review would be incomplete without favorable reference to the illustrations, all of which have been provided by Mr. George B. Cummins, of Purdue University. Unnecessary apology is made because space does not permit the depiction of variation in the shape and size of the spores. The illustrations are well done and will be much appreciated by all users of the book.

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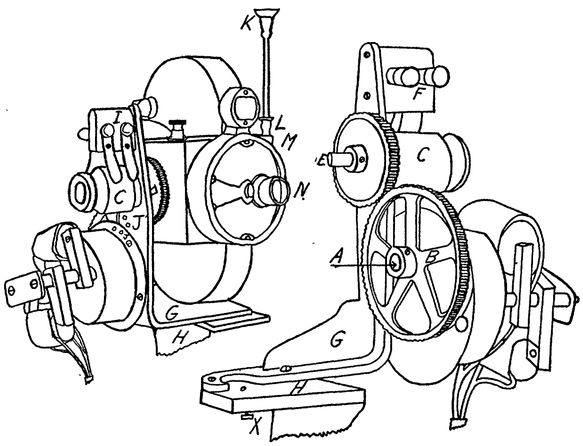
SCIENTIFIC APPARATUS AND LABORATORY METHODS

FLEXIBLE CONTROL OF SPEED AND FOCUS FOR MOTION PICTURE CAMERAS

MANY phenomena of nature that progress slowly can be studied to advantage from motion picture photographs taken at appropriate intervals of time. The film may be speeded up to a convenient duration and repeatedly shown until the process is familiar to the experimenter and his audience. Such equipment has been used for many years[1] and the chief remaining difficulties to be solved in adapting the motion picture camera for such records are a constant speed motor and a simple means of focusing the camera.

The larger double telechron motor (M-43) is light enough to be attached readily by a bracket (G) to the stand (H) supporting the camera, Figs. 1 and 2.



FIGS. 1 and 2. Telechron motor and the attachment to the stand (H) which supports the motion picture camera.

As there is practically no vibration, no special mounting is necessary when the stand is placed on a rubber kneeling pad held by bolts to the baseboard with a rubber stopper between the stand and the bolthead. A motor may be obtained with a built-in reducing gear so that the motor shaft (A, Fig. 1) will turn one revolution per minute. Suitable gears (B and D) may be interposed to give the camera drive shaft (E) any desired speed. One of the bolts holding the motor should have several positions (JJ′, Fig. 2) to allow for the different distances between the shafts when the gear combinations have a different total number of teeth. These inexpensive gears may be changed easily to give the outfit the necessary flexibility which is lacking in the commercial models now on sale at prohibitive prices. A drum (C) is provided with electrical contacts (F and I) so that a magnetic shutter may be operated synchronously with the camera.

The telescope (K) of a nasal pharyngoscope[2] may be used to see the focus of the image on the film in the camera. A bracket (M) gives strength and support and a movable stop (L) holds the pharyngoscope at the proper level in the camera. The stop will also hold it above the film when it is not being used or it may be removed entirely from the camera and a stop placed in the hole to exclude light. The tube of the pharyngoscope is small enough to pass between the shutter and the film gate of the camera. This is usable only when the camera shutter is open but does save the cost of a beam-splitter.

This arrangement is especially useful when photographing small objects or making titles. When the camera is used with the lower powers of the microscope, sufficient light is passed for focusing with the aid of the pharyngoscope. With the higher powers of the microscope, there is not enough light for visual focusing in the above manner and, in that case, a beam-splitter is required. Even when the beam-splitter is used, the pharyngoscope is useful in timing the shutter and in addition, it may be used to focus the image of a watch on the corner of the film frame by means of suitable auxiliary lenses. A detailed description of the complete apparatus will be published in the near future.[3]

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[1] O. O. Heard, *Jour. Biol. Photog. Assoc.*, 1: 4–19, 1932; O. W. Richards, *ibid.*, 2: 39–55, 1933.

[2] This focusing device was described at the second annual meeting of the Biol. Photog. Assoc. in Rochester, September, 1933.

[3] A grant from the Bache Fund of the National Academy of Sciences made possible the construction of this apparatus, which will be described in detail in the *Jour. Biol. Photog. Assoc.*, 1934.

