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The ophthalmoscope and the general practitioner

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T H E O P H T H A L M O S C O P E

A N D T H E

G E N E R A L P R A C T I T I O N E R .

Senior Thesis

University of Nebraska

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I. INTRODUCTION.

Arnold Knapp opens the preface of his volume on Medical Ophthalmology in Pyle's System of Ophthalmic Practice with the quotation, "It seems to me that the best and most hopeful feature of ophthalmology, is that it has relations, closer or more remote, with every branch of medicine and surgery; indeed with almost every branch of science." And then he adds: "These relations are today closer than ever and are important not only for the eye specialist but for the general practitioner." (1)

Medicine has grown to such proportions that it is of paramount importance to be familiar with elementary principles in the various branches in order to understand a case. This holds true especially in the field of ophthalmology. The man in general practice covers many fields such as obstetrics, pediatrics, and gynecology, internal medicine, urology and others. The medical curriculum can include only a few hours for the subject of ophthalmology. Yet it is pretty generally accepted that every internist should be in some degree familiar with the use of the ophthalmoscope. Inspection of the eye grounds should be a part of every general examination. Serious pathological intra-ocular conditions have been first discovered by the ophthalmoscope.

The use of this instrument has been looked upon by those not skilled with it as something too technical for them to learn, and a doubt has existed in their minds as whether the results obtained in using it would justify the time spent in learning its use. Its use is as readily learned as that of most other instruments of precision. While one may not become exceedingly skilled with it, because of only occasional use, it gives him yet another

point of approach in his diagnosis. Careful and intelligent use of the instrument may not only give a clue leading to a correct general diagnosis, but may be a valuable aid in the projection of a prognosis.

II. HISTORY

It has been said that medicine, as we know and practice it and as it will be the foundation of the healing art of the future, has grown and developed more in the last one hundred years than it has done in the preceding fifty centuries. Through clay tablets of Nineveh, and the "books of the dead" found with the Egyptian mummies, we know something of the development in medicine that has occurred five thousand years ago; and through recorded history we can trace that which has occurred since. (14)

The papyrus discovered by the archaeologist Ebers, which carries back three thousand four hundred years from today our knowledge of Egyptian history of the ancient Egyptian's customs, indicates that diseases of the eye were observed at the time of its inscription. According to Doctor Hurry, portions of the Ebers papyrus, in which many diseases of the eye are mentioned, date from the first dynasty. (14)

One of the earliest mentions of ophthalmology is found in a law book of 2250 B.C. In this are passages specifying the emoluments and penalties of physicians. For instance: "If a physician - - - open an abscess (in the eye) of a man with a bronze lancet and save the man's eye, he shall receive ten shekels of silver" (as his fee). If, however, the law book sets forth, the physician "destroy the man's eye, they shall cut off his finger" (6)

At the end of the fourth century, B.C., ophthalmology was already a recognized specialty at Alexandria, where Herophilus wrote a book on the eyes. At the same place and at about the same time Euclid studied the first elements of optics. (20)

It has been said that in the eye is reflected the very soul. Even the ancients, as a matter of course, had noticed that the eyes of certain animals are brilliant in the dark. Thus Pliny (Book XI Chapt 55): "The eyes of animals that see at night in the dark, cats for example, are shining and radiant, so much so that we cannot bear to gaze upon them; those of the she goat too, and the wolf are resplendent, and emit light like fire". Pliny did not however attempt to explain this phenomena, even on the basis of "soul fire".

In 1704, Jean Méry. of paris, performed his famous experiment with a cat. Having immersed the animal in water, he first noted that the pupil dilated (as a result of suspended respiration) and then beheld the fundus of the animal's eye, the entrance of the optic nerve and all the colors of vessels of the choroid. He thought that the view of the fundus was made possible by the water's filling up a multitude of tiny "unevennesses" on the anterior surface of the cornea. Five years later de la Hire explained it by the fact that the water obviated the refraction of light by the cornea. (31)

This glittering of the eyes observed in animals possessing a tapetum was ascribed to a spontaneous development of light from the eye, under the influence of the nervous system, and was supposed to become more vivid when the animal was excited. This was first contraverted in 1810 by Prevost, Rudolphi, and Gruithuisen who found that no glitter could be seen in a completely dark room, so that the appearance was due only to a reflection of incident rays. (42)

In 1796 Fermin observed a certain luminosity in the pupils of an Ethiopian albino; and in 1816 Scarpa remarked upon a

similar phenomenon in a certain disease of the fundus. In 1817 Beer described the condition fully, inventing the expression "Amaurotic cat's eye", a term still in use.

