

passage of intestinal contents, and the muscular contraction which follows. Therefore, the cicatricial fibers run circularly, and stricture results. Matas calls attention to the great frequency of multiple as compared with single stricture in tuberculosis. This is confirmation along the same line as that just cited.

In this connection I call your attention to the scar-tissue of chronic interstitial myocarditis. There is an absolute lack of uniformity in the direction of the connective-tissue fibers. In the ventricular wall pull is from every direction.

In making a circular enterorrhaphy the circular muscle bundles are split lengthwise of the fiber. In consequence, as the circular muscle contracts and distends it pulls very little on the developing scar-tissue. On the other hand, the longitudinal muscle is cut across. Its fiber ends are caught in the scar. Some small portion of these fibers degenerate, to-wit, those parts separated from their governing nuclei. The remainder of the muscle remains functionally active. In consequence, every muscular contraction pulls on the scar in the direction of the long axis of the intestine. Therefore the scar-fibers run lengthwise of the intestine. We can not avoid the scar-tissue, but so long as the fibers run properly, it does no harm.

Barbat, as the result of a continued and careful study of the histology of healing after various methods of anastomosis, makes the following observations, apropos here: "Muscle cells, after being cut, will never repair in such a way as that the muscle cells will cross over the point of division; there will always be a layer of scar-tissue at the point of union."

Van Hook says that scar tissue is always found in circular enterorrhaphy, no matter by what means one performs the operation.

Lee reports a dog which was operated on with a Murphy button five months before being killed. "There is very little scar-tissue to be seen, it being most evident in the muscular coat. It was a beautiful specimen, with absolutely no contraction present."

Dr. Barbat further says: "If we follow these suture cases, we will find that the connective tissue which is formed between the approximated surfaces begins to contract, and as the amount of contraction depends on the amount of scar tissue, it necessarily follows that with the two comparatively wide surfaces which we get in all suture anastomosis, we will have considerable contraction." I may say that I can not quite agree with this point, and I do not think that his specimens would indicate great danger in this direction. I am of the opinion that exclusive peritoneal contact is not best. The more the submucosa participates in the repair process, the better the result. Barbat says: "It will thus be seen that in order to have secure anastomosis, the perineum and submucosa are the only coats which are essential, therefore the method which approximates these coats the earliest must be the best."

I quote Harris: "The error of supposing it necessary to oppose serosa to serosa was pointed out in my former paper—September, 1892—when it was shown that peritoneum unites as readily to any raw surface as it does to peritoneum." He quotes Greig-Smith's demonstration of the advantages of sero-fibrous union.

I have examined some of the cases cited as proving the possibility of secondary stricture from growth of fibrous tissue: such cases as Keen's and Abbe's. Some of them are very difficult of explanation. Some cases can be explained on the basis of an extension of the primary process, for example, malignant disease; others

on the fact that the original outlet remaining pervious, or later becoming pervious, the artificial opening tends to close. Against these we place such cases as those of Dunne and Murphy, in which the opening was larger, some time after operation, than at the time of operating.

In looking over specimens of intestines operated on many months before the animal was killed, I sometimes find great difficulty in locating the point of operation. This will be apparent to you in some of the specimens that I show, notably some of Dr. Barbat's and one of Dr. Frank's. I am certain that some of you have noticed the complete disappearance of scars after typhoid, dysentery, violent gastroenteritis, or caustic poisons. I dare say that you have often wondered what had become of the scar-tissue in cases where you have known of a most severe typhoid a few years previously. The explanation is that in areas of great functional activity, scars have a very great tendency to disappear. Especially is this true of epithelial structures. The mucosa-healing in the intestine is most complete. The muscular regeneration is least complete, and in consequence of this last fact an old scar sometimes persists as a place of thin intestinal wall.

