Moore, (W. O.)

Diabetic Affections of the Eye.

BY

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PROFESSOR OF DISEASES OF THE EYE AND EAR IN THE NEW YORK POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL.

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DIABETIC AFFECTIONS OF THE EYE.*

By WILLIAM OLIVER MOORE, M. D.,

PROFESSOR OF DISEASES OF THE EYE AND EAR IN THE NEW YORK POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL.

> "What says the doctor to my water?
> "He said, sir, the water itself was a good, healthy water, but for the party that owed it, he might have more diseases than he knew for."—King Henry IV, Part II.

The only excuse I can offer for presenting this subject to your attention is, that during the past ten years I have seen an unusually large number of diabetic affections of the eye as compared with the number of such cases reported in the practice of older physicians. This is to be accounted for by my especial interest in this class of patients and my solicitation of diabetics for ophthalmoscopic examination from general practice, thus having sought for the cases before they sought the ophthalmic physician. What I may say will contain nothing new, but will be rather a report of my own cases, together with a *résumé* of the subject as it at present is understood, with the hope uppermost that a full discussion will be evoked and some interesting facts brought out that have hitherto been latent.

* Read before the Section in Ophthalmology and Otology of the New York Academy of Medicine, February 20, 1888.

Celsus was probably the first to clearly describe diabetes, and Galen (131 to 210 A. D.) to first call it by that name.

In 1674 Willis first associated the presence of sugar with the disease, discovered by the sweet taste of the urine. Other observers succeeded in separating the sugar, and Rollo in 1787 began the dietetic treatment by withholding vegetable food.

It is not a rare disease, is more common now than formerly. This fact is probably due to the frequent and more accurate examination of the urine. In the United States census for 1880 there are reported 1,443 deaths from diabetes, or 0·19 per cent. of deaths from all causes, against 0·17 per cent. in 1870.

*Report of Deaths from Diabetes in New York City. From the Records of the Board of Health.**

	DEATHS FROM DIABETES.		DEATHS FROM ALL CAUSES.	
	Total.	Over 15 years	Total.	Over 15 years
1878	42	41	27,008	13,174
1879	37	36	28,342	14,075
1880	44	43	31,937	15,684
1881	43	43	38,624	18,250
1882	46	43	37,924	18,264
1883	68	64	34,011	18,451
1884	68	67	35,034	18,184
1885	63	62	35,682	18,787
1886	82	78	37,351	19,566
1887	105	104	38,933	20,303

Total deaths in ten years from diabetes, 598.

Total deaths from all diseases in ten years, 344,846, or 1 diabetic in every 577 deaths.

* I am indebted for the foregoing to Dr. Roger S. Tracy, Register of Vital Statistics.

In 1867–'69 the ratio of deaths from diabetes to the total number of deaths was 1 to 1,379.

In 1867–'69 there were 49 deaths from diabetes.

In 1877–'79 there were 123, an increase of 74, which is out of proportion to the population increase.

It is more common between thirty and forty years of age, but does occur, as seen, in early life, although the older writers did not so consider. Prout states that of 700 cases of diabetes, he had met with "but one instance of it in a child five years old, and only twelve in young persons between the ages of eight and twenty." Hanner has reported the case of an infant twelve months old. G. M. Smith (1), M. D., reports one twenty-three months old, and W. H. Deane (2), M. D., of Blanford, Mass., one, a female, one year and three weeks old. Of cases treated at the New York Post-graduate School and Hospital, there were only three in the first 10,000. In the Vienna Polyclinic Romberg found the same ratio to exist. I am quite sure that the disease is more prevalent in private practice than is usually conceded, and that the reason we do not find records of such in hospitals and dispensaries is on account of the carelessness of examinations and the improper signing of death certificates. That there is also a great disproportion between the diabetic affections of the eye seen in private and those seen in hospital practice, owing to the loose way of making diagnoses, I make this sweeping statement from my recent efforts to obtain evidence as to this point in the principal ophthalmic hospitals of this country. The statistics of these institutions are utterly useless.

Hirschberg (3) remarks upon the much greater frequency of diabetes in private than hospital ophthalmic practice, and reports, of 1,638 private patients, 17 suffering from diabetes, while of 10,000 at his clinic 3 only had su-

gar in the urine. During the past ten years I have examined 97 diabetic subjects, and of this number 21 had ocular affections.

Amblyopia (without ophthalmoscopic change)	4
Cataract	4
Retinitis (glycosuric)	5
Hæmorrhages and floating bodies in vitreous	4
Paralysis of accommodation	3
Iritis (diabetic)	1
Total	21

Dufresne (14), out of 162 diabetics, had 20 with various ocular affections.

In 1798 Rollo first called attention to eye trouble in diabetes, although Blankaard in 1688 mentioned a case of blindness from this disease, in which, however, it was subsequently found that both the diabetes and the blindness were due to a tumor of the brain. Dr. Prout and Mr. France long since called attention to this association. The most common ocular symptoms usually are, first, affections of the muscular system, paralysis or loss of accommodation, and paralysis of the extrinsic muscles of the eye, usually the abducens. Then the vascular system becomes affected and we observe hæmorrhages into the vitreous, also floating bodies, the result of improper nutrition of that body. As a result of the serious changes in the vascular system, retinal hæmorrhages take place, and at the same time we find them in the vitreous usually associated. Cataract and amblyopia are found in the later stages of the disease. Iritis and keratitis are rarely seen, but have been very admirably described by Leber (16), Schirmer (17), and Wiesinger (19). It is quite natural that the first ocular symptoms noticed occur as the result of general muscular weakness. I have seen in many diabetics a temporary loss of accommodation,

which would last during a few days to a few weeks, when more than the usual amount of sugar was being voided from the system, which would give way on a proper treatment being adopted.

The cases where the accommodative disturbance was but transitory I have not counted, and will relate only the three where it remained permanent.

Case I.—Male, aged thirty, lawyer, first consulted me in 1879, complaining of difficulty in reading. On examination, V. = $\frac{20}{20}$, em. No ophthalmoscopic changes; pupils normal; accommodation, however, faulty, so that newspaper type could be seen only at eighteen inches. Convex glasses were ordered for reading (+ $\frac{1}{36}$) and near vision was restored. This patient subsequently had opacities in the vitreous, and died eighteen months later from phthisis.

