type. The key has been modified and the new terminology of Part 1 introduced into the descriptive material. The "Notes and References" following the key give comments on the geographical distribution and the economic significance of the species concerned.

This book represents a decided contribution, valuable to botanists, to foresters and to all those interested in North American woods.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

WATER-COOLED RESISTORS

THERE are numerous occasions when a resistor of high current-carrying capacity is needed in the laboratory; for example, in regulating the current of electric furnaces, in charging large storage batteries and in testing the regulation of some generators. It is the purpose of this note to describe two types of water-cooled resistors which are extremely simple and cheap to construct and which have been found satisfactory. Probably resistors of this type have been employed by others, but since their value and simplicity do not seem to be generally known, a description of them may be of interest.

The resistor is essentially a piece of wire of high specific resistance located inside of a tube through which water flows. Fig. 1 shows the construction of a fixed resistor. The tube consists of two pieces of copper tubing, C and C′, joined by a section of rubber tubing, R. A wire of nichrome, N, is soldered to the inside surfaces of the copper tubes and the external leads, L and L′, are soldered to their outside surfaces. Of course, the rubber tubing must be doubled back upon itself during the soldering process in order that it will not be injured by excessive heating. If heavy rubber tubing is employed, so that difficulty is experienced in doubling it back upon itself, it is easier to use two pieces of it joined by a piece of glass tubing. The rubber can be pushed back over the glass while soldering and then pulled back to join the copper.

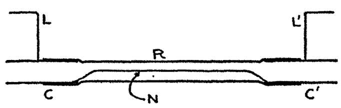

Fig. 1

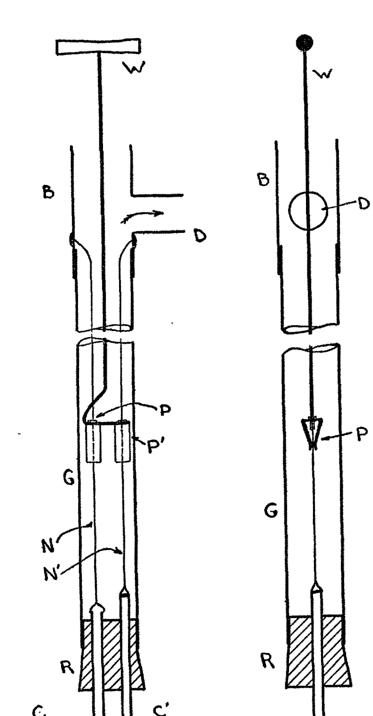

Fig. 2

Fig. 2 shows two views of a variable resistor which has proved satisfactory. G is a large glass tube arranged vertically, B a piece of brass tubing and R a two-hole rubber stopper. C and C′ are pieces of copper tubing which serve as the terminals of the resistor composed of two pieces of nichrome wire, N and N′. Cooling water flows in at tube C and out at tube D. P and P′ are phosphorbronze clips which are connected to a piece of heavy copper wire, W, by which they can be moved along the resistor, thus varying the resistance between C and C′. The upper end of W is insulated so that the operator will not receive a shock.

Nichrome can be obtained in straight wire, in helically wound wire and in flat ribbon. The variable resistors must be made of straight wire or ribbon, but the fixed ones can also be made of helical wire, thus keeping them small. No. 22 straight wire, having a resistance of approximately one ohm per foot, is readily obtainable. When water-cooled, it can carry 40 amperes safely. The quantity of cooling water required depends upon the power dissipated by the resistor. A flow of one liter per minute is ample for a resistor dissipating two kilowatts or less.

Any number of either fixed or variable resistors can be connected together so that the cooling water flows through them successively. They can then be connected electrically either in series to give a higher resistance or in parallel to give a greater current-carrying capacity. The entire group of resistors should be connected to the water supply with rubber or glass tubing so that they will be insulated from ground.