Please do not understand that I deny the possibility of a diaphragm. Operations, such as the Czerny-Lembert, which turn in a large portion of intestine in order to accomplish a broad peritoneal contact, must result in a diaphragm. I show a cast made of such an intestine. I also show a slide showing a large amount of internal projection. I do not propose to enter on a discussion of the harmfulness of these diaphragms. Rosenthal, Goetz, Roser, Chaput, Madelung and Kunner, quoted by Harris, cite cases in which the diaphragm produced marked and sometimes symptomatic obstruction. As a general proposition, we are apt to lose sight of the fact that partial diaphragms constitute a part of the physiological arrangement of the intestine.

The conclusion that I arrive at is: The possibility of secondary stricture is not great enough to constitute a legitimate objection to end-to-end anastomosis.

I have to thank Drs. Murphy, Frank, M. E. and F. G. Connell, Barbat, Herzog, Lee and Turek for the opportunity of examining specimens.

HEMORRHAGIC GLAUCOMA.

A CLINICAL AND PATHOLOGICAL STUDY OF A CASE.*

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PHILADELPHIA.

Hemorrhagic glaucoma may be defined as an ocular affection characterized by an increase in the intra-ocular tension, as the result of a previous hemorrhagic retinitis. Although now generally recognized as a distinct type of glaucoma, the pathology of hemorrhagic glaucoma is still obscure, so that the microscopical examination of each case is of value as serving to elucidate the precise nature of this disease. It is with this object in view, therefore, that the following case, which has been carefully studied, both clinically and pathologically, is reported.

The patient, G. W. H., aged 58 years, consulted the writer in December, 1894. He said that he had never had any trouble with his sight until the preceding August, when he noticed one morning on rising that everything appeared blue and that objects were seen

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indistinctly. He could not remember any illness, or having subjected himself to exposure or to any unusual strain which might have accounted for this. He thinks that the eyes were not red or painful at the time. For some months prior to these ocular symptoms, he had had attacks of vertigo in the barber's chair and at stool, and had been short of breath on slight exertion. He had had piles for years, and the month before his vision failed he had bled from his nose quite freely on several occasions.

Objects still appearing blue and his vision being still clouded, he was instigated, a few weeks after the attack, to seek relief from these conditions at the Wills Eye Hospital, where he came under the care of Dr. Edward Jackson, to whom I am indebted for the following notes:

"Patient had complained of failing vision in the right eye for the last few weeks, but without inflammation or pain. Examination shows the conjunctiva of the affected eye to be injected. The corneæ are clear, the pupils are 3 mm. in size, and respond actively to

ment, but as the drops still exerted the same disagreeable influence, he became disheartened and discontinued all treatment for several months. At the end of that time, he consulted the writer in the hope that the sight of the right eye, which had now failed him utterly, might be restored to him.

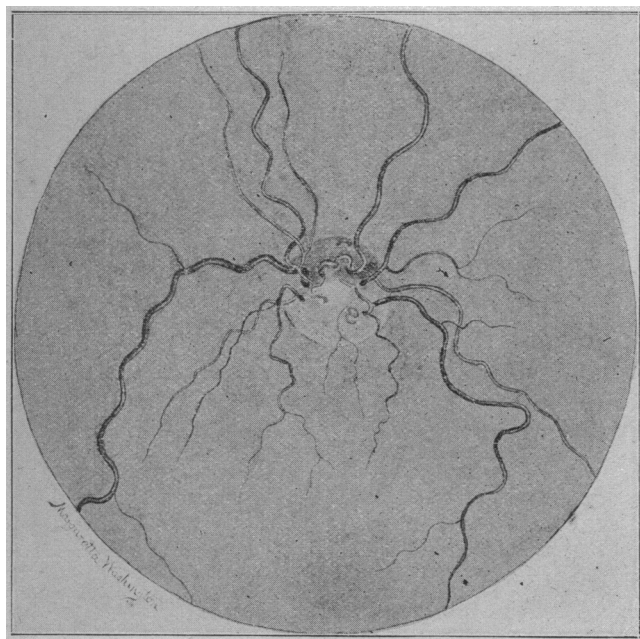
Examination showed the patient to be a large powerful man, but with marked evidence of faulty circulation. His hair was quite gray, his lips rather blue and his temporal vessels prominent. The right eye presented all the cardinal symptoms of absolute glaucoma; the globe being brick-red from deep ciliary congestion, the cornea steamy and needle-stuck, and the scleral vessels full. The anterior chamber appeared to be only slightly shallowed; the pupil was widely dilated and the iris was immobile to light and accommodation stimuli. There was a greenish reflex from the pupil and the tension was +2. On account of the cloudiness of the media, but a faint red glare could be obtained from the fundus. The eye was absolutely blind.