Case II.—Female, aged thirty-six, has had sugar in the urine for the past two years. Has never had any trouble in the eyes until three months since, when she had to put the book farther away than usual. The normal range of vision was restored only by the wearing of convex glasses. The fundus and media were normal. Any slight effort caused accommodative asthenopia. The refraction was hyperopic. This patient had V. = $\frac{20}{20}$ for distance, and after prescribing glasses was lost sight of.

Case III.—Male, aged twenty-nine, single, butcher, has had sugar in urine for the past six months, passing nine pints with ten grains of sugar to the ounce; specific gravity, 1·040. General muscular weakness; first noticed failure of sight in reading two weeks before my examination, October 15, 1886. V. = $\frac{20}{20}$, hyperopia = $\frac{1}{24}$. This patient was a friend, and I had previously examined the refraction before any diabetic symptoms had made their appearance, when emmetropia was present. Since the diabetes the hyperopia and paresis of accommodation have appeared. With the decrease in the sugar in the urine the hyperopia and accommodation also diminished. This change in the refraction of the eye is due to the change in the specific

gravity of the blood. Convex glasses gave relief to this patient. He died of carbuncle of the back, March 3, 1887.

Next to failure of accommodation, the muscular system shows its weakness in the paresis of the abducens (or sixth nerve). I have never seen this affection as a result of diabetes, or, if so seen, it has not been recoginzed. Gutmann (20), in 1883, reports a case occurring in the person of a physician, aged fifty-three, thought to be suffering from tabes, but who was found to have diabetes. He was seen by Hirschberg, who found paralysis of the right abducens, with normal pupillary reaction and accommodation. The paralysis of the abducens was complete; the patient retired to Carlsbad, and after a sojourn of two months the sugar diminished and finally disappeared, and with it the diplopia produced by the affected muscle. The sixth nerve taking its deep origin from the floor of the fourth ventricle, the portion of the brain usually affected in diabetes, is supposed to be the reason why this particular muscle is paralyzed, as the other ocular muscles get their innervation from other parts more remote from this region.

Iritis and keratitis from diabetes have been noticed, and Leber and Wiesinger in 1885 report such cases, most of which occurred in the Göttingen Clinic.

In 1857 von Leudet, in the "Gazette médicale," relates the case of a female diabetic, aged thirty-two, with keratitis of the left eye; this patient, however, had paralysis of the third and fifth nerve of the same side, and at the autopsy a tumor, syphilitic in character, was found in the brain, so that this case was not diabetic, but neuro-paralytic in origin. In 1830 Himby speaks of keratitis in connection with diabetes, but the cases are not clearly defined. Panas (21), Galezowski (22), Bellouard, Coundouris, and others have reported cases of diabetic keratitis, and in most every case it has been of the purulent form, and the inflammation of a

very passive character. One of Galezowski's cases was not diabetic, but rather due to the cerebral tumor which caused the diabetes; the two other cases reported by him were, without doubt, due to the general loss of nutrition produced by the diabetes. Most of the cases reported terminated in complete leucoma, and some in leucoma adhærens.

From what literature I have had access to, it would seem that keratitis from diabetes alone is a rare affection.

Iritis seems to be more common.

The first case reported, so far as I can learn, was in 1863, by Marchal de Calvi (23), that of a female diabetic, aged fifty, who had an irido-chorioiditis, and died shortly after from the general affection. In 1868, at the American Ophthalmological Society, Dr. H. D. Noyes (24) reported a case of retinitis hæmorrhagica occurring in a diabetic woman, aged sixty, who had had, some months previous to coming under his observation, double iritis, the posterior synechiæ showing this at the time of the examination for the retinitis. This case is reported by Noyes for the intra-ocular affection, and only incidentally are the results of the iritis mentioned, he evidently not at that time considering the iritis due to diabetes. It, however, belongs to that class.

Wickersheimer (25), in 1874, reports a patient, male, aged thirty-seven, with irido-chorioiditis.

Galezowski, 1879 and 1883, relates the case of a male, aged sixty, with iritis in the left eye and synechiæ in both. For two years the right eye had been the seat of iritis, he having been a diabetic since 1866. The left eye in three months improved.

Aladie, in the same year, reports a similar case.

Umman (26), 1881, reports the case of a priest, sixty-nine years old, with purulent iritis. Coundouris reports also a case of a male of a diabetic family, having iritis.

Leber reports nine cases of iritis, with full and complete histories.

I have seen only one case of iritis in a diabetic, and it occurred only two months before the death of the patient.

CASE IV.—Male, aged thirty-five, laborer, for two years has lost flesh and grown weaker; March 1, 1885, passing seven pints of urine daily, and eleven grains of sugar to the ounce. Has never had any trouble with his eyes; two weeks before seeking advice first noticed cloudiness of vision in R. E., followed in six days by failure of vision in the L. E. When seen by me the R. E. had V.$=\frac{20}{40}$, L.$=\frac{20}{30}$. Right iris inflamed and one or two small synechiæ showing aqueous cloudy and small amount of hypopyon, slight injection of the eyeball, and not much pain. L. E., pupil clear, though slowly responding to light; circumcorneal injection, slight pain, and no fear of light. The ophthalmoscope shows media clear in the eye. Four days later each eye has hypopyon and more marked signs of iritis. The cornea of the R. E. is slightly cloudy in the outer quadrant. A careful diet was prescribed, and the usual local measures for iritis were adopted. The patient recovered with a few adhesions remaining in the R. E. and some in the L. E. after an inflammation of six weeks' duration. The cornea remained cloudy till the time of death.

I have, in a number of diabetics, noticed a want of clearness in the vitreous where no opacity could really be determined, which would vary with the excretion of the sugar in the urine, and I suppose is to be explained by the varying conditions of the blood in these cases.

I will, however, only record cases where an actual change could be distinctly seen.

