PHOTOMICROGRAPHY OF MOSQUITOES WITH THE SINGLE-LENS REFLEX CAMERA [1]

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The writer has done a considerable amount of photomicrography of the various stages of mosquitoes with the single-lens reflex 35 mm. camera known as the "Practica FX," manufactured by the Kamera-Werkstatten (KW-Optik Works), Dresden, Germany. All procedures described herein are based on experiences with the Practica, but, since all single-lens reflex cameras work on the same principle, it is probable that very good results may be obtained with other such cameras.

In a single-lens reflex camera, the image formed by the lens is photographed right side up. A mirror, set at an angle of about 45 degrees, reflects the entering light upon a rather large ground-glass focusing-viewing screen, hence the name "reflex." The focusing screen in the Practica measures 24 x 36 mm. The film runs along the back of the camera, directly behind the mirror. A large hood surrounding the screen permits better viewing, and the picture is seen in full brilliance.

The single-lens reflex camera is free from parallax regardless of the distance from the subject, because both the viewing and taking are performed by the same lens. When the camera is mounted on a microscope, the photographer looks horizontally at the screen. A hinged-on magnifying glass permits critical focusing of the reflex image.

The Practica has the following shutter speeds: 1/500, 1/200, 1/100, 1/50, 1/25, 1/10, 1/5, and 1/2 second. A "B" setting, which is ordinarily used for taking flash pictures, permits speeds less than 1/2 second. The Practica can be put to very good use by the entomologist who is interested in photographing the different stages of mosquitoes on 35 mm. film. Superb Kodachrome slides, as well as good black and white pictures, may be obtained with a little experience.

The photo-micro attachment for the Practica is the same as that used for the Exacta, except that an adapter ring is added to fit the Practica. Since the camera lens is not used, the lens mount is unscrewed and removed from the camera, thereby avoiding the necessity for adjusting the lens opening.

After the camera is in place, any necessary adjustments as regards the picture frame and focusing can be accomplished by viewing the reflex image on the focusing screen.

Low-power objectives and oculars are very useful in taking pictures of entire eggs, egg rafts, larvae, pupae, and adults. Any compound monocular microscope having a substage condenser can be used. First, the ocular is removed; then the un-

[1] The material presented herein in no way constitutes an endorsement by the Department of Defense.

[2] At the time this paper was submitted, Entomologist, Engineer Research and Development Laboratories, Fort Belvoir, Virginia; now Lt. Commander in U. S. Public Health Service, FOA, American Embassy, Monrovia, Liberia.

Editor's note: The editor felt that Dr. Burton's manuscript as originally submitted could be shortened and made of more specific interest to mosquito control workers if certain details, e.g., a discussion of lenses, were omitted. Other reviewers shared this opinion and were also agreed that other details, which can be found in manuals of photography, could well be omitted in the interests of economy. The editor obtained permission from the author to make certain deletions, and then went on to make a few more, shortening the manuscript by nearly half. Unfortunately, Dr. Burton is now in Liberia, and could not be consulted on these changes, for which the editor must therefore accept full responsibility. The editor feels that the chief value of the paper is to those persons who are interested in mosquitoes but who are not necessarily experienced photomicrographers and that in giving instructions which are obviously the results of many painstaking trials, the paper will save other workers much of the time that is ordinarily spent in such trials.—D.L.C.

hinged photo-micro attachment is slipped over the body tube for a short distance, and the holding screw is tightened. The ocular is replaced, and the hinged portion is fastened. The camera body may be screwed on either before or after this procedure. A microscope lamp having at least a 100 watt bulb is placed directly in front of the mirror, so as to permit a maximum amount of light to pass through the microscope.