The fellow eye was almost quiet, although in addition to a faint arcus senilis above, there was a faint haze of the cornea and some congestion of the scleral vessels. The anterior chamber was of good depth; the pupil, which was 3 mm. in size, reacted well to light and accommodation stimuli; the sclera was rigid. The fundus was plainly seen, and the appearance of the optic nerve and the retinal vessels was so striking that they were thought worthy of a sketch. As seen in the sketch, the nerve was quite gray in the deeper layers, especially to the temporal side, but was markedly hyperemic and slightly swollen on its nasal half, this edge of the disc being almost hidden by the swollen nerve-fibers. There were also several minute hemorrhages on the head of the nerve, and a few corkscrew-like vessels projected from it. The outer two-thirds of the disc were embraced by a large physiological excavation, at the bottom of which the lamina cribrosa was plainly visible. The retinal veins were enlarged and very tortuous, especially on the disc, and projected into the vitreous, being twisted about one another like a cluster of angleworms. The arteries were reduced in size and their walls were thickened, presenting somewhat of a waxy appearance. The entire retina was slightly hazed, and was so swollen at the nasal edge of the disc that the distended veins were at times obscured by it. In the macular region there were several minute scattered spots of pigment. Vision equaled 5/10, and with +0.50 D. S. \subset +0.25 D. C. ax. 90°, equaled 5/5; with +3.D. additional, type 0.50 D. was read from 12 to 20 cm. The field in the left eye was normal both for form and color.

A careful physical examination by Dr. Alfred Stengel discovered a somewhat enlarged left ventricle, and a strong high-tension pulse. The sounds over the heart were free from murmurs, but the first sound was peculiarly heavy and booming in character, while the second was sharp and accentuated, especially at the base and at the aortic region. There were faint bruits in the arteries of the neck. The vessels were everywhere stiff, but not calcareous. Dr. Stengel was of the opinion that the case was one of moderate arteriosclerosis.

An examination of the urine made by Dr. S. M. Hamill was as follows: specific gravity 1024, reaction acid; microscopically, a few cylindroids and urates, but no casts.

The patient was cautioned about overexerting himself; his diet was restricted; his bowels were kept open by salines, and his circulatory apparatus regulated by

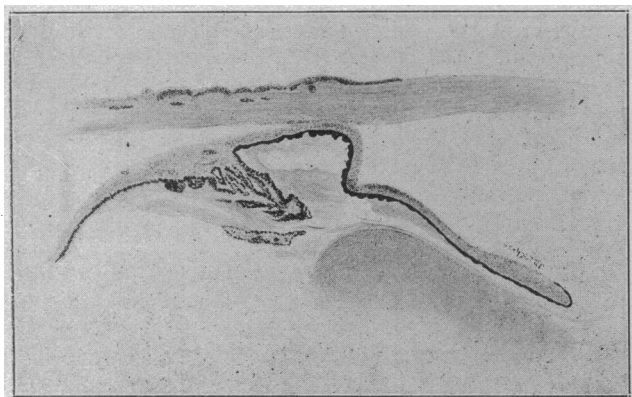


Left eye.—Showing unusual dilatation and tortuosity of the retinal vessels, particularly the veins.

light stimulus. With the ophthalmoscope, the media in the eye are clear, but the disc is red and hazy, its edges being wholly obscured except at the upper margin. The retina is swollen and hyperemic and there are innumerable hemorrhages in the papillo-macular region. The retina in the left eye exhibits a similar condition, though less pronounced. Vision in the right eye equals counting fingers at 50 cm.; in the left eye 5/10. Examination of the urine showed specific gravity of 1020, and was negative regarding the presence of albumin or sugar. The patient was placed on eserin and nitroglycerin gr. 1/100, three times daily. Three weeks later the disc in the right eye was less obscured, though the retina was still very hazy. The retinal arteries were noted as being relatively very small, with their walls much thickened. Vision of the right eye now equaled counting fingers at 5 inches."

