PHOTOMICROGRAPHY WITH ORDINARY CAMERAS—A SIMPLE TECHNIQUE

BY

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The description of a little-known method which enables anyone who knows how to use his microscope to obtain photomicrographs—which will compare reasonably with the work of elaborate equipment—ought to be of more general interest now than in peacetime, as so many doctors are working in unusual circumstances. The basis of the method depends on the fact that a camera will take a photograph of a "virtual" image—e.g., a reflection in a mirror—as easily as it will that of a "real" one. The image seen in the eyepiece of a microscope is a virtual one, and the results which can be obtained by the method described depend largely on the fact that practically all microscopes work best when the image is viewed in this way. It is relatively seldom that they are so used even in the most expensive photomicrographic equipments; even the projection oculars are to some extent a makeshift, though much better than the ordinary Huygenian type occasionally used as such. The microscope objective is so constructed that it gives its finest optical results when used with a definite tube-length and the image turned into a virtual one by the eyepiece,

Trichinella spiralis encysted in infected pork.
(Low power—1 in.; $\times 100$ approx.)

and the virtual image thus formed is focused at infinity—i.e., as seen by an emmetropic eye completely relaxed. This is the normal and ideal position, though a person with hypermetropia or myopia will naturally focus the image at the most comfortable distance for himself.

In this ideal position clearly the conditions required for photographing this virtual image focused at infinity are that the camera itself should be focused at infinity, the lens put in such a position that all the light coming through the eyepiece enters the lens, and the camera itself put truly in line with the microscope tube. The only thing left is to make the correct exposure and develop the film or plate. For all that it is so simple—literally simple owing to the excellence of present-day microscopes, cameras, and films—a few remarks on the various points mentioned may prove helpful.

Focusing at Infinity

The first point is to ensure that the virtual image is correctly focused at infinity. The simplest way of doing this is to construct a small viewing telescope of low power with which to view the image. This is easily done by sticking a small magnifying-glass of about 4-in. focus—non-achromatism does not matter—at the end of a short tube of cardboard, etc., and sliding into the other end a spare eyepiece from the microscope. This should then be focused on some distant object and its

focus for infinity thus fixed. If this gadget is then put in front of the eyepiece a small part of the image will be seen through it correctly focused. If the image is somewhat blurred a touch on the fine adjustment will bring it into correct focus. Once it has been found, as it may, that the operator's eye is emmetropic and no adjustment of the fine adjustment is needed, it is not necessary to repeat this manoeuvre every time unless lighting conditions are trying or one is doing a great deal of close work. In these conditions the focus of the eye is liable to alter sufficiently to make some slight correction necessary, though I personally have not found the need for it. If, on the other hand, the operator is myopic and wants to take a number of photographs one after the other, a simpler way is to focus the viewing gadget to show a sharp image with the microscope focused as the operator normally uses it, and then turn the gadget on to some object in the room which shows in sharp focus, and measure its distance from the gadget itself. This will give the correct distance of the virtual image, and if the camera is focused for this distance the resulting photographs will be sharp without further adjustment of the microscope focusing.

Position of Camera Lens

The next point is to see that all the light coming through the eyepiece enters the camera lens. In order to do this it is important that the camera lens should be close to the eyepiece and the lens diaphragm opened as wide as possible. Closing the diaphragm will not increase the sharpness of the picture; it will merely limit the field of view. One might mention here that, though reference has been made throughout to a microscope, the method is just as applicable to any other optical instrument using an eyepiece which gives a virtual image—such as a telescope, spectroscope, range-finder, or even a field-glass, through which, with care, excellent telephotographs can be taken. Care should naturally be taken that there is no dust on either eyepiece or lens to scatter the light and so cause unwanted fog. For this reason, also, the simple triplet type of anastigmat—such as the Zeiss Tessar, the Leitz Elmar, and the Aldis—is probably the best, as with this type unwanted reflections and flare spots are less likely to occur. However, nearly any type of anastigmat will serve, as well as any type of camera. The focal length of the lens is of some importance: the longer the focal length the larger the resulting photographs, the less the need for enlargement, the larger the plate or film required, and—a very great disadvantage—the longer the exposure needed.