For black and white photography, a film having a fast or a slow film speed rating may be used, and the exposure time varied accordingly. The writer prefers to use a film having a B.S. and A.S.A. Arithmetic Index rating of 50, such as the Kodak Plus-X (PX 135), which is a fast, fine-grained, panchromatic safety film. Its equivalents are B.S. and A.S.A. Logarithmic Index 28°, European Scheiner 29°, DIN 18/10°, Weston Speed 40, G.E. Speed 64, and Hurter and Driffield 2000. Slow film rated less than 50 B.S. and A.S.A. Arithmetic Index may be used, if desired.

No light meter is used in photomicrography as described here. When using Plus-X film, if the subject on the slide is neither too dark nor too light, the picture is taken at a shutter speed of 1/50 second. If the subject is somewhat darker than average after the light is transmitted through it, the exposure should be from 1/25 to 1/2 second. Since a cleared or entire specimen of any particular species has a yellowish or brownish pigmentation, the shutter speed will have to be varied accordingly. The beginning photographer will have to practice on several rolls of film, keeping accurate notes for each picture taken. For each picture snapped, there should be noted the genus and species of the specimen, the life history stage involved, the shutter speed used, the magnification at which the picture was taken (ocular multiplied by objective), and whether or not certain filters were used. Then, after the pictures have been developed, each photograph should be compared with the detailed data previously taken, and the particular slide studied again. Thus, after several rolls have been taken, the photomicrographer will have a very good idea of the type of lighting, shutter speed, and the best magnification to use with any particular specimen.

For detailed studies at high power, one may enlarge portions of photographs taken at lower powers, but much better results will be obtained by actually photographing the particular structure under high magnification at the outset. For instance, one may photograph an entire culicine larva under low power, then enlarge the posterior segments so as to show the pecten under a high magnification. Since the light being transmitted is decreased with increase in magnification, the shutter speed will have to be decreased as the lighting is decreased, taking into consideration the pigmentation of the specimen. Thus, referring to the example cited, if pecten teeth are photographed under 100X to 440X, the shutter speed might be set at 1/50 to 1/2 second, depending on the general light intensity at the high magnification, as viewed on the focusing screen.

Considerable use should be made of the hinged-on magnifier, which is flipped into position with a flick of the finger. This lens is quite powerful for its size, and by looking through it the subject on the focusing screen below the magnifier is seen in great detail. The fine adjustment is turned while the photographer looks through the magnifier, until the subject is seen at its sharpest setting. The magnifier may then be flipped back to its original position. The shutter is then released. A cable release is very valuable for releasing the shutter at the exact moment desired, so as to avoid moving the camera.

Since the various life history stages of mosquitoes vary in color from pale yellow to deep orange, brownish orange, or brown after being mounted on slides, yellow and blue filters may be used to good advantage. In order to obtain better detail, use a filter of the same color as the preparation, while to obtain contrast use a filter of a complementary color. Filters

of intermediate color may produce a useful compromise.

Filters may be home-made of colored glass, colored cellophane, colored inks, or colored chemical solutions, or else regular commercial filters may be purchased. When using a dilute chemical solution or dilute colored ink, the liquid should be placed in an 8-ounce flat prescription bottle, which is then placed between the light source and the mirror. Dilute methylene blue, copper sulfate, or blue ink will produce blue filters of any intensity desired; try them in ½ percent to 2 percent solutions to see results obtained. Yellow filters are made by using a 2 percent picric acid solution, ½ percent naphthol yellow solution, 10 percent potassium chromate, 10 percent potassium dichromate, or dilute yellow ink. An orange filter is made by using a 2 percent Orange G solution and a variation toward the red by using 2 percent eosin. A red filter may be produced by using 2 percent magenta red, carmine, Congo red, or dilute red ink.

When using a commercial, mounted filter, the most convenient position for it is below the stage; if necessary it may be placed over the mirror. If the filter is merely a glass disk, it should be slipped into the slot which is made to hold a filter, in the substage apparatus.

