PHOTOGRAPHY OF THE INTERIOR OF THE EYE.

BY LUCIEN HOWE, M.D.,
BUFFALO, N. Y.

THE applications of photography are already so numerous in various departments of surgery, that it is not strange some attempt should have been made long ago to picture in this way the interior of the eye. One might at first suppose the problem presented to be comparatively simple. We know that the eye itself is a camera, and when placed behind an ophthalmoscope it has pictured upon the retina an image of an eye observed. Apparently it would only be necessary to substitute for the observing eye, in this position, another camera such as a photographer uses. That the problem is a difficult one, we may readily infer from the imperfect results thus far obtained. To appreciate how little has been done, it is worth while to refer very briefly to the literature of the subject. One of the earliest references to the subject is by Dr. Rosebrugh in the American Jour. of Ophth., N.Y., 1864. He describes there an arrangement by means of which he made photographs of the fundus oculi of a cat under chloroform; but gives no results. Later, he says, "My attempts at photographing the human retina were not attended with success." Since that, the only article deserving attention appeared in the Photographic News, London, May, 1886. In this the results were given of the attempts made to produce a photograph of the optic nerve. The writers on this were able to picture the optic nerve as an irregular white blotch, but nothing more; no arteries nor veins being visible. Even this was better than any representation of the human eye previously made. It should be understood that there is no great difficulty experienced in photographing the interior of an artificial eye, like that of Perrin. The value of the appa-

ratus used was usually tested with this, and some excellent results obtained. The principal difficulties arose when dealing with the living eye. The photograph to which I venture to call attention is here presented. It will be seen that the disc is perfectly distinct, even the shading of the different parts well defined. Moreover, the vessels are so clearly shown over at least a third of the fundus that the arteries can be distinguished from the veins. A decided defect is a triangular white spot, due to the corneal reflection, seen near the edge of the picture. I wish to emphasize the fact, however, that the accompanying photographs represent the real results as they are, without attempts at retouching, modifying, or improvement of the negative in any way.

It is but fair to say that for these results I am indebted principally to my assistant, Dr. Elmer Starr, of Buffalo, N. Y., and that, imperfect though they may seem, they were obtained only after much difficulty and many variations in the details of the experiments. It may be worth while in addition to make brief reference to the difficulties encountered, and the manner in which they were obviated. First, as to the difficulty in photographing the red reflection; of late years a number of practical workers have been trying to produce plates which were sensitive to the red ray, and advances have been made gradually in this direction by Waterhouse, Ives and others, till a considerable degree of perfection is now attained.

It is unnecessary here to enter into any details concerning these processes; and to any one interested, I would refer to the Philadelphia Photographer of May the 7th of this year, where an excellent article can be found, on what is known as isochromatic photography. The plan followed in making these pictures consisted principally in treating them with the following solution:—

Erythrosine	1.5 drachms.
Ammonia (88 degrees) . . .	1 drachm.
Alcohol	6 ounces.
Nitrate of Silver	1 drachm.

Converted into chloride with hypochloric acid, thoroughly washed, and re-dissolved in ammonia; bulk made up to two ounces.

That these are sensitive to the red light is shown, at once, by the difficulty one experiences in developing them, when exposed to the ordinary light in the photographer's dark room.

Having thus obtained a plate which is sensitive, the next step was to arrange an optical appliance by which the image of the observed eye could be produced upon the plate of a camera placed in front of it. One would suppose that the ordinary demonstrating ophthalmoscope, such as has been suggested by Carter, would be sufficient for this purpose. In reality, however, it was found by no means adapted to it, principally for the reason that, on account of the weakness of the convex lens which he uses, there was not enough of the fundus of the eye shown nor a sufficient amount of light reflected from it. In order to obviate this difficulty, experiments were made with artificial light and daylight, by varying the strength of this lens and the size of the hole in the concave mirror, and trying lenses of different size also for the camera, at last arriving at the conclusion that it was best to employ:—

First.—An ordinary Argand gas burner placed in the focus of a concave mirror of about thirteen inches focus.

Second.—That the mirror have an aperture of about one half an inch.

Third.—That the light reflected from the mirror should pass through a plano-convex lens, whose focal distance was two inches.

Fourth.—That an alum cell be interposed somewhere in the line of the ray, in order to shut off as much as possible the heat which otherwise would be focussed with the light upon the eye.

It is worthy of remark, parenthetically, that such an arrangement is, to my mind, a decided improvement upon the form of ophthalmoscope ordinarily used for class demonstration, as it gives a view of a considerable part of the fundus, together with more light than is ordinarily obtained, and with less inconvenience to the patient. The third difficulty met with was that of keeping the eye quiet, when exposed to the

glare and heat of the lamp. This was obviated by the alum cell and by the use of cocaine. These and other details of manipulation may be described at another time. The simple outline of procedure seemed to be worthy of record, however. For while it must be admitted that the results here presented are not entirely satisfactory, on the other hand this is, as far as I can learn, the first time that any photographs of the interior of the human eye have been produced in which the details were even recognizable, and as such, they at least give promise of results of great practical value in the future.

I also take the opportunity to show two photographs of the interior of Perrin's artificial eye, taken by Dr. Charles A. Oliver.

DISCUSSION.

DR. OLIVER.—The two pictures exhibited by Dr. Howe are of the fundus of the artificial eye of Perrin, and were taken by Dr. Wharton Sinkler and myself, in July of 1886. They are presented to the Society to show the result of the progress of a modified method which is now being applied by the authors to the human eye. Letter A Carbutt's dry plate is used with ten minutes' exposure to an ordinary gas-light, giving an untouched and unremagnified negative with a clearly cut disc of about twenty-five millimetres in its long diameter (about × 16), surrounded by an area of one hundred millimetres diameter, upon which the retinal vessels and gross changes in the retina and choroid can be plainly seen for nearly seventy-five millimetres area round the disc; the whole being entirely devoid of any disturbing light reflexes. Phototypes of these photographs have been made, and will be combined in a future publication upon the subject, which is now being prepared by the authors.