Placing the camera so that it is truly in line with the microscope tube is not a difficult matter. It can be gauged by the eye accurately enough for all purposes, and with the tube horizontal one can in a minute or so make up a pile of books of the right height, get the camera out of its case and place it firmly on them, and take the photograph. If the tube is to be kept vertical some sort of stand for the camera must of course be used, and once this is fixed, or a block of wood made the right height for the horizontal tube, the operation is even simpler still. It is wise, though not always necessary, to put a cloth or collar round the junction of the eyepiece and the lens to exclude extraneous light, and unless a wire release is used it is best to make the exposure by putting a card between the illuminant and the microscope stage, open the shutter, and then, when everything has settled down again, give the exposure by removing the card for the time required, closing the shutter after the card has been replaced or, alternatively, switching the electric illuminant on and off—that is, unless a slow instantaneous exposure is required.

Exposure and Development

Judging the exposure is not very difficult after a few trials. Most modern films will give a reasonably good print if not over-exposed more than about five or even ten times; so if one is in doubt and is using a miniature camera with its cheap film, it is best to give two exposures—one perhaps a third what one estimates, and the other about ten times as long. One or other of these exposures should give a nearly perfect result. Where exposure needs to be exact is when photographing unstained objects such as diatoms. Using a 2-in. lens, one may say roughly that if with artificial illumination the image is uncomfortably bright and gives a feeling of glare, a fast film such as Selo H.P.2 will require about 1/10 second,

a slow film such as F.P.2 needing five times as much. Using daylight as an illuminant is a more tricky matter even with the help of an exposure-meter. Naturally, a panchromatic film should be used, and the best illuminant is an opal—not pearl—electric bulb of about 40 watts. Except for the lowest powers the illuminant should be correctly focused on the slide by a substage condenser, and those who have not used one will be surprised by the improved definition obtained when an achromatic condenser is employed instead of the ordinary Abbé. One advantage of this type is that with the top lens removed it usually makes an achromatic condenser of longer focus admirably suited to work with a 1/6-in. or lower power. When out of reach of electric light the side of an oil-lamp flame, correctly focused, is probably still the finest illuminant possible, and, as shake here is unlikely, the longer exposures required are not of much consequence.

The only point requiring special notice as regards development is the degree of contrast desired. In this case it is not a question of obtaining an artistic print but one which will show clearly the structures involved. Until ciné colour film becomes available once more we have to differentiate in a photograph by the use of contrast instead of colour-staining. Therefore films should usually be well developed to give as wide a contrast as possible without, however, in the case of miniature cameras, going so far as to increase grain size. We must use panchromatic film, which reproduces the brighter colours very much alike, and for this reason the use of colour-filters to bring out contrast is most desirable. For difficult work the skill of the photographer will be shown by his judicious use of these more than by anything else. Fortunately the filters do not need to be optically worked like those used on cameras, as they should be placed between the illuminant and the condenser. An opal bulb gives rather a reddish light, so the factors for blue filters will be decidedly more than they would be for half-watt lighting, and very much more than for daylight.

Conclusion

Many variants and developments of the general idea given here can be worked out. The owner of a twin-lens reflex, for example, may prefer to focus the image through the top lens before taking the photograph through the lower one. The fortunate owner of some high-power binocular microscopes might like to set his camera semi-permanently over one of the eyepieces, viewing down the other and snapping as often as he pleases. In the same way serial views through the thickness of a section or animal may be taken with the utmost economy of time and material by just moving the fine adjustment a definite amount on each occasion; and views, say, of the disposition of chromosomes in three dimensions or of the internal organs of an insect obtained in a very short time. When peace comes, students, who are often keen photographers, may by this means be helped to take a greater interest in many of their pathological and other slides by photographing them. In fact, the possibilities are as endless as the uses of optical instruments themselves; and even though the result may not invariably be first-class they should always be presentable and certainly full of interest.

The accompanying photograph, taken with a miniature camera, will give an impression of the work which can easily be done.