The patient employed the drops and pills which were prescribed, but did not return for further treatment as the drops made his eye painful and brought on vomiting. He then consulted several other ophthalmologists, who advised the continuance of the same treat-

nitroglycerin. Two drops of eserine salicylate—gr. $\frac{1}{4}$ to the ounce—were instilled into the right eye twice daily, preceded by a few drops of a 2 per cent. solution of cocain. After several weeks of this plan of treatment the eye became less painful and the circulation improved to such an extent that the outlines of a hemorrhage in the retina, slightly up and out from the disc, could be discerned. This improvement lasted for several months, when there was a recurrence of the attacks of pain in the eye, which radiated into the nose and was accompanied by profuse lachrymation. The iris gradually became vascular, the cornea more densely steamed and the globe harder, and the pain was so severe that enucleation was finally advised to avoid further discomfort. The patient's consent being obtained, this operation was performed without accident under ether, and the globe placed in Müller's fluid for examination. The socket healed satisfactorily. In order to protect the remaining eye from a glaucomatous attack, a weak solution of eserine was instilled into it, the proper correcting lenses adjusted, and a careful regimen of the patient's life insisted upon. As a result of these precautions, the patient's health improved, and there have been no untoward symptoms in his remaining eye.



Section through the angle of the anterior chamber, showing its complete obliteration by the adhesion of the base of the iris to the cornea.

An ophthalmoscopic examination, which was made a few days ago, showed that the circulation in the eye had improved, the caliber of the arteries was greater, and the veins were not so dark and full as at the time of the sketch. The intense striation of the fibers on the nasal half of the nerve still persisted, but the few pigment massings, the remains of the hemorrhage noted by Dr. Jackson, had entirely disappeared.

The enucleated globe was allowed to harden in Müller's fluid for several months preparatory to its pathological examination by the writer in the laboratory of the State Hospital for the Insane at Norristown. After the hardening process had been accomplished, the eye was frozen in a mixture of salt and ice and divided with a brain section-knife. Macroscopically, it was noted that the antero-posterior diameter of the globe was 25 mm., the horizontal 24 mm.; the lens was 9 mm. in its horizontal diameter, and 3 mm. in its posterior diameter; the anterior chamber and vitreous were filled with an albuminoid material, and the nerve-head was swollen.

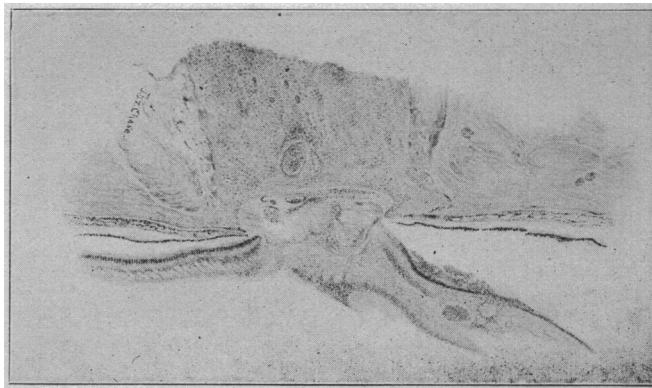
MICROSCOPICAL EXAMINATION.

Cornea.—The epithelium and Bowman's membrane were intact, although the presence of tiny cavities between these two layers, as well as the increased prominence of the lines separating the individual cells, espe-

cially in the deeper tissues, gave evidence of a considerable degree of edema. The lymph-sheaths of the vessels at the periphery were much distended, and the vessels here, in common with all through the globe, showed a decided proliferation of the lining endothelial cells of the intima, thickening of the adventitia, with hyaline change, and in many places nearly complete obliteration of the lumen.

