around a mean of + 1,200 km/sec. The apparent photographic magnitudes of the objects observed range from 10.0 to 15.0 and the mean velocity of the fainter members is approximately the same as that of the brighter. Velocities of isolated nebulae, including those previously known, have been used by Hubble and Humason to derive the velocity-distance relation for isolated nebulae. The relation parallels that for the clusters but is displaced one magnitude toward the brighter side. This displacement occurs because the nebulae observed were selected on the basis of apparent magnitude, a selection which favors the systems of high luminosity if the spatial distribution is considered. It is in the direction and of the order expected. Only six nebulae have negative velocities. Three of them, NGC 247, 253 and IC 342 are large and relatively near objects. The spectra of two others, NGC 4569 and NGC 6207, may be those of stars projected on the nuclei. Comparison of the spectral type with the nebular type shows that late-type spirals are decidedly bluer than E, Sa or Sb nebulae. The mean spectral types for these groups are: E0-7, G3.6; Sa, G3.4; Sb, G1.6; Sc, F8.8. The mean spectral type of faint nebulae is approximately the same as that of the brighter nebulae. The mean spectral type of the 100 objects observed is G2.5.

The magnitudes of 6284 stars in 350 regions of long-period variables: S. A. MITCHELL. The American Association of Variable Star Observers have under constant observation a large number of stars whose magnitudes are changing with periods fairly well known. The stars with periods greater than one hundred days are called long-period variables. Our own sun is a variable star with a period of eleven years. Long-period variables are ordinarily observed visually by comparing the magnitude of the variable with two stars, one slightly brighter and one fainter than the variable. After the originator, this plan of observation is known as the Argelander method. To obtain the magnitude of a variable with accuracy it is necessary to have for each variable a sequency of comparison stars covering the whole range in brightness of the variable and to have accurately known magnitudes for each star of the sequence. The magnitudes of 6,284 comparison stars have been determined from visual observations with the 26-inch McCormick refractor both by observations with a wedge photometer and by visual sequences. By plotting the latter against the former an accordant series of magnitudes is derived. Comparisons of the magnitudes derived at the Leander McCormick Observatory, where the observational work was done chiefly by S. A. Mitchell, with similar magnitudes derived at the Vatican Observatory, show a high degree of accuracy. Comparisons of the visual magnitudes with those made by photographic processes and known as photovisual magnitudes, derived mainly at Harvard and Mt. Wilson, show a splendid agreement between the visual and photovisual magnitudes.

Biographical memoir of Eliakim Hastings Moore: G. A. BLISS and L. E. DICKSON.

Biographical memoir of John Ripley Freeman: VANNEVAR BUSH.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ILLUMINATOR FOR CRITICAL MICROSCOPY UTILIZING AUTOMOBILE HEADLIGHT LAMPS

CRITICAL illumination for microscopy with high-power objectives requires a small (3 mm) source of both uniform and high intensity. This condition may be met admirably and economically by using a fine ground glass as a secondary source and focussing the light from a 6–8 volt automobile headlight lamp upon it. Replacement costs are almost trifling compared to the expensive ribbon filament, projection and other type lamps commonly used, while savings effected through decreased power consumption are considerable. Although a 32 candle power lamp will generally prove sufficient, both 50 c.p. and the double 32:32 c.p. bulbs are available where still greater intensity is needed as, *e.g.*, for photomicrography and dark-field illumination.

Certain types of commercial microscope illuminators have optical systems which are adaptable to the use of these headlight lamps, but when the light is concentrated to a small spot on the ground glass for the high power objectives, it no longer suffices to fill the low power field. This problem can be solved by the insertion of a supplementary lens below the substage condenser,[1] by lowering the substage condenser or by the special feature incorporated into the optical arrangement in Fig. 1. The ground glass K (dashed line in

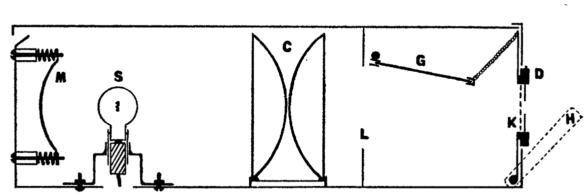

FIG. 1. Microscope illuminator in longitudinal section. Scale approx. 1/6.

Fig. 1) for the small intense source and the iris diaphragm D are mounted in such a manner that their rotation from the vertical plane lowers a second ground glass G to intercept the converging light beam at L. Thus, merely by a quarter-turn of the handle H, a source of proper size and intensity for the low power field is obtainable. This extreme simplicity is dictated by the experience that accessories operated by more complicated motions are soon relegated to a state

[1] I. I. Kornhauser, *Stain Tech.*, 10: 91, 1935.

of "innocuous desuetude" by all but the most assiduous microscopists.