BIRMINGHAM HONORARY STAFF

In the latest annual report of the Birmingham United Hospital (which includes the General Hospital, founded in 1766, and the new Queen Elizabeth Hospital at Edgbaston, founded in 1938) the Board pays a grateful tribute to its honorary medical and surgical officers, upon whom heavy burdens have fallen. They are discharging important duties under the Ministry of Health, requiring frequent visits to many outlying hospitals, and yet they have continued to serve the United Hospital unsparingly. It is mentioned that as a body, speaking through the Medical Committee, which is composed solely of members of the staff, they have consistently refused to accept any portion of the funds derived from contributory schemes. From time to time there has been set aside a small percentage—at present 1%—of maintenance fees paid by the ordinary non-contributory patients. The small sums so accumulated have been applied by the Medical Committee in furtherance of the interests of the hospital. Officers who have been marked out for staff appointments have received financial help in undertaking postgraduate studies

in important medical centres in Europe and America, and in addition new scientific equipment has been bought for the hospital from this fund. It is stated to be the desire of the staff that the question of adequate payment for services rendered shall remain in abeyance until such time as the Royal Colleges of Physicians and of Surgeons or the British Medical Association have expressed their views, and proposals have been put forward which would operate on a national, or at least a regional, basis.

The honorary medical and surgical staff of the Birmingham United Hospital numbers 36, and in addition there are 15 honorary consultants. The normal capacity of Queen Elizabeth Hospital of 516 beds has been temporarily increased, and the average occupation during the year covered by the report was 592. At the General Hospital, working within a limit of 160 beds, 6,240 in-patients were admitted during the year. The comparable figure for the last pre-war year, when three times as many beds were available, was just upon 8,000, so that more than three-quarters of the number of patients have been treated in one-third of the beds—meaning a quicker turnover and the use of the hospital only for the acute stages of illness, with consequent heavier work for the nursing staff, to whom also a tribute is paid for its "admirable spirit of cheerful service."

UNCOUNTED LONDON

For the first time in its history it is not possible to state the population of London. The London citizen may from the superficial aspect of its streets conclude that it is more crowded than ever, but the statistician is silent on the subject, saying only that the population is much smaller than before the war. The absence of this governing figure takes away much of the value of the statistics which are given in the report of the County Medical Officer of Health for 1942.¹ We are told, for example, that the deaths of Londoners during that year were 7,500 fewer than during the year before, and the births 7,000 more, but the rates per 1,000 of population cannot be given. The picture of the infectious diseases incidence is a little more clear, since the heaviest incidence is among children, and it is known that the child population has increased. The number of elementary school children went up by 72,000 during 1942, and that fact must be borne in mind, otherwise an increase of nearly 9,000 in the number of notifications of measles and of 2,000 in those of scarlet fever would be misinterpreted. In general, the pattern of the health of London repeats that of the whole country. Deaths from influenza, rheumatic fever, pneumonia, and infectious diseases showed a gratifying decline. Infant mortality fell to 50 per 1,000 births, although that figure is above the record low rate in 1939 of 47. The rate of maternal mortality fell to 2.51, but in 1939 it was 1.97. It is worthy of note that of the 40,000 births in London, 12,000 took place in the Council's hospitals, and 11,000 others were attended by midwives under the Council's domiciliary scheme. Figures are never quite what they seem, and their deceptiveness is increased in the confusions of war. From a superficial study of the figures for attendances at the venereal diseases clinics in London one would suppose that venereal diseases were declining. The total of new cases in males seen at the clinics in 1942 was just half of what it was in 1938; but the clinics deal mainly with civilians who, at the younger ages, 18 to 30, are not nearly so numerous in London, especially the men, as in pre-war years. Another factor to be borne in mind is the success of the drug treatment of gonorrhoea, which means that many patients who formerly attended the public clinics are now treated by private practitioners. "There is little doubt," says Dr. Allen Daley in his report, "that in each sex the incidence rate is increasing." The school medical service of London assumed a more normal shape during the fourth year of war with an elementary school population increasing from 148,000 at the beginning of 1942 to 220,000 at its close. An examination of 88,000 children in the four age groups (that is, on entering school, at 7, at 11, and at 13 plus) was carried out, and unsatisfactory nutrition was discovered in 6.2%, being almost the same proportion (6.6%) as in 1938, when the examination covered twice the number of children. That the nutritional condition of the great majority is satisfactory is attested by some independent observers, among others by Dr. Sydenstricker, an American authority on deficiency diseases, who, at the request of the Ministry of Health, made a sample examination. In the examination of the 88,000

¹ London County Council. *Interim Report of the County Medical Officer of Health and School Medical Officer for the Year 1942.* (6d., post free 7d.)