In 1847 Babbage exhibited to Wharton Jones a model of an instrument for examining the interior of the eye. It was a small pane of silvered glass from which a portion had been removed. In 1854 Jones made the discovery known to the world.

In 1851 Hermann von Helmholtz published an account of an ophthalmoscope to be used in the investigation of the living retina. But people were shy of using it. One distinguished colleague told Helmholtz that it would be too dangerous to admit naked light into a diseased eye; another was of the opinion that the mirror might be of use to oculists with defective eye sight, but thought that he himself had good eyes and wanted none of it. (31)

Germany, however, was the first country to estimate the ophthalmoscope at its proper value. When Helmholtz first published his discovery, he wrote "I do not doubt, judging from what can be seen of the state of the healthy retina, that it will be possible to discern all its diseased conditions, so far as these, if seated in other transparent parts, such as the cornea, would admit of diagnosis by the sense of sight. - - . In brief, I do not consider it an overstrained expectation that all morbid changes of the retina or the vitreous body that have been found in the dead subject will admit of recognition in the living eye; and expectation that appears to promise the greatest progress in the hitherto incomplete pathology of the organ". This statement has not only fulfilled its expectations, but has exceeded it. (42) From the time of his description of the

ophthalmoscope not a year has passed without some new discovery in the field of pathology which it has opened to our inspection and study.

Very soon things seen with the ophthalmoscope began to connect themselves with lesions of organs other than the eye, and general disease processes, upon which the existence of such lesions threw early and important light. Men interested in other branches of medicine soon found important help in ophthalmic diagnosis. Clifford Albutt, Jonathan Hutchinson, Hughlings Jackson, Sir William Gowers, and others utilized the new window through which the condition of the central nerve system could be studied. Choked disc quickly became one of the most important signs of brain tumor. Atrophy of the optic nerve, retinitis and choroiditis became new evidence of syphilitic infection. "Albuminuric retinitis" was found to be a symptom of renal disease. Later it was discovered that retinal vessel degeneration was connected with general cardiovascular disease. Diabetes was found to produce retinal changes. Many diseases came to lack thorough study unless ophthalmoscopic examination was included. All in all, the eye was found to be a museum of pathology, in which the pathologic processes of many diseases could be studied during life. (14)

III OPHTHALMOSCOPIC EXAMINATION

A well ordered plan of ophthalmoscopic examination would include the following; (1) Preliminary examination of the eye with the mirror alone at a distance of one metre from the patient; (2) Examination with the mirror alone at a distance of about twenty cm. from the patient. This is sometimes called the distant direct method. (3) Examination by the indirect method. (4) Examination by the direct method. This discussion concerns the direct method by which one examines detail under magnification and is comparable to microscopic examination under high power. (26)

The essential portion of the ophthalmoscope is a perforated mirror mounted on a convenient handle and supplemented behind by a disc containing convex and concave lenses. The mirror reflects light into the eye, while the aperture allows a portion of the light, after returning from the patient's eye, to pass into the eye of the observer. Illumination may be from a lamp in the handle. The rays may pass through a cylinder of glass ground obliquely, so acting as a prism, and reflecting rays into the eye of the patient. The prism covers the lower half of the sight hole leaving the upper half free so that the rays reflected from the eye may be seen. This prism reflector has largely replaced the mirror formerly employed. There is a lens disc supporting a series of lenses arranged successively from weaker to stronger. Any of these can be brought opposite the sight hole by the finger applied to the milled edge of the disc. Opposite each lens is a number indicating its strength

in diopters. These range from plus twenty to minus twenty so that the eye may be examined at any depth between the cornea and fundus. (22)

Examination with the ophthalmoscope is best conducted in a dark room. The patient's pupils may be dilated with a solution of two percent cocain hydrochloride, or one percent homatropine and hydrobromide, except in cases of glaucoma, so that the lens is uncovered, as well as the entire eye ground to be studied. The effect is readily counteracted by myotics such as one fourth to one percent eserine. (34)

On examining a right eye, the observer should be seated on the patient's right, holding the ophthalmoscope in the right hand and should use his own right eye. The reverse is true when examining a left eye. Both the patient's and the observer's eyes should be held open, preferably, and the latter at a little higher level than the former's. In case of a squint, the eye not under examination may be covered so that the eye under examination will look straight ahead. (34)

The examination should begin at about twenty five cm. distance in order to note a red glare or reflex through the pupil from the choroidal coat of the eye. Then get as close to the eye as possible. One's own accommodation if possible should be relaxed. The image will be erect, and, ⁱⁿ emmetropia, the fundus is magnified about fifteen times. (26)

IV THE FUNDUS OCULI

The fundus of the eye, containing the nerve fibres of the retina and choroid is a fruitful source of study of disease changes. Sometimes the first manifestation of serious systemic disease is some interference with visual acuity, and a study of the fundus oculi leads to such other examinations as to make a diagnosis of serious pathology of some remote organ. There is scarcely a pathological condition occurring in the deeper structures of the human eye that is not the result of some general systemic condition.