It is well to provide means for opening the circuit automatically in case the cooling water is accidentally shut off to prevent the resistor from burning out. This can be done readily by connecting in series with the resistor a short piece of the same wire of which it is made and placing this piece so that it is within the stream of water issuing from the end of the resistor when the flow is normal but is out of the stream when the flow is reduced. By varying the angle which the emerging stream of water makes with the vertical and the distance of the piece of wire from the orifice any desired sensitivity can be had. With proper adjustment, this piece of wire will function as a fuse, burning out before the water has quite stopped flowing and thereby protecting the resistor.

No careful study of the durability of the resistors has been made. The following tests will, however, serve to show that their useful life is reasonably long. A fixed resistor made of No. 22 wire carried 20 amperes for 20 hours and then 25 amperes for 20 hours more. At the end of the test, it was in perfect condition and its resistance had changed by only about ½ per cent. A variable resistor carried 25 amperes for 20 hours and was operating satisfactorily at the end of the test. Other resistors have given satisfactory service in the laboratory for longer times, but no record of their performance has been kept.

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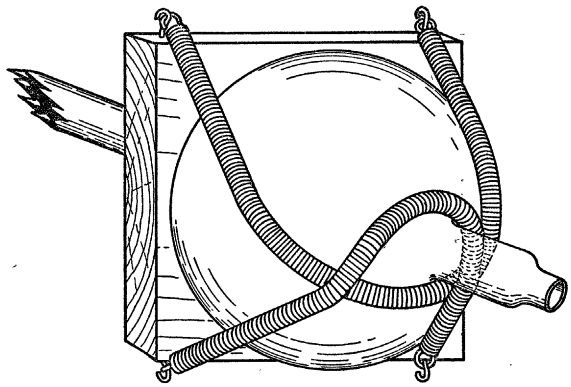
GLASS BLOWERS' HOLDER FOR LARGE FLASKS

THE holding of flasks, larger than a liter, in glass-blowing operations is usually a troublesome matter. The ordinary snap type of holder is not generally supplied in these sizes. An extremely simple device which the writer has found to be quite satisfactory is depicted in the accompanying sketch and requires only a few explanatory comments.

The flask is held against the base by two long U-shaped springs, which are looped over the neck of



the flask. The springs are those used to close screen doors and, where necessary, can be kept from contact with the glass by strips of asbestos paper. Round-bottom flasks are held more firmly if the base is provided with a slight hollow or if a thin cork ring is placed between the wooden base and the flask. A cork ring around the neck of an erlenmeyer flask will keep the springs from slipping down and permit such a flask to be held securely. For convenience in manipulating this holder it is desirable to have a detachable handle. A suitable handle and base is at hand in most laboratories in the form of old wooden funnel stands.

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SPECIAL ARTICLES

THE ORIGIN OF PIGMENT CELLS IN AMPHIBIA

IN the present study the methods of transplantation and explantation have been employed to decide between the divergent views that have been held regarding the origin of pigment cells in the amphibian embryo—whether from connective tissue, leucocytes, epidermis or ganglion crest. Embryos of *Amblystoma punctatum, A. tigrinum* and *A. mexicanum* (axolotl, both black and white) have been used in the experiments.

Explantation experiments: Pieces of the neural folds (anlagen of the ganglion crest) from the trunk region of *A. punctatum* neurulae were explanted into Holtfreter's solution. Melanophores appeared in every explant within six days (37 cases). Prospective flank ectoderm was explanted in the same way. In only one explant out of 20 did melanophores develop. It is probable that in this one case some ganglion crest cells were included at the time of operation. Flank ectoderm and mesoderm explanted at older stages up to stage 32 (non-motile embryo with elongated tail bud) gave negative results. When transplanted to the abdominal wall or explanted at stage 32 or older, melanophores invariably developed in the graft or explant. It is apparent that the flank tissues are not capable of forming melanophores until a much later stage than the ganglion crest cells. It is probable that the cells of the ganglion crest migrate into the flank at stage 32. Hence they are included in flank explants after this stage.

Defect experiments: The neural folds in the trunk