CASE V.—*Floating Bodies in the Vitreous and Opacities in the Lens* in a woman aged fifty, Mrs. C. This patient first showed the signs of diabetes four years before. About six months before coming under the writer's notice she complained of dimness of

vision, with "specks before her eyes." These symptoms gradually increased, and when seen by me, 1884, she had vision=$\frac{20}{40}$ each eye, pupils normal, field of vision normal; the ophthalmoscope showed very many floating bodies in the vitreous, and some small fresh hæmorrhages; the appearance was about alike in each eye; the retina and optic nerve seemed normal. The lens showed a few striæ in the peripheral portions. At this time the patient could read with correcting glasses for a short time only. Much sugar was being voided. Whenever the quantity of sugar diminished in the urine the vision improved. During the remainder of her life the eyes gave annoyance, and on two occasions—for a period of five weeks, during which time the diabetic symptoms were more pronounced than usual —vision was so bad that reading could not be indulged in. On these two occasions the opacity of the lens was much increased, and the lens, in fact, generally cloudy. On the disappearance of the severe diabetic symptoms the lens gradually cleared, the floating bodies in the vitreous remaining, but the vision improving so that she could read for a short time.

This case would seem to be one like that reported by Nettleship, where cataract disappeared on the subsidence of the severe diabetic symptoms.

The patient died in diabetic coma in December, 1887, with no increase in the opacity of lenses or vitreous. The patient was the wife of a physician of this city, and was very carefully treated.

Case VI. *Floating Bodies in the Vitreous, and a Small Opacity in the Right Lens.*—W. H. R., male, aged twenty-nine, seen by me in January, 1888. V.=$\frac{15}{30}$, Em. Seen by Dr. Satterthwaite. Reads Jaeger No. 3 with + $\frac{1}{40}$ from 8 to 18 inches. Has floating bodies very small and fine in vitreous of each eye, and opacity of the right lens, outer and lower quadrant. Has had diabetes for past year; has become emaciated and otherwise shown marked debility. Is an artist and can do work only for a short while at a time. This patient is still under observation.

Case VII.—Female, aged forty-seven, married, has had fail-

ing vision and "spots before her eyes" for the past eight months, has emaciated during the past year, and has passed large quantities of urine with a specific gravity of 1·040 to 1·045, containing sugar. Examination of eyes showed V.=$\frac{20}{50}$ each; ophthalmoscopic picture showed lens clear, but the vitreous filled with numerous fine floating bodies and ten small fresh hæmorrhages. The retina and optic nerve were normal. Each vitreous had a similar appearance except the hæmorrhages. This patient had recurring hæmorrhages until her death, January 17, 1886, from diabetic coma. At no time were there hæmorrhages into the retina.

Case VIII.—Male, aged thirty-eight, for two years before coming under observation had had diabetes, passing 8 pints of urine daily, with 20 grains of sugar to the ounce. When first seen, March, 1885, marked emaciation was noticed, with much muscular weakness. R. V.=$\frac{20}{70}$, L. V.=$\frac{20}{40}$. Ophthalmoscopic examination showed many floating bodies in the vitreous, and several small hæmorrhages. The fundus was normal. This patient, under careful and systematic treatment, improved, so that only 10 grains of sugar to the ounce was voided, and with this improvement the vision also increased. The patient, however, died soon after December, 1885, in an attack of pneumonia.

Cataract.—Opacity of the crystalline lens has from very early times been considered as one of the most common affections of the eye in diabetes mellitus, and it is only recently that the text-books speak of other diabetic affections of the visual apparatus.

According to Roberts, it occurs once in 45; according to Bouchardat, once in 38 diabetics; while Griesinger, out of 225, found cataract to exist in 20. In the St. George's Hospital it occurred once in 28 cases; Frerichs found 19 out of 400; and Graefe asserts that he has found them present in one quarter of all diabetics. In 858 diabetics collected from various sources already reported, together with my own, I find that diabetic cataract occurs once in every

17 whose glycogenic function is disturbed. In regard to the frequency of diabetic cataract to other forms of lenticular opacity it is difficult to say, as in the various hospitals the diagnosis is not accurately made, the special kind being rarely recorded—*e. g.*, of 8,933 cases of soft and hard cataract, non-traumatic and not congenital, recorded in the principal eye hospitals of New York, Brooklyn, Philadelphia, Boston, and Baltimore, only 4 are recorded as of diabetic origin, or 1 diabetic cataract in every 2,223 opacities of the lens. I am quite sure that this ratio is far too small. Badal, out of 20,000 patients with eye diseases, found 52 with diabetic affections of the eye, and of the latter number 13 were cataract.

It occurs in advanced cases, yet it also happens that attention is first directed to the diabetes by the disturbance of vision, more especially by the rapid formation of the cataract. As a rule, both eyes are attacked, though the maturing is not usually equal.

The origin of cataract in diabetes was formerly attributed to the withdrawal of water, from the experiments made by Kunde in 1856, who produced an opacity of the lens in frogs by desiccation or the introduction of substances having a strong affinity for water, such as salt and sugar under the skin; these experiments were afterward confirmed by Weir Mitchell and others.

Von Graefe, on the contrary, pointed out that such lenses (diabetic) did not, like those of frogs, lose their opacity by being laid in water, and that they did not, like the latter, show any formation of vacuoles in their interior. The non-appearance of cataract in diabetes insipidus also tells against its origin in mere deprivation of water. In view of the fact that several cases of spontaneous disappearance of cataract on the improvement of the diabetic symptoms and the decrease in the sugar voided, as reported by Seegen, Nettle-

ship, and others, and as seen in Case V of our series, it would seem more probable that the abnormal constitution of the blood, its saccharinity, as well as that of the other fluids, favored the formation of cataract. Sugar has been detected in the lens and in the aqueous and vitreous humors, as shown by Liebreich, Knapp, and Lohmeyer. In my own practice I have seen four diabetic cataracts, or 1 in 14 of the diabetics examined.

Case IX.—Male, aged forty-six, laborer, came to the New York Eye and Ear Infirmary, March 18, 1881, complaining of failure of vision in each eye, more marked in the left—R.$=\frac{20}{200}$, L.$=\frac{5}{200}$; ophthalmoscope showed a cataract in each, of a soft variety and progressive in character; fundus normal, so far as could be seen. This failure of vision came on three months before coming under observation, and has rapidly increased. Examination of the urine by Fehling's test gave evidences of sugar. Patient voiding eight pints of urine daily. The patient was put on antidiabetic diet, and the amount of the sugar diminished. The vision, however, gradually decreased, and perception of light only remained. After three months' careful treatment for the constitutional disease, the lens of the L. E. was extracted, and, save a mild form of iritis, no serious difficulty was experienced in the healing process. The patient was operated on at his home, and lived two years after the operation, dying of pneumonia on December 28, 1883.