Here as elsewhere, a full appreciation of what is normal should be had before one can come to the conclusion that a departure from the normal is present. It may take some time to learn just how much of a departure from an absolute normal is to be passed by before pathological conditions are to be thought of. This knowledge comes with the study of a large volume of cases. Human eyes are plentiful and may be studied even though it is not always possible to dilate the pupil due to inconvenience of the patient. One should learn, however, to see into the eye without always using a mydriatic. The medical man who constantly has his ophthalmoscope on his desk can look into the eyes of a great number of patients in the course of a few days. He will soon get the "hang" of the instrument and know what is the normal appearance of the fundus.

(24)

(A) The Optic Disc

In observing the fundus, the optic disc is first sought

by having the patient look a little to the nasal side. It is a pale pink color and almost circular, being 1.5 mm. in diameter appearing larger in myopia and smaller in hyperopia. The edges are sharp and a little irregular. If the pigment does not extend up to the disc, a narrow white scleral ring may show through the retina. Retinal pigment epithelium may be heaped up around the disc forming a ring of black, usually not continuous. These are not pathological.

The central portion and temporal portion of the disc are paler than the rest of it. The central vessels emerge from this area which has a physiological "cupping". The center of this cup is dotted with gray spots which are the meshes of the lamina cribrosa through which nerve fibres pass. If there is no "cupping" the disc is uniformly pink and the vessels may divide before emerging at the surface. (26)

The color of the disc is frequently due to the white fibres of the lamina cribrosa seen through the nerve fibres. The gray spots in the lamina, when seen, are due to the non medulated nerve fibres reflecting less light than the white connective tissue fibres. (26)

Although the margins of the disc are normally well defined, they may become sharp in primary optic atrophy, blurred in "choked" disc and obliterated in a severe neuritis. The disc looks excavated in optic atrophy and raised in "choked" disc. The degree of choking may be measured in diopters by taking the difference between the lenses which give clear vision of the nerve head and of the retina. (37)

(B) The Retinal Vessels.

The retinal vessels are derived from the central artery and vein and divide into two branches, a superior and ^{an} inferior branch. Each of these divide into temporal and nasal branches. They then divide dichotomously into innumerable branches. (26)

The arteries are lighter red, straighter and narrower than the veins, the difference in size being about two to three. (26) Should the calibre of the same vessel vary in different parts of its length, then it is a serious pathological feature not usually present without other profound pathological changes in the same eye. (27) The veins are more tortuous and a darker color due to the blood column. The arteries have a bright silvery streak running longitudinally down the center due to the reflection of light from the cylindrical surface. (26)

The actual vessel wall is not seen because of its translucency. This feature aids in an opinion on the state of the wall of the vessel. Translucency can be determined easily, at the points where the vessels cross one another, except where a large superior or inferior main branch crosses a corresponding large vein. In such cases the blood column is so thick that the underlying vessel cannot be seen at all. This is true even in children. Therefore the translucency can be said to be normal in medium and small vessels, but not in the whole length up to the disc. If the translucency is gone in medium and small vessels, according to N. Pines of London, it is a certain sign of arteriosclerotic changes in the wall. The tunica media, even in a state of tonic contraction as in pure hypertension should still be translucent. Translucency of the vascular wall is one of its most delicate qualities and it diminishes or disappears

first of all while other signs are only beginning to show.

At the point of crossing, the artery depresses the vein but does not change its calibre or shape. This portion of the vein is not seen as clearly as the whole vessel. It may be compared to one piece of string lying on top of another. (15)

(C) The Macula lutea

The macula lutea is situated slightly less than two disc diameters to the temporal side of the edge of the disc a little below the level of the horizontal diameter, and is in the line of direct vision. Dim illumination should be used to prevent as much constriction of the pupil as possible. (26)

It is a small round area of deeper red than the rest of the fundus, varying in appearance according to illumination, refraction, and complexion. There is usually a foveal reflex due to a reflection of light from the walls of the central foveal depression. There may be two or three of these rings of silvery light. This area is always devoid of visible vessels. The macular region is supplied by twigs from the superior and inferior temporal arteries, and an occasional cilioretinal artery from the disc.

