Physiology. — *"A new ophthalmoscope"*. By Prof. J. K. A. WERTHEIM SALOMONSON.

(Communicated in the meeting of December 28, 1918).

In a former communication made at the meeting on April 27th 1917 I showed a collection of photographs of the living human retina. I described and exhibited two different photographic ophthalmoscopes, the second of which has been in regular use and gives satisfactory results. As a matter of fact we can also use it for simply showing a retina to any person not familiar with ophthalmoscopy, as the instrument can be easily adjusted in exactly the right position before the eye to be examined, the observer only having to focus the image. But if an instrument of this kind has to be used solely for demonstrating purposes a thorough reconstruction including many modifications might prove judicious. In that case we ought to provide for the possibility of using several different magnifications, which in the case of the photographic instrument, giving a real image of 40 millimetres in diameter would have been irksome. With the photographic instrument the ocular magnification amounted to 3.5 times, corresponding to an absolute enlargement of the fundus of about 15 diameters.

In the second place we should have to discard the arclamp the light of which for our purpose can only practically be dimmed by absorbing light-filters.

We might have substituted for the small screens used for intercepting the light reflected by the ophthalmoscope lens some more appropriate means, at least if photography were not intended.

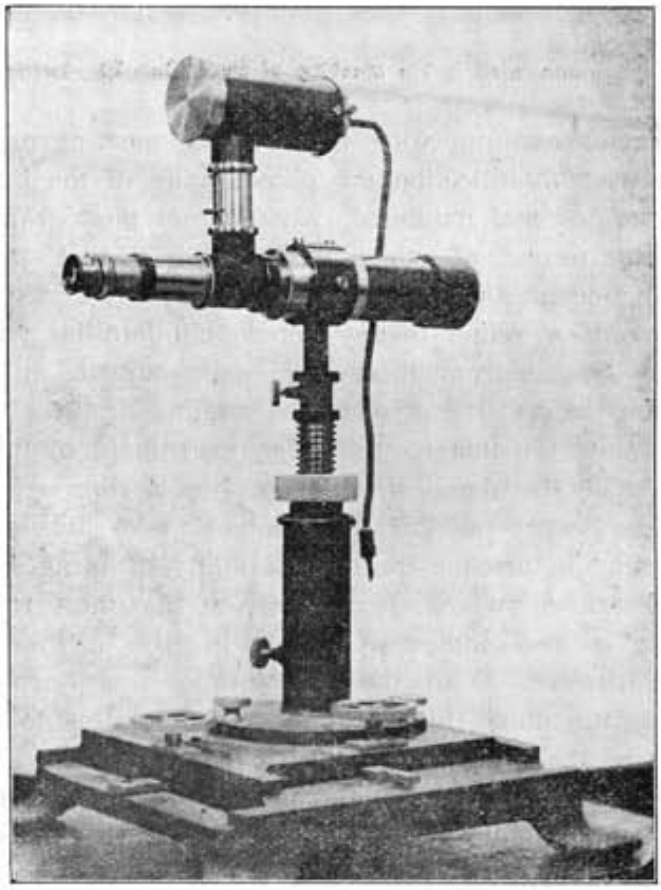
Lastly it should be possible to materially reduce the dimensions of the whole apparatus, rendering it more easy to handle.

Starting from these considerations, I have built an entirely new instrument, to be used solely for viewing the retina and showing it to students as yet unskilled in the art of ophthalmoscopy.

The principle of indirect ophthalmoscopy has been applied as was also the case with the photographic instrument. For illumination a small 25-candle power gas-filled lamp with a straight tungsten filament-spiral was used, normally burning on a 4-cell accumulator or on a small alternating current transformer for 8 Volts secondary.

The light intensity is generally reduced with a sliding contact variable resistance.

A condensor projects the image of the filament on a narrow slit. A lens placed on the slit projects the condensor aperture on the



ophthalmoscope lens, the light being deflected 90 degrees by a small totally reflecting prism placed beneath the slit, so as to permit of placing the illuminating tube at a right angle to the axis of the viewing tube, containing the ophthalmoscope lens. The real image of the retina, formed by the ophthalmoscopelens can be examined through an aperture beneath the prism. We inspect that image with a kind of short microscope, the objective of which has a focal distance of 55 millimeters, the eye piece being one of the Huygenian type as used in the ordinary microscope. The magnification is altered on the use of different eyepieces.