Insect preparations usually give more satisfactory photomicrographs when yellow, orange, or red filters are used, since the details stand out very well. When a blue filter is used, a contrast is produced, so that certain organs and fine markings stand out very sharply. The entomologist may check the effect of filters by using them while studying mounted specimens during routine work.

It is suggested that the beginner carry out the following procedures in order to learn quickly the fundamentals of photomicrography of insect preparations. Select an excellent slide of a culicine larva, complete in every detail and of medium yellow intensity, and set the posterior end under a magnification which will enable all details of the 8th and 9th segments to be seen on the focusing screen. Without using any filter, photograph this view in sequence at the following speeds: 1/100, 1/50, 1/25, 1/10, 1/5, and 1/2 second. Then repeat this sequence, using a yellow filter; repeat using a red filter; and finally repeat while using a blue filter. Have the film developed and make 3 x 4 inch prints, or 5 x 7, if the photographer is doing his own developing. Remember to keep accurate notes, so as to identify each print properly. On each print, write the appropriate data concerning speed and filter. Now lay out all the prints, and study them carefully. The amateur will learn more about photomicrography in this manner than by any other system of guess work. If a very light colored and a very dark colored microscopic preparation are available, the entire procedure may be repeated, if desired. After a while the photomicrographer will be able to look at any preparation and know just what kind of filter to use, if any, and the best shutter speed to use, so as to bring out the most detail. It must be re-emphasized that the color of the preparation at the desired magnification is the key to determining which speed and which filter (if any) are to be used. Many pictures can be taken without using filters at all, if the preparation is a good one.

Kodachrome transparencies of mosquito preparations usually come out very well when a few simple rules are followed. Daylight Type film (K135) is used. Since the film speed rating is only 10, the shutter speed must be less than that used with Plus-X black and white film. Excellent results are usually obtained at 1/25 second when an average subject is photographed, but darker preparations may necessitate 1/10 to 1/5 second. A very light subject will necessitate using 1/50 second. A yellow, orange, or red filter will bring out many details, and should be selected according to the color of the preparation. A blue filter is of no value in color photomicrography when using Daylight Type film, as the entire preparation will then come out blue.

A very important thing to remember is that various scales, teeth, and hairs are in

different planes; consequently, not all such structures will stand out in any one field. It may be necessary to take photographs at different levels or planes if pictures of such structures are desired. Critical focusing with the aid of the hinged-on magnifier will ensure sharpness of the image.

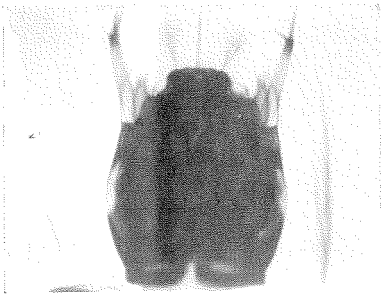

FIG. 1.—Head of *Anopheles maculipennis,* 1/50 of a second.

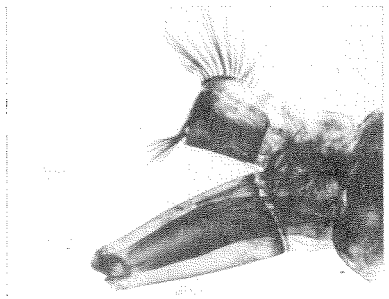

FIG. 2.—Larva of *Aedes dorsalis,* 1/25 of a second, yellow filter.

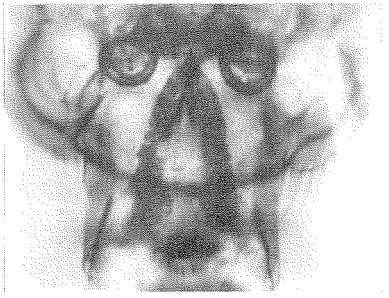

FIG. 3.—Spiracle of larva of *Anopheles maculipennis,* 1/50 of a second, 150 X.