(26) The yellow color of the macular lutea is due to a color matter distributed through the central layer and to a less degree through the outer fibre layer. (30)

(D) The General Fundus

The appearance of the fundus varies with the complexion.

(26) In children of darker complexion it has a bright lustre resembling the shimmer of watered silk, and is a darker red.

(22) The choroidal vessels are seen as brighter red streaks.

In albinos the choroidal vessels are more clearly seen because

the sclera shines through between them with a white appearance. In people of medium complexions, the spaces between the choroidal vessels are uniformly red, with occasional delicate punctate stippling, especially at the periphery. (26) The extreme periphery of the retina is toothed or serrated,. The outermost part of the retina, in spite of the histological structure, is blind. (30) A tigroid fundus is one in which the choroidal vessels are separated by deeply pigmented polygonal areas. (22)

The choroidal vessels are broad and ribbon-like, lacking a central reflex streak, and anastomosing freely. Retinal vessels do not anastomose. Retinal vessels normally do not pulsate, but the veins may be seen to pulsate at a sharp bend near the disc due to transmitted pressure. This effect can be intensified by light pressure on the globe. If retinal arteries pulsate, it is pathological, and such things as aortic regurgitation, aneurysm, or exophthalmic goiter may be suspected. (22)

(E) The Order of Fundus Examination

The order of examination of fundus details should be systematic. First the details of the disc should be observed, physiological or pathological cupping, blurring of its edges, or swelling. Then the vessels; abnormalities in arrangement or distribution should be noted. Presence of cilioretinal vessels is noted. Note the details of individual vessels, such as relative size, irregularity of contour, varicosity, visibility of walls, and abnormalities of the reflex streaks, trace the vessels of the periphery. Look for hemorrhages, white spots, and exudates. The macula may be brought into view by having the patient look into the light where shadows or reflexes, black or white spots, and exudates or hemorrhages should be noted. (34) Last of all,

look at the periphery. Due to the oblique axis of rays through the lens a low convex lens must be used here.

V. DISEASES OF THE EYE

The changes occurring in the fundus oculi have a distinct value in the diagnosis and prognosis of certain diseases. To the man working in the field of general medicine, according to Walter R. Campbell's statement, the ability to recognize five fundi is of particular importance. The first, of course, is the normal fundus. The others are the arterio sclerotic fundus, the diabetic fundus, the nephritic fundus, and the fundus of malignant hypertension. It is not only desirable to differentiate one of these pictures from another, but also from other diseases of the eye. Of great importance also is the ability to recognize an abnormal or unusual fundus, which necessitates calling on a trained ophthalmologist for assistance. (7) This last statement is significant because very often it is the general practitioner who has the first opportunity to examine the patient.

The normal fundus has already been touched upon. The more fundi of normal individuals one can examine, the better is one prepared to recognize the abnormal fundus.

(A) The Arteriosclerotic Fundus

Changes in the fundus in arteriosclerosis are important, since they indicate similar lesions in other parts of the body especially the brain. (4)

Tortuosity of retinal vessels near the disc is thought to be important, but diagnosis is difficult when one considers the large variations in tortuosity of normal vessels. In an edematous retina the vessels weave in and out of focus by assuming different depths in the retinal layer, and pursue a tortuous course over the fundus. The macular arteries may resemble a corkscrew.

This is in pronounced cases. Less pronounced cases may require fine discrimination. (7)

The size of the vessels is not usually changed. In speaking of size it must be remembered that the vessel itself is not seen due to its transparency, but rather the size of the blood column. If, however, the intima thickens, it is usually of a patchy character, and is shown by a contraction of the blood column alternating with regions where its width is normal. This is characteristic of an intimal sclerosis of considerable severity. The light streak on the artery is normally one fourth of the width of the artery. With the development of a medial sclerosis this becomes wider and assumes a burnished copper appearance and sometimes appears to be finely beaded. In that this sign is only an exaggeration of the normal, and is somewhat dependent upon the amount and quality of the light used, considerable care must be exercised in its interpretation. When well marked, however, it may be regarded as definitely pathological.

Important signs of vascular sclerosis are to be found at the crossing of arteries and veins. Normally the vein is visible right up to the artery wall, and faintly visible through it. In arterio-sclerosis the vein becomes invisible for some little distance from the arterial blood column due to the increased thickness of the arterial wall. The direction of the vein, in more severe cases, is distinctly changed as it is crossed by an artery. The vein may turn sharply to pass over or under the artery at a right angle, and turn back to continue the original direction.

