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MICRO WORLDS

Brian Ford, scientific author and broadcaster, tells how simple it is to take photographs through a microscope.

SOMETIMES people look in amazement at some of our pictures of microscopic structures — they are struck by the beauty, and the unexpectedness of it all. And perhaps they are intrigued to realise that a jagged rock face is really the tip of a finger, or that there are so many delicate, translucent organisms in a drop of stagnant water from somebody's garden pool.

But above all, the photographers who see them react most strongly. They are mainly used to conventional images and orthodox views of life and matter, and this glimpse into a world of the unknown is almost startling. It is a reaction intensified by the knowledge that this is a new field to almost all of them — a specialised discipline that they could never afford to enter.

And that is all wrong. There is no need to utilise expensive apparatus or costly attachments in order to enter the world of microscopic photography — indeed almost anyone could do it. I realise that sometimes we all read statements of that sort which assume you already possess a single-lens reflex with automatic aperture control . . . but in this case I mean it quite literally.

Anyone with a box Brownie and a toy microscope can take pictures of this sort. In fact, if you were to take them as I did at first — when I was in school and used projected images recorded as negatives on bromide paper — you don't need a camera at all!

The popularity of toy microscopes makes it fairly likely that you can get hold of one already. If not, then why not buy one next time you plan some investment in new equipment? There are very good small instruments on sale which won't cost five pounds — and imported bench microscopes are cheaper than most standard accessories.

A magnification in the region of x50 to x200 is the most propitious for amateur use. Some of the toys which boast of magnifications nearer the x500 mark give a curved field of view which is not evenly in focus, and in addition the amount of transmitted light becomes so dissipated over the eyepiece field that it is too little to give a photographic image. A single, bright, reliable objective lens is far better than a range of magnifications of uncertain quality.

It is the objective that is nearest to the specimen slide, of course; and in most cases the distance between the slide and the lens itself is less than a centimeter. The correct way to focus is to place a slide on the stage with the objective lens almost touching it; and then rack up — as we say in the trade — until the specimen appears in focus.

You will find it important to cultivate that as a habit. Unfortunately the natural impulse for the beginner is to rack down — and it is the crunching sound of a disintegrating specimen slide that tells him he's gone too far. For some reason everyone assumes that the microscope will be in focus when its objective is several inches away from the slide — in fact on almost every occasion that I have seen a microscope on TV or on the cinema screen it has been set up in this way. As you will find out, it's quite wrong.

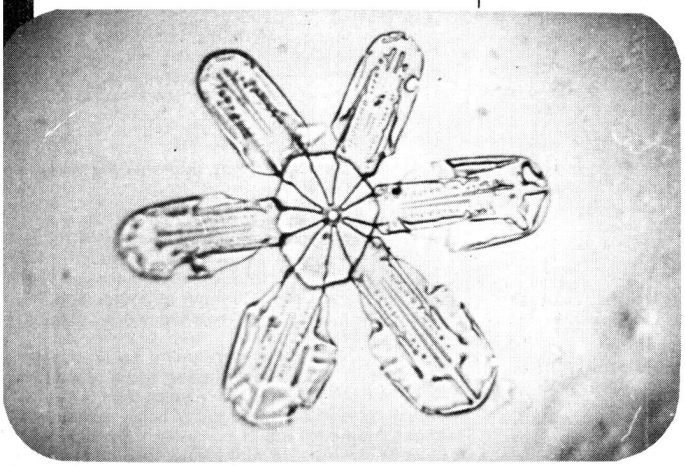
Having focused on the slide, you will find it easiest next to adjust the light. Do not try to use sunlight as it will dazzle — but northern light from bright clouds is excellent. For colour film (either balanced for artificial light or in conjunction with a correction filter) a slide-projector supplies an excellent light source which most amateur microscopists never think of.

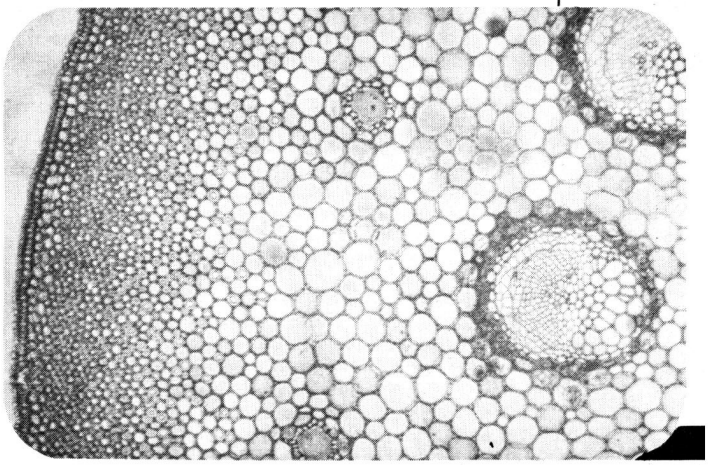
Try to adjust the amount of light so that it is just a little on the bright side (just slightly more than the eye finds comfortable, in other words) and that will probably give good results with medium speed films at 1/25 or 1/30 second exposure and an aperture of around f/2.8. Take care not to cut down the aperture or an image of the iris will appear on the film, cutting off the corners in an annoying fashion.