Case X.—Female, aged forty-eight, widow, sewing-woman. First noticed failure of vision in January, 1883, and three months previously had noticed an increase in the quantity of urine voided. The increase in urine came on shortly after a severe sorrow, since which time she has lost weight and become very melancholy. Examination revealed double soft cataract, R. V. $=\frac{20}{100}$, L. V.$=\frac{20}{50}$. Fundus normal; antidiabetic treatment was directed, and rigidly adhered to for two months, when the quantity of sugar in the urine diminished, and with it a general improvement in the patient's physical and mental condition. The eyes, tested again at this time, showed R. V.$=\frac{20}{50}$, L. V.$=\frac{20}{40}$. The patient, becoming tired of the prescribed method of

diet and treatment, went back to the former ways of living, and four months later the vision was as when first examined. Shortly after this the patient went to a distant Western town, and I have not since learned of the result.

Case XI.—Male, aged fifty-three. First seen by me at Burlington, Vt., in May, 1886. Previous to April, 1885, his health had been very good, but about that time he was affected with a great thirst, passed large quantities of urine, and gradually lost strength and flesh. When first seen by me he had large quantities of sugar in the urine, which had a specific gravity of 1·035. Failure of vision rapidly supervened, and, when examined, cataract of a bluish-white luster was observed in each eye, though more marked in the right. The fundus was normal. R. V.$=\frac{20}{100}$, L. V.$=\frac{20}{70}$. Constitutional treatment was prescribed and the patient advised to report in a few months. The patient, however, did not report, and after a lapse of eight months I learned, by inquiry, that the patient had died of exhaustion on December 14, 1886, the vision being so that he had only perception of light.

Case XII.—Male, aged sixty-one, merchant, seen in my private practice, April 18, 1885, with the history of failing vision for the past four months, associated with increase in the quantity of urine passed, containing much sugar. Specific gravity 1·040. No gout or rheumatism, or anything of importance in the family history. Examination of the eyes revealed in R. E. incipient cataract, with striae in many places, having the usual appearance of senile cataract; in the L. E. the lens looked more like the soft variety, and was more opalescent. The fundus was normal—R. V.$=\frac{20}{70}$, L. V.$=\frac{20}{50}$. This patient was placed on a careful diet, and iodide of potassium prescribed. This method of treatment was kept up for seven months faithfully, and with the result of improving very much the general condition, and with some effect on the opacities in the lenses. One year after the first examination the vision was, R.$=\frac{20}{100}$, L.$=\frac{20}{70}$.

The patient died of diabetic coma three years after the first appearance of the general disease without an operation for the cataract.

Besides these four cases seen by me, I know of one in the practice of Dr. E. G. Loring where he extracted a cataract in a diabetic subject with very excellent results and without any reaction; also of one case in the practice of Dr. Thomas R. Pooley.

We are to make a distinction between cataract occurring in diabetic subjects from ordinary senile changes and those coming from the loss of nutrition produced by the disturbance of the glycogenic function. For we may, I think, extract with freedom those lenses occurring in old people having sugar in the urine, whereas in the young diabetic we may have serious inflammation and necrosis of the cornea following the operations for the removal of the cataract. I should not hesitate to operate upon any case of cataract in a diabetic after a few weeks' treatment of the general disease by proper remedies, and think that the poor results previously reported were due to the infection of the parts, the lowered vitality having less power to resist the germs, and that if proper antiseptics had been employed better results would have been obtained.

The spontaneous disappearance of cataract as above mentioned gives us a point in the treatment to by all means try and diminish the quantity of urine voided, and especially to look for syphilis as a cause of the diabetes, and when it is found, iodide of potassium will be found to have most excellent effects. The use of Carlsbad waters is said to have caused diabetic cataract to disappear or to greatly diminish the opacity.

Diabetic Retinitis.—We next come to the deep-seated affections of the eye, in which the long-continued derangement of the glycogenic function causes changes in the vascular system generally, and when hæmorrhages are prone to occur in any part of the body, as the brain, retina, or spleen. According to Artigalas (30), whatever the symptoms

associated with retinal hæmorrhages, it is always dependent upon the fibrous degeneration of the arteries, and that if the degenerative process continues, cerebral hæmorrhage is very apt to follow.

Mauthner in 1868, in his work on ophthalmoscopy, says: Eduard Jaeger (28) found retinitis in a person with diabetes mellitus; others have since then declared it possible (Nagel, Virchow), and by Martin and Galezowski it is positively asserted. Jaeger's case was that of a male, aged twenty-two. No record is given of the quantity of the urine, or sugar in it. Bouchut (29), Desmarres, Martin, and others report similar cases, and seem to be unable to distinguish it from albuminuric retinitis.

Noyes, at the American Ophthalmological Society in 1868, reports the case of a woman, aged sixty, diabetic for several years, and who in the previous year had double iritis, resulting in posterior synechia. When seen by the reporter, R. V. $= \frac{20}{40}$, L. $= \frac{20}{60}$. In the retina of each were found specks like fatty degeneration, with a few hæmorrhages. In the right eye the vitreous was noticed to be hazy. He says the appearances are absolutely identical with what he has often seen in cases of chronic renal disease, and the case was at first so considered. Minute and careful records of the urine passed and tested were kept, and sugar only without albumin discovered. In concluding the history of the case he says: "Pure glycosuria is capable of causing retinitis, and that the ophthalmoscopic appearances can not be distinguished from those which belong to albuminuric retinitis."