As to those details of mechanical construction which are subject to individual taste and preferment, only brief comments will be made. Fixed in position at C are the heavy condensing lenses of local length 14.0 cm and diameter 11.4 cm. The lamp socket, shown mounted on the bottom of the housing for diagrammatic convenience, is actually attached to the one side. With the socket free to move in a sleeve which is fastened to a vertically sliding base, the luminous filament may undergo the required rotational and two-dimensional adjustment in the transverse vertical plane. Coincidence of the direct and mirror images of the filament on the ground glass at K is secured by adjusting the three screws which support the concave mirror M on the rear wall of the lamp housing. The radius of curvature of the mirror is 5.6 cm. All focussing mechanisms are accessible from the outside.

For the low-voltage source, a transformer with a secondary tapped at 5, 6, 7 and 8 volts has proved convenient. This enables the light intensity to be readily controlled by a 4-contact dial-type switch. Where chromatic filters are employed, as is customary in critical investigations of many sorts, such intensity control does not appreciably alter the relative color values. Radio filament or toy transformers are obtainable at very reasonable prices from wholesale supply dealers and, if necessary, can be arranged in series or parallel, in order to supply adequate current at the proper voltage.

Since the above was written, valuable data on the operating characteristics of headlight lamps and filters have appeared in an article by Waterman.[2]

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ELECTRO-ULTRA-FILTRATION APPARATUS

DURING the course of a study of mercury-protein solutions in which some of the mercury was bound in a non-polar linkage, great difficulty was encountered in freeing the solutions from an excess of mercury salts.

Precipitation of the unbound mercury usually resulted in a simultaneous precipitation of the protein-mercury compound. Ultra-filtration was very slow due to clogging of the membranes, and electro-dialysis could not be used on account of the relatively low rate of mobility of some of the mercurials. It was therefore necessary to devise a new means for the separation of unbound mercurials from mercury-protein compound.

The apparatus herein described was used successfully in preparing solutions of a number of protein-mercury compounds. It consists (Fig. 1) of a collodion-covered alundum thimble containing a coiled platinum electrode and a wide glass tube with a short, wide Cellophane-covered side-arm containing another platinum electrode. The glass electrode chamber is left open for sampling. The alundum electrode chamber is provided with a close-fitting rubber stopper and a suction tube which is connected to a vacuum line. These two electrode chambers are dipped directly into the solution to be ultra-filtered. When current is applied to the electrodes, the gradient in potential between the two electrodes discharges the protein from the outer surface of the alundum thimble, and ultra-filtration can proceed without danger of clogging the collodion membrane.

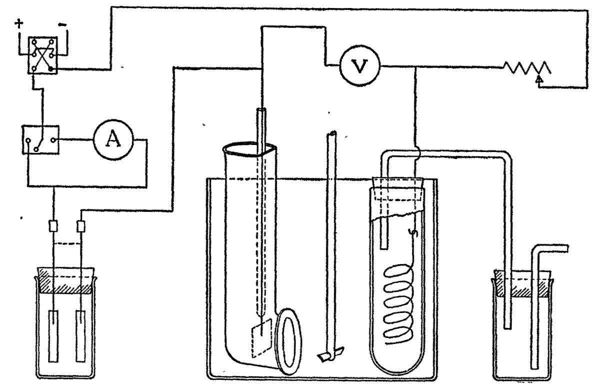

FIG. 1

In order to give the protein a negative charge, the solution must be kept on the alkaline side of the isoelectric point. This is accomplished by adding small amounts of alkali to the glass compartment containing the positively charged electrode. Should it be necessary to keep the solution on the acid side of the isoelectric point, the same result can be obtained by reversing the sign of the electrodes by means of a commutator.

Up to 115 volts can be applied if the entire apparatus is cooled in an ice bath. A.C. current can be used by cutting in a tantalum rectifier which has sufficient capacity for this type of work. The rectifier is easily made by immersing a 10×3 cm strip of tantalum in a 5 per cent. solution of sulfuric acid. A strip of lead can be used as the opposing electrode. A monomolecular layer of oxide on the Tantalum strip is effective in completely rectifying the current flow. An ammeter can be cut in to determine the current flow. The ultra-filtration proceeds with greater speed than does the concurrent dialysis. Nevertheless, the latter process is effective in speeding up the process of separation. Whereas only ions will be separated out of solutions in an electro-dialysis apparatus, small molecules and molecules having a small polar moment will be separated out by this apparatus.

[2] H. C. Waterman, *Stain Tech.*, 10: 113–26, Oct., 1935.