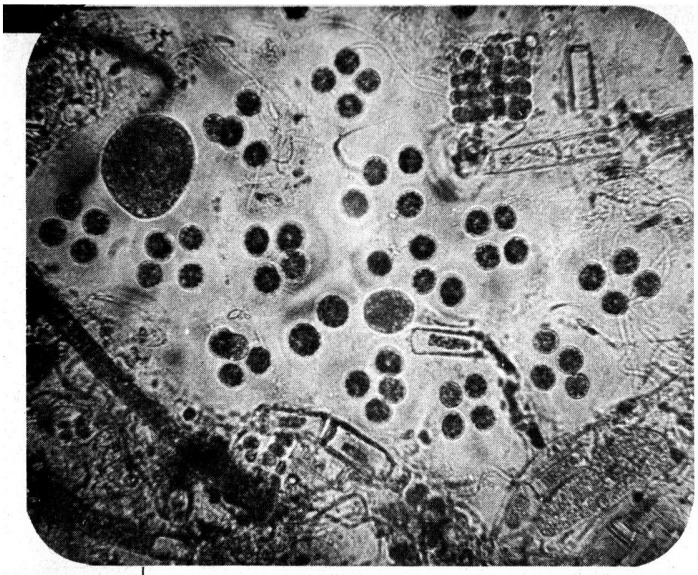
Now let us turn to the way of using the three main types of camera.

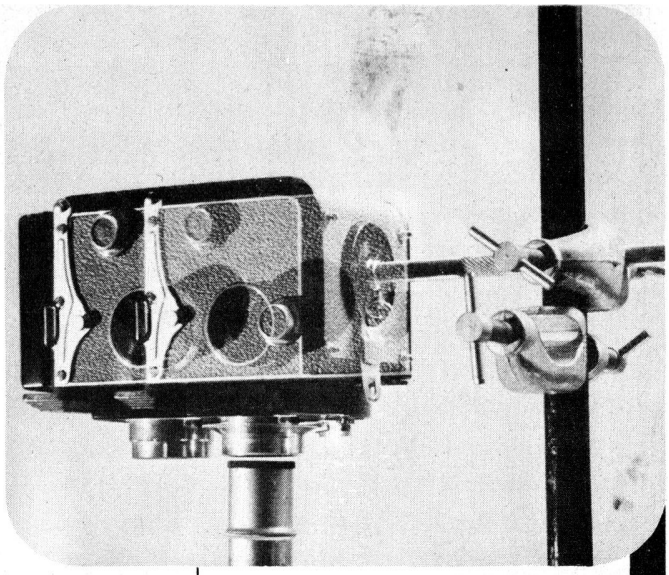
The single-lens reflex is the easiest to use, of course; and there's no reason at all why it shouldn't be hand-held. Focus the slide ordinarily and then place the camera adjacent to the eyepiece — but not touching it. The camera lens can be focused at its nearest setting, in which case the centre of the field of view will more completely fill the frame, or at infinity, in which condition you will get more of the view in. Then, with the camera pre set to maximum aperture and an exposure of around 1/25 second, finally focus the microscope and

BELOW LEFT: This photograph was caught on a freezing slide and photographed with a Brownie camera, hand held. Microscope, camera and photographer were outside, in the cold! BELOW RIGHT: Transverse section of a typical plant stem.









ABOVE LEFT: A likely piece of slime! Algal cells from a stagnant ditch. This picture was taken with the camera hand held, through a pre-1914 microscope. ABOVE RIGHT: Double exposure shows how twin-lens reflex cameras can be set for focusing down the microscope eyepiece, then moved along to get the taking lens in line.

expose the frame.

Twin-lens reflex cameras can be used in an essentially similar fashion, but it pays to focus on the viewfinder screen and then reposition the camera so that the picture lens is adjacent to the microscope instead. The double-exposure shown top right illustrates the principle of this technique.