I am of the opinion that retinitis occurring in diabetes before the kidneys are diseased can be diagnosticated as such, and that it has distinctive characters. That, however, when the kidneys are diseased, as so frequently happens in the latter part of diabetes, we get a mixed form of retinitis,

which is indeed difficult to determine from the ophthalmoscopic picture. Lagrange (32) gives the following points in differentiation between retinitis from Bright's disease and diabetes:

Diabetic Retinitis.	*Albuminuric Retinitis.*
1. Tendency to marked atrophy of the optic nerve.	1. Less marked, and the nerve not becoming entirely atrophic.
2. Hæmorrhages multiple, disseminate, and alone.	2. Hæmorrhages equally multiple, but mostly in posterior part of fundus.
3. Extensive alterations of fundus throughout.	3. Mostly in the macula lutea and optic nerve.
4. Hæmorrhages not continuing throughout.	4. Remaining throughout.
5. Exudations small in amount and scattered.	5. Exudations white, fatty in character, with much infiltration of retina and nerve.
6. Changes frequently.	6. Remains a long time the same.

One symptom is, however, more characteristic—namely, hæmorrhages into the vitreous are common in diabetic retinitis, and not so in retinitis from kidney lesions. This is to me an important point in diagnosis, and is a clinical fact which has been noticed by several observers. Why they should occur in this affection and not in Bright's disease is probably due to the more marked changes in the vascular system in diabetes.

As regards the frequency of the retinal affection, Badal, in 52 diabetic affections of the eye, found retinitis 17 times, and in our 21 diabetic affections of the eye, 5 retinitis with hæmorrhages, or some over one fourth of the cases.

In the eye infirmaries of this country for the past ten years I find no recorded cases of the disease. That it does occur is certain, but the diagnosis is not made.

Case XIII.—Male, aged forty-three, clerk, first seen by me on March 18, 1883, when the following history was obtained: For two years past has had a desire for sweet things to eat, and has voided much urine; emaciation has occurred, and great muscular weakness. Ten days before first noticed a failure of vision in the R. E., which for twenty-four hours increased, then remained as at the time of examination, when vision in R. E.=$\frac{20}{70}$, L. E.=$\frac{20}{20}$; no refractive error. Ophthalmoscope showed hæmorrhages into the vitreous and into the retina, the optic nerve was not swollen, and there was no infiltration of the retina. The hæmorrhages were minute and scattered over all parts of the fundus.

25th.—R. E.=$\frac{20}{100}$; more retinal hæmorrhages and some signs of exudation in its tissue. Examination of the urine at this time showed sugar in the urine, seven pints being voided daily, and with a specific gravity of 1·038, and seventeen grains of sugar to the ounce. Bromide of arsenic and a careful diet prescribed, and this treatment rigorously adhered to.

April 25th, one month later, R. V.=$\frac{20}{30}$, and the ophthalmoscopic picture found to be changed. Vitreous hæmorrhages absorbed, and only a few opacities now remaining. Retinal hæmorrhages absorbing, and in some places entirely absent, a slight staining showing the site of the former extravasation. Urine and sugar diminished in quantity, voiding now only three pints daily, and only a trace of sugar.

This treatment continued for another month with good result as to the quantity of urine and sugar voided, but with no further improvement in the vision.

The patient left the city for the sea-side, and after bathing in the surf contracted pneumonia, and died, September 18, 1883, of catarrhal phthisis. The vision remained the same as at last reported, so I learned from the family.

Case XIV.—Male, aged thirty-nine, residing in Jamaica,

L. I., sent to me, May 2, 1884, with the history of gradual emaciation and loss of muscular weakness for the past year, and sudden loss of vision in both eyes one week before. Examination revealed V.$=\frac{20}{70}$ in each eye. No improvement by glasses; can not read the largest test-letters of Jaeger's.

Ophthalmoscope shows hæmorrhages into each vitreous, which are fresh and abundant, and in the retina, scattered throughout, are fine punctate extravasations in the macular region and also distant from it; optic nerve hyperæmic but not infiltrated; no exudations into the substance of the retina; the blood-vessels are about normal in appearance. No albumin or casts found in the urine, although many examinations were made. Sugar by the fermentation test was present; the specific gravity was 1·034, and the quantity eight pints daily. The cause of the diabetes in this case was supposed to be due to an injury received in falling from an ice-boat the previous winter, as the health began to decline from this out. The field of vision for sight and color appeared to be normal. Bromide of arsenic, diet, and rest were ordered, and followed for six weeks, when it was found that no improvement had taken place either in the general condition or the eyes, the latter being the same as regards vision; the interior, however, showed some different arrangement of hæmorrhages.

Iodide of potassium was prescribed, and three weeks later specific gravity was 1·028, sugar less, and the quantity of urine also; no albumin. R. E.$=\frac{20}{50}$, L. E.$=\frac{20}{70}$ (as before). Vitreous and retinal hæmorrhages absorbing, and less hyperæmia of optic nerve. This treatment was continued until August, when the patient went to California, where he died, December, 1885, as I learn, from exhaustion, the eyes remaining always bad, but so that he could read large type.

Case XV.—Female, aged forty-three, seen by me while in the office of Dr. E. G. Loring. In the summer of 1885 the patient, while in the Catskills, noticed failure of sight in one eye, her attention being called to it by the annoyance of seeing objects floating in front of the eye. This gradually increased until she sought advice.

On examination, it was found that vision in R. E.$=\frac{20}{70}$(+),

the other being normal. Ophthalmoscope revealed numerous hæmorrhages into the vitreous and also in the retina, some infiltration of the retina, and only a few exudations. The optic nerve slightly congested, the retinal hæmorrhages were scattered throughout the fundus. The appearance of the retinal picture, together with the vitreous hæmorrhage, led me to ask in reference to the quantity of urine voided, when it was brought out that the quantity was in excess, although the patient, an intelligent woman, had not given it much concern. She had also a great desire for sweetmeats. Examination of the urine revealed sugar in large quantity and no albumin. Under treatment by two different physicians, who regulated the diet, she improved, and the retinal appearance changed the vision in power to $\frac{20}{40}$. The restricted diet prescribed being irksome, the patient relinquished it, and, on returning to ordinary diet, the diabetic symptoms reasserted themselves, the eye symptoms again becoming worse by the recurrence of fresh hæmorrhages. The patient is still living and under the care of Dr. Loring, to whom I am indebted for the use of his notes.

