replicas can be made semi-permanent by mounting them dry, on slides. Each should be covered with a clean, dry cover slip, gently but not too firmly flattened, and carefully sealed around the edges with adhesive cellophane tape or by a gummed label with a hole neatly cut in the center. If a gummed label is used, care should be taken to use a minimum of moisture in sealing. The films are hygroscopic, and absorption of moisture may cause them to swell and flatten, losing their delicate impressions. The replicas should be protected from moisture when stored, and of course, should never be exposed to solvents that will soften the film.
Fig. 1. Hair of dog (Samoyede), 275x.

Fig. 2. Eye of fruit fly (Drosophila melanogaster), 550x.

Fig. 3. Eye of house fly (Musca domestica), 50x.

Fig. 4. Under side of rhododendron leaf, 550x.
A permanent record of especially good replicas may be made by photographing them. The accompanying figures represent photographs of nail polish replicas, taken on Kodak Plus X film with a 35 mm camera (Contaflex IV). The camera was mounted on an inexpensive copying stand and lowered over the microscope. A single lens reflex camera is convenient but not necessary, since focussing need not be done through the camera. If the object is brought into critical focus by observation through the microscope, a sharp image will be cast on the film if the camera is then positioned so its lens is at the normal eyepoint or slightly above it. The lens may be removed from the camera, or it may be focussed at infinity with its iris diaphragm set to the widest aperture. With reasonable care the camera can be centered satisfactorily over the microscope without any need for viewing through the camera.

It is advisable to use shielding to prevent stray light from entering the camera, unless the room illumination is low or the camera is very close to the microscope ocular.

The photographs shown here (Figs. 1-4) were taken without removing the camera lens and without shielding it, in dim room illumination, showing that acceptable pictures can be obtained by this simple method. However, it is essential to eliminate vibration, to focus carefully, and to have the subject well illuminated. It will be necessary to experiment to determine the correct exposures for any given set of conditions.

References

New Books

“New Books for the High School Science Shelf” is a reprint of a bibliography compiled by Louis Panush published in School Science and Mathematics, October, 1961. The cost for a reprint is 35c and it may be obtained from Louis Panush, MacKenzie High School, Detroit, Michigan.

"Challenge"

A series of 13 half-hour educational television programs, produced at Argonne National Laboratory, will be shown throughout the country under the title of “Challenge.”

Information Handling

The Biological Sciences Communication Project of the AIBS has published a bibliography, “Information Handling and Science Information,” and it may be ordered from AIBS for $2.00 per copy.

Research

Research and development by private industrial firms in 1960 amounted to 10.5 billion dollars. In 1959, 9.6 billion dollars was spent. Over fifty percent of this expenditure is financed by the government.