A non-reflex or box camera is set up under slightly more chancy circumstances. The field of view is selected and focused as before — but this time you do not have any means to check the focus before exposing the film. So take care to relax the eye completely when focusing — i.e. see to it that, as far as you can, your eye is fully accommodating and staring at infinity.

Then, with the camera set at infinity too, the image will probably be in focus in the frame. Only trial and error will prove the point, but it is a technique that gives far better results than you might at first imagine.

There is no satisfactory way of checking exposure times without an expensive photometer. But the rule-of-thumb approach I have outlined will bring you to within striking distance of perfection, and if you carefully note all the conditions when you expose a picture you can compare results and make amendments next time if necessary.

One of the commonest errors is to find mysterious grey patches on the negative. More often than not they turn out to be dirt on the microscope lenses. The eye, in its conveniently efficient manner, manages to ignore them when you set up the instrument but there they are, larger than life, on the finished result.

To see them it is best to rotate the eyepiece and then the objective when looking down the microscope. The movement of the dirt particles betrays their presence at once — and not only that, by carrying out the manouevre as described you can see at once which lens element is the dirty one. Use a clean cloth (a fresh handkerchief is ideal) to clean them, or a lens brush or tissue if you want to be pedantically professional about it. The end of your tie may be the right shape to do the job, but it has a tendency to have hung in gravy or dishes of developer at unguarded moments and is, as a result, not very suitable for delicately cleaning high-power lenses . . .

The specimens you can use to experiment with are many. Without doubt it is best to start off with prepared slides. Most camera shops and the larger toy-shops too have selections of microscope slides. Purchase some with bags of detail — the sting of a bee is a non-starter as a photographic object, but the head of a house-fly (even though it sounds very ordinary by comparison) has far more exciting detail worth capturing.

Sections of plant tissues are invariably good subjects for the camera. The nature of plants gives them a characteristically thickened cell wall, and this means that their structure is somewhat 'foam'-like — a little like a bar of aereated chocolate broken in two. The cell walls show up clearly at a whole range of magnifications and their designs are endlessly fascinating. The zones in which the normal 'padding' tissues are situated show up as large regular cell configurations which become individually smaller towards the periphery of the plant itself.

The smaller cells that form in groups are concerned with special processes in the plant (such as the conduction of food materials from the leaves to the remainder of the tissues). And the largest cells of all, with specially thickened walls, are those of the xylem — the 'x' is pronounced like a 'z' — which are the tube-like vessels along which sap is conducted upwards from the roots.

Sections of animal tissues are interesting too, though you will find them more difficult to interpret. In animals the cell walls are hard to see at all — there is only a thin cell membrane instead — but the nucleus, or controlling centre, of each cell is visible as blobs (generally stained blue or purple) closely clustered together.

So much for the histology lesson — but it does pay to have some kind of idea what you're looking at!

No doubt you will want to look at the life going on around you.

The first specimen of this sort to apparently dawn on most people is — blood. I can picture the scene: Dad busily trying to polish a spare piece of clear photographic plate to catch the precious fluid while young son sits grizzling on the step, not in the least convinced that an inspiring piece of serious scientific study is at the end of it all.

And by the time that the glass slide has been dabbed onto the oozing, grazed knee, and its all-important specimen is actually ***there,*** under the lens, what does it look like?

I'll tell you — it has the appearance of a lump of brown porridge. I suspect that brown porridge is probably the more photogenic.

The best way to see blood cells is to take a finger-prick sample of blood and smear it onto a standard 3x1 inch slide. Use a sharp needle and gently jab at your own finger, just below the nail-bed. It ***doesn't*** hurt. Bring the end of the glass slide into contact with the small blob of blood that results, and then — with another slide — scrape the drop along from one end of the slide to the other. It spreads out to form a very thin, almost grey smear in which the cells will be well separated out.

