A BROAD SOURCE OF MONOCHROMATIC LIGHT

M. J. Buerger and H. A. Huntsinger,
Massachusetts Institute of Technology.

An efficient source of monochromatic light is essential to any precise determination of the optical constants of crystals and is even a necessity in many routine identifications of crystals having strong dispersions of principal optical elements,[1] or of crystals, which must be immersed in highly dispersive liquids. The simpler types of monochromatic illuminators usually suffer from one or more of several disadvantages; the light is not sufficiently intense, except when mechanically agitated, as by tapping; the heat given off is excessive, due to a large volume of flame; or the source of light is too narrow. In order to be of any use in obtaining the interference figures so essential to accurate work, the source must be sufficiently broad to fill the upper focal plane of the objective with light. Of course, a narrow source may be made to serve, with the aid of a lens, but the adjustment of such an optical system constitutes a continual source of annoyance.

In the design illustrated in Figure 1, these undesirable features are eliminated. A Bunsen burner or Tirrell burner forms the nucleus of the apparatus. In order to bring the source of the light nearer the level of the substage mirror, it is advisable to saw off and discard the upper half of the burner barrel. The end of the shortened barrel is equipped with a wing top flame spreader, *a*, of the type ordinarily used in bending glass tubing; this imparts breadth without excessive volume, to the flame. The active salt giving rise to the monochromatic light is fed into the flame from a platinum gauze trough,[2] *b*, which is welded to a piece of half-

[1] This difficulty is especially prevalent with certain colored inorganic salts as well as with many organic compounds.

[2] There are various ways of feeding the active ion into the flame, but this method, the writers believe, combines simplest construction and easiest manipulation with reasonably long life. The life of the flame, using lithium sulfate, is about five hours, varying somewhat with the salt capacity of the trough. A simpler feeder consists of a series of loops in platinum wire, each loop carrying a salt bead. The life of such an arrangement, however, is only about a quarter of an hour with lithium sulfate, or about an hour with sodium tetraborate. Another alternative may be had by treating a strip of perforated platinum foil as described by Peck (*American Mineralogist*, **7**, 1922, pp. 104–106). The writers were unable to realize as long a life as that noted by Peck for this feeder, only two hours as a maximum being obtained for lithium sulfate. (N. B. Lithium chloride is so deliquescent that, when not undergoing ignition, it dissolves in its own absorbed water and drips away; lithium nitrate

millimeter platinum wire, *c*, which, in turn, is fused into a suitably bent pyrex glass tube, *d*. While the gauze may be independently supported by clamping the glass tube to a ring-stand, it is desirable to attach it directly to the burner barrel by means of a brass arm, *e*. The welding of the wire to the trough is easily accomplished after

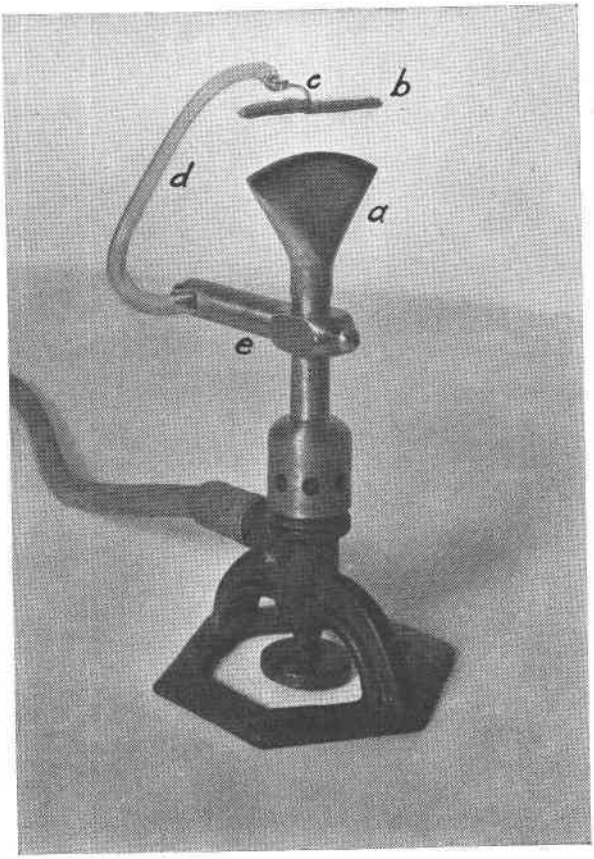

Figure 1.

heating the platinum to a white heat in the flame of a burner; the two pieces are merely tapped smartly together with a hammer.

In operation, the salt melts in the trough and the gauze dis-

---

has a tendency to attack platinum, see Edward Thorpe: *Dictionary of Applied Chemistry*, *London*, 1913, **IV**, p. 304). Platinum black, electrolytically deposited on platinum foil, also does not give a very long life.

tributes it to the flame after the fashion of a wick. The trough should just touch the plane of the flame evenly at about the height of the top of the flattened blue cone. In starting the burner, however, the trough must be heated to whiteness within the flame and the salt melted before the operation is satisfactory.

It may be worth while to say a word as to the range of use of the monochromatic light source. It appears to be a prevailing opinion that work with monochromatic light must be done in a dark room. Such a small, enclosed space has the disadvantage of becoming easily heated. This circumstance renders working conditions uncomfortable and also necessitates the application of extreme and unreliable temperature corrections to the refractive indices of the immersion standards. By taking very simple precautions in local light shielding, the monochromatic source may be efficiently operated in a large, well-ventilated and normally illuminated laboratory, provided direct sunlight does not enter. The following arrangement of apparatus is recommended for microscopic work: The laboratory table should be near the center of the room, or at least well removed from the walls, in order that heat reflection from them be reduced to a minimum. If the observer works with his back toward the windows, his own shadow will exclude reflections by the sides of the crystal grains from this source. A black cloth screen suspended from a horizontal wire just in front of the microscope and reaching down to the level of the microscope stage, will similarly exclude direct reflections of the monochromatic light by the sides of the grains, as well as insulate the slide from this direct source of heat. A second black cloth screen should be placed a short distance beyond the light source for the purpose of excluding all light coming from this general direction except that of the desired monochromatic source. The use of cloth screens, in this manner, allows the normal air currents of the laboratory to freely circulate and carry off the heated air in the immediate region of the burner.

The standardization of refractive index liquids on a single-circle goniometer, using the minimum deviation, hollow prism method, may be carried on under equally comfortable conditions. A cloth screen is necessary behind the monochromatic source. A cardboard screen may be hung upon the collimator to insulate the prism from the direct heat of the burner, and another cloth screen can often be advantageously placed to exclude reflection of bright objects by the prism sides.