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Inexpensive "quartz wedges"

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A quartz wedge is useful, even essential, in the demonstration of retardation and birefringence. This accessory device is fragile, and prices have multiplied over the years so that a wedge may cost $500.

Optical wedges can be made cheaply of ordinary clear acrylic plexiglass. Such plastic is isotropic. Experiment shows, however, that heating, softening, and stretching a strip of plastic produces a strong permanent anisotropism. Of several different techniques tried, the most successful was as follows.

A strip of plastic (say 20 cm × 2.5 cm × 6 mm) is clamped to the tops of the open jaws of an ordinary machinist's vise and heated by hot air from a heavy duty hair dryer. When the plastic is uniformly heated over a length of about 8 cm, it begins to distort or sag slightly. Tension is applied quickly and smoothly by opening the vise, the material elongating up to about twice its original length. If the plastic is stretched too quickly, or if it is not hot enough, the plastic will stretch and break—about one in three attempts failed in this way. On stretching, the material necks down, both thinning and narrowing.

On stretching, retardation increases from zero in the unstretched parts to that corresponding to 3rd order colors in the middle of the necked part. Edges of the necked parts show higher birefringence than the middle parts. Sections suitable for wedges, showing a wide range of birefringence, are cut out, ground so that the unstretched end is thinner than that with high birefringence, lapped to give plane surfaces, and attached to glass microscope slides. A finished wedge measures 4 cm × 7 mm, the thick end being about 3 mm. The wedges are used in a laboratory exercise in a course in optical mineralogy by simply moving the wedge on the microscope stage across the field of view and observing the sequence of colors. The "fast direction" is parallel to the length of the wedge, the direction of stretching.

An attempt to repair "gypsum plates" was not successful. A plug cutter and drill press were used to cut discs of suitably birefringent material to fit the original metal holders, and these were lapped, polished, and glued into position. Since the plate is inserted into the optical system, the material must be of high optical quality—homogeneous, with plane, parallel surfaces. These specifications are hard to meet if one uses the simple techniques described.

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