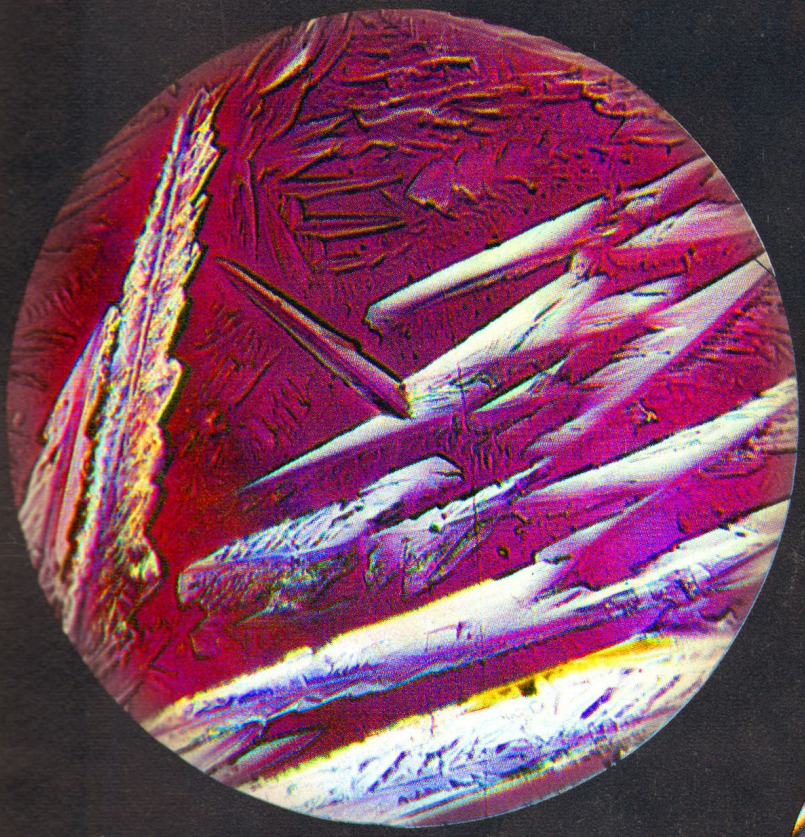
The easiest way to see them is to simply put the slide under the lens and focus — no stain, no oil, no mountant, not even a cover-slip; and you can photograph the results if you care to.

Do not be put off by the apparent complexity of the subject. It is available to all.

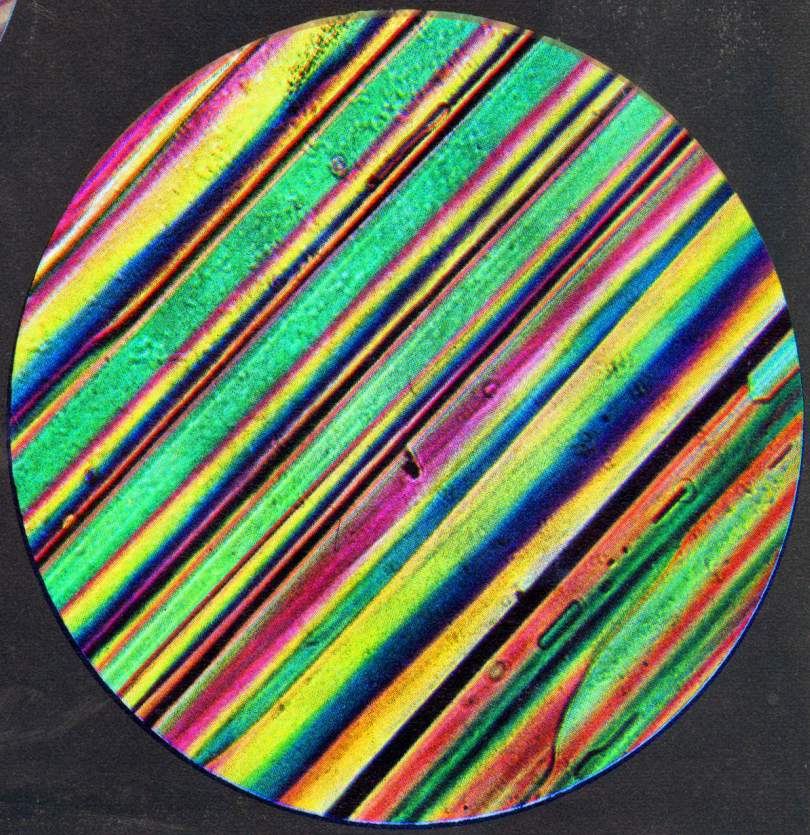
Turn over for micro-colour

Micro Worlds

The small, translucent, oval-shaped objects in this photo-micrograph are the egg cases of the human hair louse. They are attached to the hair of a teenage girl. The picture was taken on Kodachrome II, using flash illumination.



These very small crystals formed when a drop of strong chemical solution evaporated. Two pieces of polarizing filter were used to produce the vivid colour. One filter was placed in front of the light source; the other over the microscope eyepiece.



These long, thin crystals were also taken by polarised light. The colours of the crystals changed as the filter in front of the light source was rotated. A camera lens was not used on the Pentax body used to take these pictures. The image was formed on the film by the microscope lenses only.