Case XVI.—Female, aged sixty-three, first seen by me at the Post-graduate Hospital, December, 1886. Patient a hard-working woman, coming for defective vision in each eye, R. $= \frac{20}{100}$, L. $= \frac{20}{200}$. Ophthalmoscopic examination showed well-marked hæmorrhages into each vitreous and each retina. Those in the vitreous were large and those in the retina small and scattered throughout the whole fundus, and not, as in retinitis albuminurica, in the macular region. This patient was not emaciated, and the only symptom complained of beside the dimness of vision was a strange sensation in the region of the heart. She was referred to Dr. W. H. Porter, who found albumin in the urine and a sound over the heart, which he thought to be due to an opening in the aortic valve, congenital, and not as the result of disease. Later, sugar was discovered in the urine and the albumin disappeared. She was put on the iodide of potassium treatment and she gradually improved, the sugar remaining in the urine but greatly diminished in quantity. The vision improved so that she could go to and from the hospital, where at first she had to be led. When seen by me, Janu-

ary, 1887, R. = $\frac{20}{50}$, L. = $\frac{20}{30}$, and she could read Jaeger No. 4 with correcting-glasses. The ophthalmoscope showed optic nerve of the right eye pale on the outer half, and in numerous points on the retina stainings showing the former position of the hæmorrhages. The vitreous and lens were both clear. Visual field not contracted nor any change in that for color.

The patient is still under the care of Dr. Porter for the general disease. He considers that the diabetes was the cause of the albumin in the urine when first seen, and that its disappearance is due to the less work the kidneys have to do owing to the diminished quantity of urine voided.

Case XVII.—Male, aged fifty-two, clerk, seen first October 9, 1885, when he complained of failure of vision for three weeks past, more rapidly during the past two days. Has not been in good health for one year, being weak and irritable; has lost twelve pounds in weight in as many months. Passed eight pints of urine daily and has great thirst. R. E. = $\frac{20}{100}$, L. = $\frac{20}{20}$. Ophthalmoscope shows vitreous and retinal hæmorrhages, more abundant in the former, and small and punctate in the retina and scattered in all parts.

Optic nerve has red look and outline somewhat indistinct.

No exudations into the retina save one or two points near one vessel near the macular region.

Examination of the urine revealed large quantity of sugar; no albumin or casts. Specific gravity, 1·039, and ten grains of sugar to the ounce. Diet, iodide of potassium, and Windsor water were prescribed, and the patient carefully adhered to it for two months, when the R. V. = $\frac{20}{50}$, and decrease and absorption of the intra-ocular hæmorrhages to a considerable degree, though some remained in the vitreous and retina. The restricted diet becoming unbearable, he returned to ordinary fare, and with it an increase in all the diabetic symptoms; and again failure of vision in each eye, R. = $\frac{20}{100}$ and L. = $\frac{20}{40}$, thus for the first time showing vitreous and retinal hæmorrhages. While under the careful treatment the sugar and urine decreased, and he had to only follow the injunction laid down in

the "Code of Health of the School of Salernum" (1), which says:

> "At least six times in every fleeting day
> Some tribute to the renal function pay."

This patient passed from under my observation, having returned to Ireland, and I have not been able to learn of the final issue of the case.

It will be noticed that in all these five cases reported by me vitreous hæmorrhages were present, and I consider this of much importance in arriving at the diagnosis of glycosuric retinitis from the ocular symptoms alone. I have endeavored to ascertain how frequently this affection occurs in private practice, and have asked many of my friends, and have found, as a rule, that it is exceedingly rare, or if seen it is not so recognized, but rather attributed to some other cause. Dr. Pooley has furnished me with the notes of two cases taken from his private case-book. I would urge the more careful system of indexing diseases in private practice, so that when statistics are wanted they can be had access to and thus much labor saved the compiler.

Amblyopia in Diabetes.—There can be no doubt, in the light of our present knowledge, that diabetes produces amblyopia, which is central, and in which the visual field is not interfered with, but in which there is usually a central scotoma for red and green, and occasionally for blue; that the defect improves with diminution of, and increases with the quantity of, sugar in the urine; that it comes on rather suddenly, and increases, then varying according to the diabetic condition; that it rarely produces blindness, but may result in partial atrophy of the optic nerves. This class of cases may very easily be mistaken for the amblyopia ex abusu, unless care is taken to examine the urine for sugar, as the symptoms are much the same, and, as most men

smoke, it is very easy to conclude that that is the cause of the amblyopia. Galezowski was probably the first to point out this resemblance, and, according to him, the diagnosis is very difficult without examination of the urine. The most important distinction drawn by him is that amblyopia ex abusu usually occurs in both eyes; that in diabetic amblyopia one eye may escape. This has not been our experience; from the cases observed by me all have been affected in each eye; this has been also the experience of Mr. Nettleship. It is my firm conviction that the amblyopia occurring in *smokers* having diabetes is due to the loss of nutrition produced by that disease, and not to the effect of tobacco on the system.

Since the invention of the ophthalmoscope much has been written on amblyopia in diabetes, without cataract, and without retinal hæmorrhages or other visible lesions. And it is this particular form of ocular affection that is extremely interesting. A very careful exposition of this subject is presented by Mr. Nettleship and Dr. Walter Edmunds, of London, in the "Transactions of the Ophthalmological Society of the United Kingdom" (4), 1882, and from this we have made frequent use:

In 1858 Desmarres (5) records the case of a woman, emaciated by diabetes, passing much sugar, with the sight so bad that she could no longer read. Also, a male, aged twenty-five, passing large quantity of sugar, with vision so bad that he can neither read nor write. After seven months' treatment, health improving; the vision was so much better that No. 8 Jaeger, with glasses, could be read.

Begbie, 1861, writing in the "Edinburgh Medical Journal," says he was familiar with a form of "diabetic amaurosis," coming on earlier than cataract, advancing gradually, and remaining permanent. He cites no cases.

The same year Lecorché, in an elaborate paper on "Diabetic Amblyopia," says the cause will probably be found to be a par-

tial or general atrophy of the optic nerve, occurring independently of changes in any part of the brain. The suggestion that some cases of diabetic amblyopia were due to cerebral cause had been previously made by von Graefe (7), who had reported several cases of various forms of eye disease in diabetes.

Seegen, 1870, reports a case of a male, aged thirty-eight; amblyopia, with no ophthalmoscopic changes; vision improved under treatment.

