A simple monochromator.

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AN easily constructed apparatus, giving illumination by light of any chosen colour, and of adequate purity in a narrow spectral region, has been made and found satisfactory in the determination of the optical properties of crystals.

Light of high intensity is focused on an adjustable slit, rendered approximately parallel by means of a lens, and passed through two hollow prisms containing alpha-monochloronaphthalene. In the widely divergent spectral beams the microscope moves along a calibrated arc and any desired wave-band of reasonable purity may be selected. The apparatus is illustrated in the accompanying diagram (fig. 1) and photograph (fig. 2).

A small carbon arc (*A*) using direct or alternating current gives adequate intensity, allowing for a narrow setting of the slit, with corresponding purity of the monochromatic beam. A lamp (as shown in the photograph) fitted with a 500-watt projection bulb is more convenient and satisfactory for most purposes, and, with a wider slit setting, even lower power may be used, but at the expense of purity of the required spectral colour. A heat filter should be interposed between the light source and the slit.

The white light, well screened, is concentrated by a lens (*B*) on to the adjustable slit (*C*) which is about ½-inch long, fitted into the end of a 10-inch tube. A lens (*E*) of 4 inches focal length is centred and cemented into a wooden plug which slides in this tube and is adjusted into position later. The hollow prisms (*F* and *G*) are made from 4-inch squares of ¼-inch plate glass, and 4½-inch triangles for the base and lid. The squares for the sides are accurately bevelled at 30° on two opposite edges, utilizing a 30° wooden block for the purpose, cemented together with a paste of very finely ground glass, sodium silicate, and a little zinc oxide; temporarily bound together by tape and kept at 30° C. for several hours. Each prism is then ground and cemented to its base and ground to take its lid. The prisms are charged with alpha-monochloronaphthalene. This liquid is relatively cheap and stable, has a high dispersion

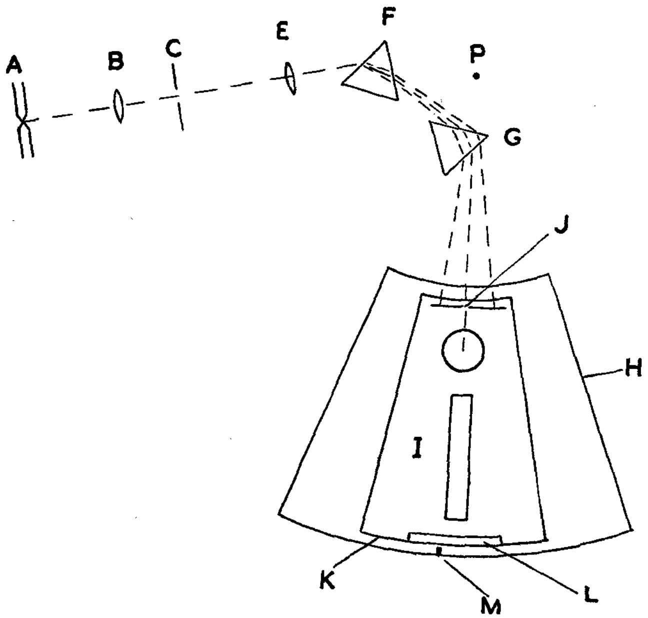

Fig. 1. Diagrammatic arrangement of the apparatus. (About one-tenth actual size.)

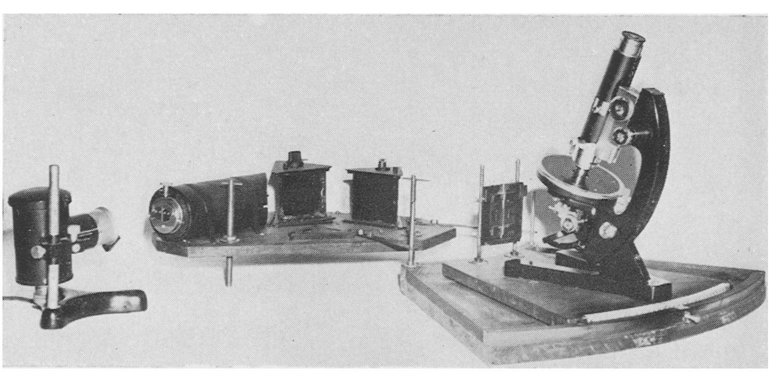

Fig. 2. Photograph of the monochromator.