When using an ocular and an objective of very low power simultaneously, the lighting is often distorted, due to the inherent nature of the 3.5X and 2.5X objective and to the height to which the body tube must be raised when using such objectives. The light becomes concentrated in the very center of the preparation. This phenomenon can be remedied by removing the substage condenser, so that the light is not too concentrated.

All of the procedures described above pertain to photomicrography through the compound monocular microscope, making use of transmitted light. Let us now consider the use of the stereoscopic dissecting microscope.

If a dissecting microscope is mounted on a mirror-bearing base, light may be either transmitted or reflected. When the opaque metal plate, which is ordinarily in position beneath the glass stage, is removed, the subject on the slide is viewed by transmitted light as with the compound microscope. The photo-micro attachment may be affixed either to the left or to the right tube, and the camera will then be set at an awkward angle. In this way, the subject may be photographed as heretofore described, but results are not quite as sharp as when the compound miscroscope is used. It is not necessary to cover over the ocular which is not in use. The low-powered stereoscopic microscope permits photography of an *entire* larva, pupa, or adult.

If the white plate is slipped into position, an entire adult mosquito may then be photographed by means of reflected light from above. This light must be very strong and intense, otherwise the image appearing on the focusing screen will be too dark, and the picture will not come out. The adult may be mounted on a pin, and the pin thrust into a cork so as to bring the specimen into the position desired; else the specimen may simply be laid upon the stage. A lower shutter speed is necessary for such cases, due to the diminished lighting, consequently, it will be necessary to use speeds of 1/10, 1/5, 1/2 or 1 second, or more. Use the same procedure of photographing sequences at different

speeds, as already described, in order to see what the results are at the various speeds under this particular method of lighting.

Pinned adults may be photographed without the microscope if a series of extension tubes is on hand. The addition of special close-up lenses will shorten the focus. When using extension tubes, it is necessary to increase the exposure time as registered on a standard exposure meter. An exposure meter should always be used for taking pictures other than through the microscope.

MOSQUITO SURVEY OF HORN ISLAND, MISSISSIPPI

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Entomological surveys in connection with insect control activities were initiated at Horn Island Installation, Mississippi, in February, 1944, and were continued through July, 1945.[3] Considerable data were accumulated during this period on the insect fauna of Horn Island, including prevalence, seasonal distribution and breeding habitats of various species of mosquitoes. A summary of the mosquito surveys is presented as a further contribution to previously published accounts on the distribution of mosquitoes in the southeastern states. Although all species recorded in Table 1 have previously been reported from the state of Mississippi, only two species have been reported from the island chain just off the coast of Mississippi. These represent collections from Ship Island as follows: *Anopheles atropos* by Komp (1926) and *Aedes taeniorhynchus* by Dyar (1926). An examination of the records of the Fourth Service Command Medical Laboratory revealed several unpublished records that were submitted as miscellaneous collections from these islands. The collections are listed by species, number collected, type and date of collection and locality. The symbols in parentheses indicate the types of collection; (L) larval and (R) resting station: *Aedes sollicitans,* 22 (L) February 23, 1945, Ship Island; *Aedes vexans,* 1 ♂ (R) February 24, 1945; and 1 (L) February 23, 1945, Ship Island; *Anopheles crucians,* 3 (L) June 2, 1943, Cat Island; *Anopheles bradleyi,* 3 (L) June 2, 1943, Cat Island; *Culex salinarius,* 7 (L) February 23, 1945, Ship Island; *Culiseta inornata,* 42 (L) February 23, 1945, Ship Island.

Horn Island Installation occupies a central position on Horn Island which is located in the Gulf of Mexico approximately six to eight miles from the coast of Mississippi near Pascagoula. The island is twelve miles in length, varies from one-fourth to three-fourths of a mile in width and in shape resembles a slightly curved horn. The terrain is low and sandy with the exception of the longitudinal central portion which is slightly higher in elevation and covered irregularly by small groves of slash pine *(Pinus caribaea).* Several large lagoons and many smaller

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