Another author (9) reports the case of a male, aged forty-two; one eye nearly blind from old injury, with diabetic symptoms for six months; passing daily one pound of sugar; vision in the only eye failing for a month before coming under observation. The ophthalmoscope revealed disc somewhat pale, but no other changes. Vision and refraction not stated.

Leber (10) reports three cases, one of which, probably, does not belong to this class, but the other two may be considered.

Male, aged forty-three, passing sugar, but no albumin; amblyopia of R. E., V. $= \frac{1}{2}$; field normal for vision and colors. L. E., high amblyopia; shadows at center of field, and fingers at five feet in outer part; inner half of field absent almost. Final recovery with both, on improvement in the general symptoms. Four years later the vision is reported as being good. A scotoma for white and colors at the central and outer central part of the field was left. No ophthalmoscopic changes.

Male, aged fifty, double equal amblyopia, with central scotoma for colors, but no contraction of the visual field; V. $= \frac{20}{70}$. No ophthalmoscopic changes. He was treated as a case of amblyopia ex abusu, and vision improved to $\frac{20}{30}$, each eye. Two months later, R. E. again became bad; V. $= \frac{20}{200}$; scotoma still present in both. Urine now examined, and found to contain sugar. Under treatment for the diabetes the vision improved.

Forster (11), female, aged sixty two, having diabetes, in whom the discs became pale, and subsequently showed signs of atrophy. The field in this case was normal.

Galezowski (12), in 1878–'79, reports the case of an officer in the French army, aged forty-eight, passing one hundred and fifty grains of sugar daily. No contraction of the visual field, but

vision so imperfect that he could not discern faces at nine feet. No ophthalmoscopic changes. With diminution of sugar, some improvement in the amblyopia. Albumin, later, was found in the urine. He also reports the case of clergyman, aged forty-four, V. $= \frac{1}{6}$; nomal color perception; visual field normal; no ophthalmoscopic changes; much sugar in urine.

Eales (13), of Birmingham, England, reports a case of a diabetic with amblyopia, male, aged fifty, without ophthalmoscopic changes, having a scotoma for red, green, *and blue.* This patient died shortly after being seen.

Bresgen (13), in 1881, reports the case of a male, aged twenty-four, diabetic, with symmetrical amblyopia, V. $= \frac{20}{200}$, with central scotoma for red and green, and with no contraction of the visual field or ophthalmoscopic changes. With an increase in the quantity of sugar voided the amblyopia increased to $\frac{2}{200}$, and the color scotoma increased also in size.

Mr. Lang, Mr. Nettleship (4), Dr. S. Edmunds, and Dr. Lanford, of London, have reported similar cases. Nettleship has reported the case of a female diabetic suffering from amblyopia. In this case there was no question of smoking.

I have myself seen four cases having central amblyopia, all having each eye affected; two were males and two were females; all had perfect visual fields, and all scotomata for red and green; the men smoked moderately, and the women not.

The accompanying fields of vision are shown, giving the scotoma area, the blind spot, and the visual field.

The histories of these cases are as follows:

Case XVIII.—W. A. S., male, aged thirty-nine, sent to me by Dr. Galer, of Newtown, N. Y., in 1880; the patient had been suffering from diabetes for two years, and most of that time passing sugar. One month before his visit to me he first noticed trouble in his eyesight; this gradually increased until such time that he could not see to read. When first seen he had R. V.$=\frac{20}{200}$, L. V.$=\frac{20}{50}$. No ophthalmoscopic changes. On testing the visual field, it was found to be normal; the color

field showed a scotoma for red and green, as shown in the figure marked No. 1. At this time the patient was passing fifteen

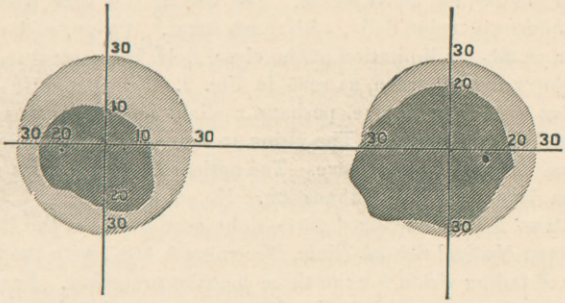

FIG. 1.

grains of sugar to the ounce of urine. The media were clear, and the eyes looked perfectly normal. Three weeks after the first examination the R. V.$=\frac{20}{200}$, as before, and the L. V.$=\frac{20}{70}$. A more rigorous treatment was adopted, the sugar diminished in quantity, and the amblyopia improved, but there was no change in the scotoma. The patient died one year later in diabetic coma. No autopsy.

CASE XIX.—Female, aged forty-nine, married. Mother of

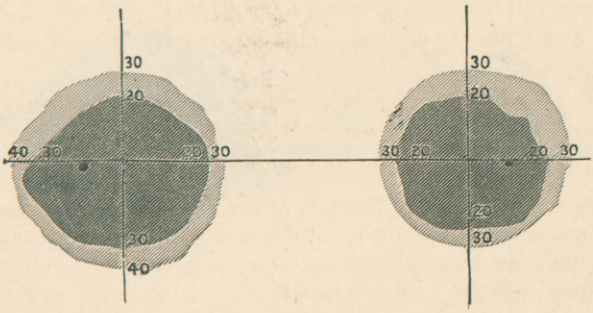

FIG. 2.

three children. Sent to me by Dr. Fassit, of St. Albans, Vt., with the history of having had diabetes for the previous six

months. One week before coming under my observation she noticed failure of vision, which came on suddenly, and so much so as to give her much alarm. She was at this time passing 150 ounces of urine daily, with much sugar. Vision, each eye, equal to $\frac{20}{200}$, no limitation of the visual field, but central scotoma for red and green, as seen in Fig. 2. No change in the fundus was noticed save, perhaps, a slight pale color to temporal half of the disc. The vision in this case never became worse and did not improve. The patient died two years and seven days after, from exhaustion. No autopsy.