Sclera.—This coat was infiltrated in places with round cells, and was somewhat thickened posteriorly about the entrance of the optic nerve. A section across one of the anterior perforating arteries showed a hyaline thickening of its walls.

Anterior Chamber.—As shown by the sketch, the angle of the chamber was obliterated, though clinically the chamber appeared deepened. This was occasioned by the marked retraction of the entire plane of the iris with the exception of its base, which was in close contact with the cornea. The chamber was partly filled with homogeneous transudate, which extended into the posterior chamber and occupied the space between the fibers of the zonule and thence back into the vitreous, where it formed a layer on the inner surface of the retina.



Section through the head of the optic nerve, showing intense neuro-retinitis, unusual vascularity of the head of the nerve, and embolism of the central artery of the retina.

Iris.—The base was quite atrophic. The stroma was dense, and contained but few vessels, and the lumen of many of these was almost obliterated. There was a layer of organized lymph on its anterior surface, which had occasioned by its contraction a marked degree of ectropium uveæ. There was but little pigment in the membrane, except at the pupillary border, where it was found in irregular clumps, instead of the normal pigment cells. The pupil was dilated.

Ciliary Body.—The muscle fibers were atrophic; the tissue was infiltrated with fluid, the processes were pushed forward and occasioned a stretching forward and inward of the fibers of Müller of the retina. Owing to the adhesions formed by the base of the iris and the cornea and the changes in the ciliary body, the posterior chamber was greatly enlarged by a large saccular dilatation of its outer angle.

The Retina.—This membrane was covered by a sheet of organized lymph, which was blended with the disorganized internal retinal layers, and was thickest on the temporal side. Its deeper layers contained but few cells, while the more internal were freely organized. The inner surface was covered with a thick layer of mononuclear round cells, many of which had assumed a spindle form. A detachment of the retina on the temporal side had been occasioned by a contraction of the

mass. The retina was thrown into numerous folds, and in places there were large cavities between the retina and the sheet of lymph, which were filled partly with transudate and partly with fresh extravasations of blood.

The retina had been the seat of an intense inflammation, its layers being blended into a firm mass, richly infiltrated with wandering cells filled with blood-pigment. The rods and cones were broken down into irregular globules, and the space between the retina and the pigment layer, which remained attached to the choroid contained an extensive hemorrhage. Farther to the temporal side, the retina showed less inflammatory reaction, but the hypertrophied fibers of Müller were drawn out into long processes by the exudate, and by their separation allowed the formation of numerous smaller cavities, which were filled with fluid. On the nasal side of the nerve the same effect had been produced, but the cavities were smaller and there were no marked inflammatory changes. Throughout the mass there were small hemorrhages. Anteriorly, the retina showed changes due to long-standing edema; hypertrophy of the supporting fibers, cystic degeneration of the fiber layer, and disappearance of the ganglion cells. In this membrane, as elsewhere, the same vascular changes had occurred as were described above. The pigment epithelium was irregularly proliferated, especially in the papillo-macular region, and in many places was separated from the lamina vitrea of the choroid by a faintly staining exudate.

Optic Nerve.—The excavation was .5 mm. in depth, and was filled in by the mass of organized lymph, and by the retinal fibers which had been pulled over the edge of the cup by the contraction of the newly-formed tissue. The lamina cribrosa was bent backward and the excavation occupied the entire nerve-head. The central vessels showed a marked degree of thickening of the walls and proliferation of the endothelium. The veins were full of blood, but the lumen of the main artery was partly filled with a mass of spindle cells, which was firmly filled with the proliferated endothelium. Sections of the vessel within the nerve indicated that the obliteration at the time of enucleation was, in this place, incomplete, as a small channel remained on the nasal side, which contained fresh blood-corpuscles. Sections of the temporal branch of the artery within the lymph mass, however, showed complete obliteration. The connective-tissue septa of the nerve were very much thickened, and the nerve-fibers were completely atrophic. The supravaginal space was distended.