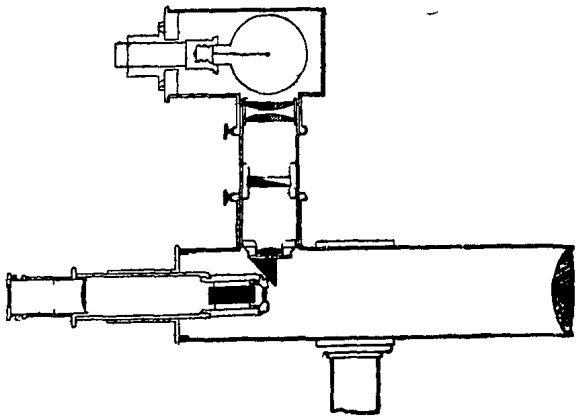
In order to eliminate the images reflected by the ophthalmoscope lens, the following arrangement is used. A small achromatic double

image prism of calcspar and glass is placed between the condensor and the slit and causes two images of the filament to be projected in the plane of the slit. Only one of these, formed by the ordinary rays falls in the slit, the other falls on one of the slitplates and is arrested. Consequently the eye is illuminated with polarised light and the images reflected by the ophthalmoscope lens are also polarised. By means of a nicol prism placed in the microscope tube these reflexes are extinguished. The light illuminating the retina and reflected from the fundus of the eye has become depolarised and can be observed with the microscope. As a matter of fact the retina is clearly seen without any appreciable disturbing reflexes from the surface of the intervening media. Also the retinalreflexes, which in young patients are nearly always very noticeable, seem to be very slightly lessened.

The construction of this ophthalmoscope appears to possess some advantages. According to the HELMHOLTZ-GULLSTRAND theory we use one small part of the pupil in the patient's eye for transmitting the illuminating light-cone, whereas another part of the pupil takes up the narrowest part of the double cone of rays emerging from the retina and passing into the eye of the observer. These cones should be entirely separated by a narrow unused zone both of the cornea and of the anterior and posterior surface of the lens. Only in this way is it possible to prevent the occurrence of reflexes emerging from these surfaces which pass into the eye of the observer and disturb the ophthalmoscopic image by diffused light from the substance of the cornea and the lens. With my instrument the reflexes can never reach the observer as they would also be obscured by the nicol prism. Therefore we have only to consider the light diffused by the illuminated parts of cornea and lens. The lens is in this respect more troublesome than the cornea, especially in young individuals, whereas in adult patients both show nearly the same opalescence. Consequently we might in some cases — at least theoretically — lessen the distance between the illuminating and observation cone of light, and we should be able to examine eyes with narrow pupils — at least smaller ones with our instrument than with other instruments of the same kind. The reason that I have adjusted the instrument without considering this possibility may be found in the fact that I wished to have an instrument which would be ready for use with any patient without any adjustment except of course the final focussing.

With this instrument we can see at once 27° of the fundus of an emmetrope eye, corresponding to about $4^1/_2$ diameters of the papilla

nervi optici. The whole field is remarkably flat, and sharp up to the edges. The magnification is generally about 14 diameters, or about the same as when the eye is examined with the direct method, but with an angle of view many times greater. By using stronger



eyepieces the image, which is in the upright position, can be magnified up to about 50 times, the angle of view of course being somewhat reduced. As the illuminating filament can be regulated to any desired degree of brightness we can even with this high magnification get a profusion of light, and exceedingly clear and sharply defined images of the fundus.

When in use the distance from the patient's eye to the instrument is about 90 millimeters. The only change necessary when examining different patients, is the focussing. In cases of strongly myopic, hypermetropic or astigmatic eyes, examination is still possible with the patient wearing his own glasses.

The ophthalmoscope lens in this instrument is one of the well-known aspheric aplanatic single lenses of 43 mm. clear aperture, made by Zeiss. One might use any other aplanatic combination of lenses, provided the focal distance and aperture were satisfactory. The multiple reflexes from a combination of lenses would be obscured as effectually as those from a single lens.
