### (4) Photomicrography.

**New Method of Illumination for Photomicrographical Purposes.***—Dr. A. Köhler's method of illumination consists in so adjusting the relative positions of the condenser beneath the object and the source of light that an image of the source is formed approximately in the plane which is the common base of all of the pencils proceeding from the projection system to the several points of the image. This plane will usually be near the hinder focal plane of the objective. The source of light must therefore be placed approximately in the hinder focal plane of the condenser. The course of the rays in this case is seen in the upper part (above the line A B) of fig. 23. $L_1$ $L_2$ is the source of light in the hinder focal plane of the condenser C. O is the plane of the object in which three points $o_1$ $o$ $o_2$ are marked. The position of the object is chosen so that it is beyond the focal length of the condenser. $p$ is the objective serving for the projection, with the iris diaphragm J in its hinder focal plane. In this plane there is produced an inverted real image $l_1$ $l_2$ of the source of light $L_1$ $L_2$.

The angular aperture of the pencil which meets the plane of the object in the optic axis is equal to the angle under which the virtual magnified image of the source of light $\lambda_1$ $\lambda_2$, produced by the condenser, appears from the plane of the object. This can be regulated by diaphragms placed directly in front of the source of light. The figure shows that the illumination of the whole field of view is uniform, even if

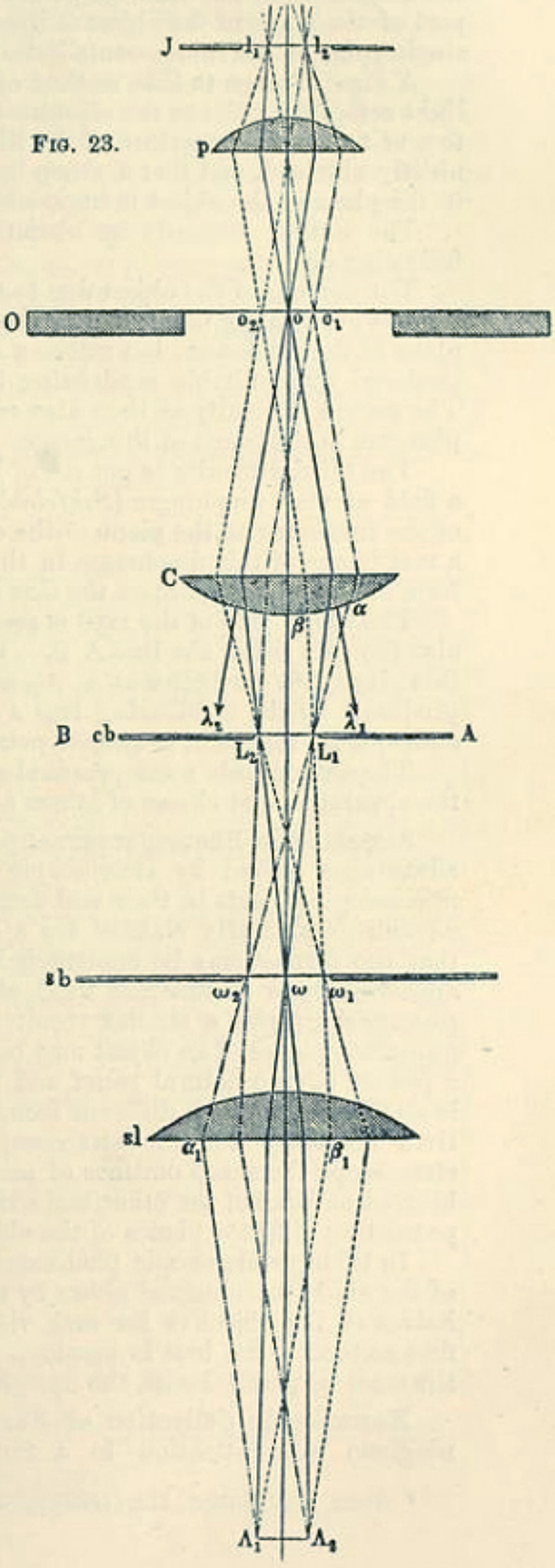


FIG. 23.

* Zeitschr. f. wiss. Mikr., x. (1893) pp. 433-40.

the brightness of the different points of the source is different; for every part of the plane of the object is illuminated by a pencil to which every single point of the source contributes rays.

A disadvantage to this method of illumination is that the source of light comes too close to the object. Other difficulties are that a graduation of the angular aperture of the illuminating pencil cannot be conveniently obtained, and that a sharp limitation of the illuminated surface in the plane of the object is impossible.

The author succeeds in obviating these three difficulties by the following devices.

The heating of the object due to the close proximity of the source of light is avoided by not bringing the source itself into the hinder focal plane of the condenser, but rather a magnified or diminished image of it produced by a suitable condensing lens of not too small focal length. The second difficulty is then also removed by the use of suitable diaphragms in the plane of this image.

The third difficulty is got rid of by the use of what the author calls a field of view diaphragm (*Sehfeldblende*) placed in the conjugate plane of the condenser to the plane of the object. The condenser then throws a real image of this diaphragm in the plane of the object, the size and form of which depend upon the size and form of the diaphragm.

The whole path of the rays is seen in fig. 23, taking into account now also the part below the line A B. The source of light is no longer in this plane, but far below at $\Lambda_1$ $\Lambda_2$, and $L_1$ $L_2$ now represents its image produced by the condensing lens *s l*. The "Sehfeldblende" is at *s b* and $\omega_1$ $\omega$ $\omega_2$ represent conjugate points to $o_1$ $o$ $o_2$.

The author adds some practical suggestions as to the adjustment of the apparatus, and choice of lenses and sources of light.

**Stereoscopic Photomicrography.***—Dr. W. C. Borden points out the advantages offered by stereoscopic photomicrographs in representing microscopic objects in their real form through the effect of relief. The advantage generally claimed for a drawing over a photomicrograph is that the former may be constructed so as to represent an object as it appears viewed at different focal planes; but by means of stereoscopic photomicrography a similar result may be obtained, for the two most important planes of an object may be superimposed and combined so that a picture having natural relief and sharpness is produced. This result is attained by using a different focus for each exposure in the two negatives necessary for the stereoscopic picture. When viewed in the stereoscope the sharp outlines of each negative are found to override the blurred outlines of the other, and a single stereoscopic picture is produced presenting different planes of the object in sharpness and relief.

In taking stereoscopic photomicrographs the necessary lateral views of the object are obtained either by tilting the object or by using different halves of the objective for each view. With low power objectives the first method is the best to employ. In tilting the slide the axis of the tilt must be parallel with the upright axis of the object.

**Remarkable Collection of Photomicrographs.**†—Mr. K. M. Cunningham calls attention to a remarkable collection of photomicro-

* Amer. Micr. Journ., xiv. (1893) pp. 329-33. † Tom. cit., pp. 339-42.