Choroid.—This membrane was little affected beyond an enormous dilatation of its vessels, with bundles of newly-formed connective tissue scattered through it in places. There was some round-cell infiltration beneath the areas of intense retinitis.

Vitreous Chamber.—The retina and the inflammatory mass on the head of the nerve were covered with homogeneous exudate previously described in connection with that in the anterior chamber. From the center of the mass on the nerve there extended into this exudate a channel about the width of the central artery, the walls of which were at first composed of several layers of spindle-shaped cells, but were soon represented by a single layer of flattened cells. This channel was partly filled with red blood-cells, and evidently represented a new blood-vessel springing from the organized exudate, and extending into the vitreous chamber. In the homogeneous exudate surrounding it there were numerous small collections of blood-corpuscles, mononuclear cells

which showed vacuolization and disintegration of their nuclei, and cells containing absorbed pigment.

The changes which have just been described are most striking and their significance deserves careful consideration. Dr. E. A. Shumway, who kindly studied a series of the sections for the writer, has given the following explanation of them, which seems to be both pertinent and conclusive:

The finding of an occlusion of the central artery raises the interesting question: Was this the primary cause, and the subsequent changes in the nerve and retina secondary to it, or was the thrombosis dependent on the inflammation of the surrounding tissues? I think that the answer can be readily given if we compare the clinical history of the case with the pathological findings. In the first place, the process was slow in onset, and the failure in vision was not sudden, but gradual. The ophthalmoscopic examination, which was made some time subsequent to the beginning of the affection, showed a marked neuroretinitis, with numerous changes in the exudation in the nerve-head, and in the substance of the surrounding retina. There was considerable tortuosity of the venous channels, but no noticeable change in the size of the arteries. Moreover, the presence of a similar, though less-marked condition in the fellow eye, and the evident changes in the blood-vessels throughout the system, point to the fact that we are dealing here with changes due to disease of the general vascular system, and not with a mere local disturbance. The pathological examination, therefore, confirms the clinical diagnosis. As a result of the endarteritis and periarteritis of the retinal vessels, there occurred a severe inflammation of the head of the nerve and neighboring retina, with hemorrhages from the diseased vessels, an outpouring of lymph and round cells, subsequent organization of this inflammatory mass, with detachment of the retina, atrophy of the optic nerve, hemorrhage into, and round-cell infiltration of, the vitreous; glaucomatous symptoms then supervened, the filtration angle of the anterior chamber was closed by the forcing forward of the ciliary processes and lens, and as the base of the iris became adherent to the periphery of the cornea the glaucoma became absolute.

While there is still far from unanimity among pathologists regarding the changes which occur in the ocular tissues in hemorrhagic glaucoma, the majority of observers agree that the most constant lesions are found in the blood-vessels, and more especially those of the retina and optic nerve. Undoubtedly this view largely resulted from the thesis of De Bourgon, which showed, in a comprehensive review of the literature, that these tissues were the most frequently affected in the cases hitherto reported.

Thus, of 13 complete pathological examinations which had been made, all exhibited vascular lesions in the retina, such as miliary aneurysms, hyaline and amyloid degeneration, and periarteritis and sclerosis. In 7 of these cases there were lesions in the vascular system of the choroid also.

As a result of this initial general vascular disturbance it appears that a diminution in the circulation of the blood follows that favors the occurrence of hemorrhages, which are rather the result of diapedesis than of rupture of the vessel walls.

As De Bourgon has pointed out, a vicious circle is thus inaugurated: the diminution in the circulation giving rise to the hemorrhages, and the hemorrhages, in their turn, in conjunction with a fibrous transformation of the retina which occurs in the majority of the cases, contribute still further to the stasis of the blood-current. As a result of this, the hemorrhages increase in number, become more extended, and the circulation is finally so impeded that venous thrombosis ensues, in association with a dilatation of the capillaries. Serous exudation then takes place, the intraocular pressure increases and the glaucomatous attack is precipitated.