Case XX.—Male, aged forty-eight, seen by me at the Post-graduate Medical School Clinic, December 3, 1887, with the history of failing vision for the three months preceding. Examination of eyes revealed V.$=\frac{20}{70}$ each; no ophthalmoscopic change; visual fields intact, but color scotoma for red and green was found in the central part of the visual field. (See Fig. 3.) This patient was voiding nine pints of urine daily, with large quantities of sugar. The patient was treated by the administration of iodide of potassium; the sugar was diminished, yet the amblyopia continued as before. The patient died eight months later, from asthenia. The eyes were examined repeatedly, but no ophthalmoscopic change could be discerned.

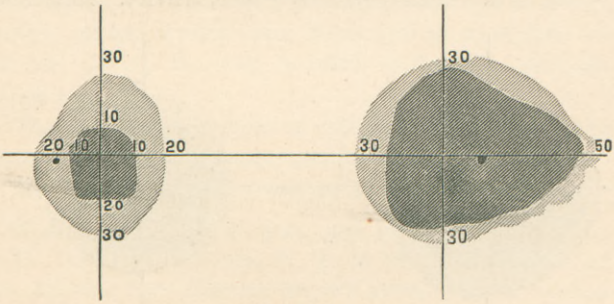

Fig. 3.

Case XXI.—Female, aged fifty-one, widow, first noticed an increase in her urine in 1882, in the early part of the year, after having received a severe fall on the back; eight months after

this she noticed a failure of vision in the R. E. and then in the L. E.; it finally became so bad that she could not read. When seen by me at my office, in December, 1882, she had V. $=\frac{20}{50}$ each, not improved by glasses, and with normal pupils and no ophthalmoscopic change except, perhaps, a slight dirty look to the optic disc. No albumin in urine, but sugar in abundance. The visual fields, as usual, were normal, and green scotoma centrally placed; red was with great difficulty and inaccurately seen. Six months later the patient was examined again, and vision of each eye equal to $\frac{20}{200}$, and scotoma for red and green still present in the L. E.; ring scotoma. (See Fig. 4.) Sugar in urine more than before. Patient died December 3, 1883, of gangrene of the right foot. No autopsy.

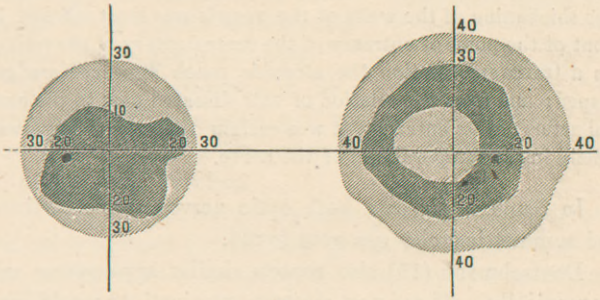

FIG. 4.

In each of these cases I regret that an autopsy was impossible, for it would have been interesting to make an examination of the optic nerves in these cases. Dr. Walter Edmunds and Dr. J. B. Lawford, of London, made such an examination in the case of a patient aged twenty-nine. The optic nerve showed marked changes throughout the whole length of the orbital part of the nerve; in the diseased area was found thickening of the trabeculæ and of the walls of the nutrient vessels; the fibers in the nerves seem to have been destroyed, and to be replaced by an

irregularly granular structure, in which there is a large number of staining nuclei.

Mr. Nettleship reports, also, the post-mortem appearances of the optic nerve in a similar case:

Microscopical examination of the optic nerve showed changes in the orbital portion of the nerve; the portion posterior to the optic foramen was not examined. Longitudinal sections were made of the nerve, and transverse sections at various points. The longitudinal sections showed no changes anterior to the lamina cribrosa. Posterior to the lamina, on one side of the nerve, was a tract with well-marked pathological changes, atrophic nerve-fibers, increase of nuclei, thickening of the connective tissue, trabeculæ, and of the walls of the small vessels. The thickening of the walls of the vessels was most marked in front of the point of entrance of the central artery of the retina. On a transverse section the atrophic patch appeared wedge-shaped; and from the relation of this diseased part to the central artery, at its entrance, it was certain that the change was chiefly in the temporal half of the nerve.

In Samelsohn's case both optic nerves were examined and symmetrical changes were found.

Deutschmann (15) also reports similar appearances microscopically. These post-mortem examinations would lead us to conclude that we have a subacute retro-bulbar neuritis and a subsequent atrophy of the optic nerve-fibers. That the cause of this neuritis is the poison in the blood produced by the derangement of the glycogenic functions. That not only the optic nerves are affected, but also the sciatic and others throughout the system.

Sachs (18), in an elaborate paper on central scotoma, finds the same appearances as above described, and as shown in the accompanying diagram (Fig. 5).

From this clinical picture of the affections of the eye occurring in diabetes it will be seen how varied and how

numerous are the ways the poison of the disease shows itself in the same organ, and how we may, from the eye symptoms alone, make a diagnosis of unsuspected diabetes.

In conclusion, the following practical points may be summarized.

1. In view of the recorded facts, shall we not urge the examination of the urine for sugar in every obscure ocular affection?

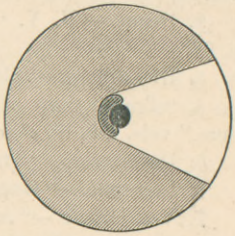

FIG. 5.—Transverse section of the optic nerve, showing wedge-shaped atrophic spot to the outer side of the nerve (after Sachs).—"Archiv f. Augenheil.," Bd. xviii.

2. Cataract occurring in a diabetic may be extracted without danger if the patient is previously treated for the general disease.

3. Retinitis occurring in diabetes is usually associated with vitreous hæmorrhages, and that this is a point in favor of the disease rather than retinitis from kidney affection.

4. Diabetic amblyopia is usually associated with central color scotoma for red and green, with visual fields intact, and does occur independent of amblyopia from tobacco and alcohol, as shown by our cases. And, further, diabetes can be diagnosticated by amblyopia when no diabetic symptoms exist.

5. All the diabetic affections of the eye are the result of poor nutrition produced by the disturbance of the glycogenic function, and that the more marked the disturbance, the more profound and more deep-seated the ocular affection.

6. The changes occurring in the eye are also taking place in other tissues of the body at the same time.

"To man's short reach of mind and scanty powers,
How much is dubious in the things he sees,
How much eludes his sight!"

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