($n_F - n_C = 0{\cdot}03$), low inflammability and vapour pressure (B.P. 259° C.). Any yellow discoloration should be removed by shaking with activated charcoal and filtering. The prisms, after charging, are fitted with their triangular lids, using a temporary seal such as glycerine and starch, and are blackened on the outside, leaving windows for the passage of the light beam.

The tube and prisms are fixed on one board carrying a spirit level, fitted with vertical screws allowing the height of the assemblage to be varied. The prisms are held in place, but removable, and arranged in the approximate position of minimum deviation for the middle of the green band. They are covered with a black metal hood, which is not shown in the photograph.

Where only a visual estimate of the colour and wave-band required is adequate, the apparatus may be used without addition. The microscope with mirror is placed in the beam and adjusted in position for the colour required, the intensity and purity being varied by the slit. The arrangement described below increases the scope and convenience of the apparatus, for the wave-lengths utilized are known within fairly narrow limits, or may be selected immediately by reference to a scale.

A stationary base-board (*H*), fitted with a rim, carries a moving platform (*I*), which may be locked in any desired position, on which the microscope is squarely placed. The platform is free to move in a circular arc such that any given point on it describes a circle whose centre lies at the origin (approximate) of the diverging beams when projected backwards (point *P*). To fulfil this requirement, the top of the base-board is fitted with two steel strips on edge, bent to the correct curve, which serve as rails, and engage with small wheels let into the under part of the sliding platform. A distance of about 12 inches from the microscope mirror to the nearest prism is found most satisfactory, and the radii of the curve of the inner and outer rail are fixed accordingly.

The prism-board and the base-board are linked by two steel arms; one end of each is bolted to the prism-board, the other ends being drilled and passing over vertical round posts on the corners of the base-board. In this way correct angular relationship between the prisms and the base-board is maintained, at the same time allowing for vertical adjustments of the prism assemblage to accommodate different light sources and easy dismantling. At the end of the platform an adjustable slit (*J*) in a large frame, capable of vertical movement, is centrally placed to intercept the coloured beams. On the face of the frame, which is painted white, the spectral bands and lines may be seen, and as the slit moves with the platform and microscope, any given wave-band may be selected to pass through the slit to fall squarely on the microscope mirror.

On the curved vertical edge of the platform nearest the observer, which should be exposed about ½-inch above the top of the rim of the base-board, a millimetre scale (K) is attached, and along the horizontal surface of the platform a curved white sliding scale (L) is so arranged that readings on the millimetre scale may be referred to wave-lengths marked on the sliding scale after calibration. Both these scales, which move with the platform and its microscope, may therefore be read with reference to a mark (M) on the base-board against the millimetre scale.

To calibrate the instrument, both the collimator and platform slits are nearly closed, and the arc carbon is moistened with sodium chloride. The lens in the tube is now adjusted into permanent position, to give the sharpest image of the sodium D-line on the white frame of the platform slit. The slit itself is now brought exactly over the D-line and the reading on the millimetre scale noted; the prominent lines of thallium and lithium salts are read in a similar manner.

The lines are most clearly seen if all extraneous light is excluded and the arc carbons are separated rather widely. Wave-lengths in microns, most easily recognized and adequate for calibration, are those of lithium 0·6104 (reddish-orange), 0·4602 (violet), sodium 0·5890–96 (yellow), and thallium 0·5351 (green). If flame spectra are used, the spectral line should be brought into view through the platform slit. The sharpness and purity are increased by a long-focus lens placed near the prism, but this has been found to be unnecessary; if it is fitted, it must not be moved after calibration.

A curve is constructed relating scale readings to the wave-lengths utilized together with wave-lengths in common usage such as the F-, E-, and C-lines, which are transferred from the curve on to the sliding scale.

Readings are thus made virtually independent of variables such as temperature changes, microscope mirror position, slit openings, &c. In using the instrument under a given set of conditions, the platform slit and D-line are made to coincide, and the microscope and mirror properly adjusted to receive the light. The sliding scale is then moved until the D-line calibration coincides with the reference mark on the base, and for this set of conditions the readings will be found to be correct for any other wave-lengths selected.

For a reasonably accurate setting of the instrument it is usually sufficient to adjust the yellow band over the platform slit, and it is not necessary to see the D-line itself. For refractive index work and similar optical studies the essentially parallel light given by the instrument is particularly suitable, giving strong Becke-line effects, with or without condensers. With convergent light for interference figures, requiring higher intensity, wider slit openings are necessary, and the light should be diffused just before entering the condenser.

With good facilities the instrument without lamp may be made and calibrated in three or four days at a cost of about £5 for materials.