AN APPARATUS FOR CONSTANT DELIVERY OF EQUAL WEIGHTS OF TWO OR MORE LIQUIDS

AN apparatus which delivers several liquids at a constant rate and at the same speed for each liquid

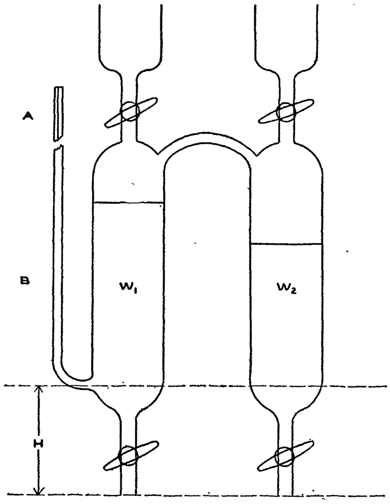

FIG. 1.

independent of density or viscosity is shown in Fig. 1. The system W_1, W_2 with the intervening air space acts as a balance so that if W_1 becomes momentarily lighter than W_2 owing to the liquid having run out faster, it necessarily slows up and W_2 speeds up until the weights are again equal. By the use of a side arm B the hydrostatic head is made equal to H until the level of W_2 reaches that point. It is preferable that the liquid in W_1 be the less viscous since air bubbles pass through it. W_1 may be used as a control liquid only and not one of those to be used for experimentation.

The rate of flow is governed by the capillary A. If the flow is to be varied a number of capillaries of different lengths or bore may be kept in hand so that by means of rubber connections the rate may be quickly changed.

Fig. 2 shows results of an experiment in which glycerine of specific gravity 1.25 and water at 1.0 and of viscosities 4.9 and 0.0089, respectively, were used as the liquids.

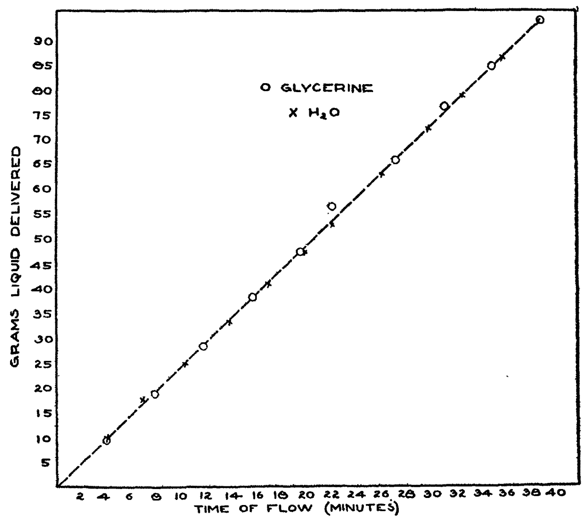

FIG. 2.

Obviously by similar air connections any number of added tubes containing liquids or solutions may be used. The rate of flow is not governed by either the shape or dimensions of the container, since it is dependent only on H and the capillary A. The same holds true for the temperature of the system above H so that the solutions may be at different temperatures and yet give equal rates of flow in weights per unit time.

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SPECIAL ARTICLES

THE SPIRAL GROWTH OF SINGLE CELLS

IT is clear that all cases of spiral growth or movement in organisms are not produced by the action of the same factors, even though it is possible in a general way to describe the twisted or helical forms of growth as due to the resolution of two growth vectors, one longitudinal and one rotational. Whatever may be the ultimate explanation of twisting of such complex structures as trees, it is exceedingly interesting that spiral structure is exhibited by so many single plant cells. The spiral layers of the walls of wood cells, the coiled chloroplasts of *Spirogyra,* the whole organization of the coenocytic cells of *Chara* and *Nitella* and the spiral growth of the fungus *Phycomyces* may be taken as examples. It remains to be shown, of course, whether the spiral form of multicellular plants is referable in some way to the spiral growth of their cellular components. At the moment the need is for an analysis of the cause of spiral growth in the simplest cells available.

The only living plant cell in which it has been possible to measure simultaneously growth and twisting about the long axis is the coenocytic spore-bearing cell of *Phycomyces,* where Oort[1] found at 17.5° C. an average rate of elongation of 39μ/min. and an average rate of rotation of 3.7° per minute. For cells of diameter 114μ, the angle which the main direction of growth makes with the longitudinal axis of the cell (therefore the inclination of the spiral, and the angle at which micellae are incorporated into the chitinous

[1] A. J. P. Oort, *Proc. Acad. Sci. Amsterdam,* 34: 564, 1931.