Colour Microscopy in Ultra-Violet Rays

ULTRA-VIOLET microscopy has important advantages in the study of different microscopic objects[1]. In 1939 I suggested a new method of microscopy in ultra-violet rays, making use of selective absorption or reflexion of microscopic objects in the ultra-violet[2].

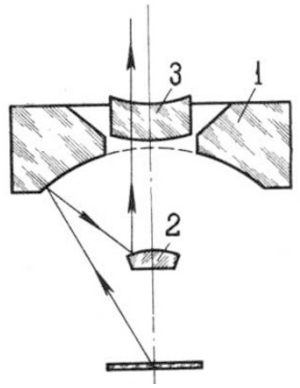
The first version of this method—the photographic one—is the following: a colour photomicrograph of a non-coloured object is taken in a way similar to that used in ordinary three-colour photography. The only difference is that to take the photograph three wave-lengths in the ultra-violet are used, whereas the reproduction of the three separation negatives is made with the help of the three primary colours in the visual, namely, red, green, blue. The hues of the details of such colour photomicrographs are given by the difference of densities of negatives taken in the ultra-violet, hence by the ultra-violet spectral absorption or reflexion curves for the corresponding parts of the object. The colours obtained are, of course, conventional; the image of the object is, so to say, shifted on the wave-length scale from the ultra-violet into the visible.

Some colour photographs taken in the way described are reproduced elsewhere[2,3]; they are illustrative of the possible applications of the method.

It is of great interest to construct instruments for direct colour vision in the ultra-violet without the use of the photographic methods. I have recently worked out and described two similar versions of a method for visual colour microscopy in the ultra-violet[1,4]. In the first, one each of the three ultra-violet wave-lengths excites one of the three primary colours on a fluorescent screen covered with a mixture of three substances, differing in the colour of their fluorescence, as well as in their excitation regions. In the second version, two rotating disks with three light filters each are used. Each filter of the first disk allows a certain part of the ultra-violet spectrum to excite a fluorescent screen and the corresponding filter of the second disk transmits one of the three primary colours of the white fluorescence excited.

The most essential part of the arrangement for colour vision and colour photography in the ultra-violet is the objective of the microscope. As is well known, it is not possible to realize achromatic objectives of large aperture for the ultra-violet with the use of the transparent lenses available for that region of the spectrum. Hence up to now only 'monochromat' objectives for monochromatic light had been devised by Rohr and Köhler[5]. The only attempt to use for this purpose the new reflexion optics was made recently by Johnson[6]. For colour microscopy, especially the visual kind, achromatic objectives are required. Therefore an objective of a new type based on reflexion optics (numerical aperture 0·50, $f = 6$ mm.) has been made by S. Gershgorin, P. Radchenko and myself following the suggestion of Gershgorin. The optical scheme is shown in the accompanying drawing. The reflexion objective, in contrast with the monochromat of Rohr and Köhler, allows the use of a broad spectral region; in consequence the arrangement is greatly simplified, more convenient light sources being used instead of the high-voltage spark of Köhler's microscope, and the expensive quartz monochromator being replaced by light-filters.

The method of staining of objects by organic dyes that are adsorbed on the tissues of the section, applied by biologists, is not highly selective enough and is usually characteristic only of a relatively large group of related substances. More refined investigations are made possible by the use of specific microchemical reactions that result in the formation of dye substances in the object itself. Unfortunately, most of the substances formed as the result of such reactions do not show any marked colour. Hence the search for microchemical colour reactions, especially for complex albumin compounds, is a difficult task. If, however, ultra-violet 'colours' typical for a great number of substances could be found, it is easy to visualize a new field of 'ultra-violet microchemistry', making use of the selective ultra-violet absorption of the products of the microchemical reactions. The development of this field which will follow the development and simplification of the microscope for visual observations in the ultra-violet will constitute an essential addition to the method of colour investigation of microscopic objects by means of the characteristic absorption of natural substances.



1, 2, MIRRORS; 3, FLUORITE LENS TO COMPENSATE FOR THE CHROMATIC ABERRATION OF COVER GLASS.

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Reverberation in Small Glass Tubes

A CASE of what at first seemed anomalous resonance has been found here in the course of blowing small bulbs on the end of capillary tubes of "Pyrex" brand glass. If a piece of capillary tubing of this glass of between 0·7 mm. and 4 mm. bore and about 8 cm. long is melted at one end and a bulb of about 1 cm. is blown, during blowing and afterwards the tube will be heard to emit a note the frequency of which depends principally on the diameter of the bulb but also on the stem length and the bulb temperature.

If the bulb is thick-walled, the note may continue for a minute or longer; or if the bulb is held in the flame at about 700° C. the note may be sustained indefinitely, or at least until the bulb collapses. While the note continues, an appreciable efflux of air seems to take place from the tube.

Evidently the oscillation starts in a way reminiscent of the troublesome oscillations which make Clement and Desormes' classical experiment on specific heat