attempted to discuss may well be adapted to use in private practice without change of material importance. It has been the method followed by the author for eleven years in private practice and the results obtained have proven the reliability and dependability of the objective method of refraction. My associates in the Attending Surgeon's Office have adopted this method of objective refraction; and with the opportunity offered for observing the final results obtained in the refractions

performed in this office, it may be said in all fairness that the objective method of determining and correcting errors of refraction has proven itself to be superior in every respect to subjective methods. The proof has been so convincing and conclusive that all subjective methods have practically been discarded, and the refraction work of the Department of Ophthalmology of The Attending Surgeon's Office is based entirely upon objective methods.

FUNDUS PATHOLOGY WITH THE RED-FREE LIGHT OF VOGT.

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This paper calls attention to (a) A new Symptom of Retinal Atrophy, and (b) Macular and Foveal Changes. With illustrations showing the apparatus used to furnish the light. Read before the Chicago Ophthalmological Society, February 17, 1919. (See p. 351 for Discussion.)

In the normal fundus the red-free light gives us the first absolute demonstration of the yellow coloring at the

Fig. 1. Lamp with filtration apparatus, after Vogt and Affolter.

macula in the living eye. Owing to an increased contrast new details of the macula and fovea can be seen.

With it we can also measure by comparison the yellow discoloration of the lens in age and in monolateral aphakia.

In addition the increased visibility of the retinal nerve fibers with the red-free light is of great importance. In a

recent article Vogt draws attention to the fact that optic atrophy with our present method of examination is only diagnosable at the nerve-head and from the vessel caliber of the same. The retina, however, though it no doubt is regularly involved in the atrophic process, shows no ophthalmoscopic changes. With the red-free light he is able to see the nerve striations of the retina and study their pathologic changes.

In optic neuritis and retinitis the nerve fibers are coarser, single bundles intermingle, while elsewhere they are interrupted and seem to recede in step-like layers.

Aside from these inflammatory changes he finds certain modifications of the nerve fiber striations in optic atrophy. In complete postneuritic, as well as in primary and glaucomatous atrophy, also in that complicating retinitis pigmentosa and fracture of the base of the skull, there is found a white, marble-like mottling of the surface.

Most interesting and instructive are the cases where one optic nerve is normal and the other atrophic.

A case of this type, following fracture of the base of the skull, five years ago, in a male, now forty-five years of age, is described.

With the ordinary illumination there are no changes except those of atrophy at the nerve-head and its vessels. With the red-free light, however, we find a total absence of the retinal striations in the atrophic eye. In their place there is a delicately mottled marbled surface. Also, a thin, whitish line on either side of the vessels, invisible with ordinary illumination. In a case of partial postneuritic atrophy complicating multiple sclerosis there was a reduction in the visibility of the nerve

Fig. 2. Honey-comb appearance of macula.

fibre striae, and in certain zones they were absent.

This herewith described disappearances of retinal striations must be added to the symptomatology of optic atrophy, and must be conceded to be the only known visible ophthalmoscopic sign of retinal atrophy, if we exclude the more or less indefinite picture of shrinking of the vessel caliber. Of especial practical importance are further detailed observations made with the red-free light in retrobulbar neuritis.

In the diagnosis of this quite common and often obscure eye disease, we must at times make absolute dependence on such subjective symptoms as the statement of the patient as to his habits, nyctalopia, central scotoma, etc.

Several authors have drawn attention to degenerative changes in the

retinal vessels which accompany this disease. They are, however, not always present and often difficult of diagnosis. If present they are not necessarily pathognomonic of retrobulbar neuritis. The latter is also true of the so-called temporal pallor of the disc, which is often found in normal fundi.

It is therefore of great practical value that we have in the red-free illumination a method at our disposal with which we can diagnose degenerative changes of the maculopapillary bundle in retrobulbar neuritis.

The changes found with great regularity (eight cases) are the above described absence of striation and a substitution therefor of the marbled zone in the papillomacular bundle.

Vogt has been able to observe similar changes and degenerations in this same retinal zone in cases of ascending atrophy of this central nerve tract in isolated disease, and degeneration of the macular and foveal zone.

Very recent anatomic investigations have proven that the macular zone is practically absent in the eyes of Albinos. The investigations of Vogt and Affolter seem to confirm this as they fail to find the yellow coloration at the macula in the eyes of living Albinos. This leads to the conclusion that the absence of the yellow coloring matter deposited in the macula is in direct or indirect relation to the lack of pigment in general.

In the past few months I have been able to study many fundi with the red-free light. The yellow coloration of the macula is most beautiful. I note a greatly increased visibility of the foveolar reflex of Dimmer. It shows as a most luminous spot, much more glistening, for instance, than any so-called cholesterol crystals I have ever seen.

Further investigation in this zone with the red-free light I am sure will make of greater value the work of Haab, Dimmer, Gullstrand, and others who have made this physiologically so important, and pathologically most vulnerable retinal area, the object of

so much observation, study and research.

Vogt describes certain pathologic honeycomb-like changes of the macula, visible only in the red-free light. They were found especially in cases of retinitis pigmentosa, and continued during certain long periods. A year later, in one case, he found them less marked. In other very advanced cases they were absent.

Vogt also has noted this vacuoli formation, for a period of several months, in cases of injury to the macula following contusion of the bulb. Later on they gradually disappeared.

Fig. 3

Effect of change of posture showing gravitation of hyphema.

Fig. 4

He considers them symptoms of vascular and cystic degeneration of the macula.

Leber has described similar vacuoles of the macula anatomically and presumes that the bursting of some of their thin anterior walls could produce, in time, the condition we know of as "hole in the macula."

Vogt gives a most interesting description of vacuoles of this kind in a case of embolism of the central retinal vein. Two large, nearly circular, spaces in the center of the macula showed a hyphema in their lower thirds. After a few days these two became confluent. Quite a number of other smaller vacuoles, partly containing blood, were visible and remained so for months. If the patient would be examined lying on one or the other side, this precipitate would slide or

gravitate to the altered position. On the patient's resuming the upright attitude they would return to their original site in about two minutes.

Following this experiment a distinct clouding of the clear contents of the cyst above the hyphema was repeatedly noted and continued for a short period, due to a whirling or stirring up of the pigment disturbed in its complete precipitation.

All of these observations prove that cystic degeneration of the macula can produce the condition we call "hole in the macula," and account for the great length of time so often consumed in

gradually bringing about this interesting pathologic condition.

Many new reflexes in various parts of the retina and true folds not due to separation or detachment are fully described by Vogt in several recent articles. Affolter also emphasizes the greater visibility of delicate vitreous opacities, deposits on lens and vascularization of the cornea, with the red-free light.

It is not expected that this method will supersede the ordinary light for ophthalmoscopy. Certain conditions, such as exudative zones, the changes of retinitis proliferans, medullated nerve fibers, and the star figuration of retinitis, for instance, are seen in better contrast with our old light. There is no doubt, however, that with the red-free light we have added a most valuable and helpful method of diagnosis.