The papilla is found by tracing down the vessels, and should

be examined for color, condition of margin, level, and the vessels. In arterio sclerosis there is slight if any abnormality of the papilla. (7)

The retina should be examined for other abnormal findings such as edema or white areas. The macular region particularly should be examined for a partial or complete macular star. Macular apoplexy or hemorrhage may be a local manifestation of arterio sclerosis. (14) In the simple arterio sclerotic fundus these appearances are not a necessary feature of the condition. The hemorrhages seem more likely to be present if high blood pressure accompanies arterio sclerosis, and are commonly superficial and flame shaped, though round punctate hemorrhages in the deeper layers of the retina also occur. Chorio retinitis is occasionally seen in simple arterio sclerosis though it also accompanies syphilis, tuberculosis, and nephritis. Partial sclerosis represented by pigmentation and depigmentation, alone or intermingled with white areas, are to be found in a fundus deep to the retinal vessels. The macular area and peripapillary area are most frequently affected, but the degree of injury is seldom so great as with syphilis or nephritis. (7)

The characteristic features of the simple arterio sclerotic fundus are found in varying degree in other fundi to be described, or in other words, the peculiarities of such fundi are usually engrafted upon a basis of arterio sclerosis, or raised blood pressure, or both.

(B) The Diabetic Fundus

N. Pines, in his paper on sclerosis of the retinal vessels,

decries the lack of attention given to ophthalmoscopic examination in the study of diabetes. He cites several cases in his own experience which emphasize the importance and helpfulness of ophthalmoscopic examination.

A man aged 52 years, suffered from diabetes two years previously. His only complaint on presenting himself was general malaise. Urine normal, sp.gr. 1.015, blood pressure 140/70. Fundi: translucency lost, copper wire color, light reflex dotted. White lines on the discs and the crossings. The right superior nasal vein going up from the disc passes over a focus of old chorio retinitis; the vein is very narrowed at this point and much banked above it. Many spots of chorio retinitis, corresponding to the lower temporal branch of the lower artery. In the central part of the retina, near the macula, many fresh spots of chorio retinitis. Nothing in the left eye. The sugar tolerance, accordingly was tested. The resulting diagnosis was mild diabetes mellitus. His general health and eye condition were improved by dieting.

(28)

A woman, aged over fifty years, was seen at the ophthalmic out patient department of the London Jewish Hospital on April 15, 1927. The diagnosis of diabetes mellitus was made two years previously in the medical department, and she was treated accordingly. Six months before she was admitted to a large teaching hospital for a minor operation, and was told that she did not suffer from diabetes; but her eyes were not examined there. Fundi: translucency lost, copper wire color, light reflex dotted. The veins are crushed by the arteries and deflected centrifugally. Many small hemorrhages.

Many old and fresh diabetic exudations, especially in the right eye, where a star is formed. Blood pressure 225/125. Urine: sp.gr. 1.020, sugar plus plus, albumin plus. The reader will no doubt agree that if the fundi had been examined in the large teaching hospital, the diabetes would have been detected in spite of the negative urine findings at that time. (28)

The fundus changes of diabetes do not occur in the young and have no relation to its severity. The diabetes is usually of some duration before they become easily recognizable. It is equally true, however, that diabetes of long standing may be present without any alterations in the fundus other than those of simple arterio sclerosis. (7) Clifton M. Miller states that the retinal changes due to diabetes are rarely as characteristic as those due to nephritis. Most frequently the changes present are such that one can only say that they are either diabetic or nephritic, and leave the differentiation to further systemic examination. (24)

While the diabetic fundus has some points of resemblance to other conditions, certain points are rather distinctive. Fine rounded, yellowish white solid masses with sharp edges, sometimes confluent may occur between the papilla and macula and surrounding the macula. (7) These are grouped irregularly and not in the form of stellate figure. Sometimes there may be numerous punctate hemorrhages. There is no swelling of the optic nerve and retina. (4) It may be said that even mild diabetes attacks the retin-

al vessels, but most probably to the same degree that vessels are affected in other parts of the body. (28) In case of greater severity, hemorrhages of varying size appear, and in the most severe cases the retinal exudate and papilledema are present. This becomes difficult to differentiate from those of renal injury, since raised blood pressure and albuminuria are also present at this stage. The earlier degrees are susceptible to diabetic and insulin treatment, but the more severe degrees are not. This is all the more reason for making an early diagnosis, an argument for making use of ophthalmoscopic examination. (7)

The picture in diabetic lipemia is an unusual and exceedingly characteristic one. The eye-ground as a whole is pale as in anemia. The artery and vein are the same color, a creamy white at the vessel margins, particularly in the periphery of the fundus, with an increasing amount of red tint toward the mid line of the vessel period. As the fat appears to collect along the vessel wall and even infiltrate it, one continues to find the sign present, though drawn blood no longer shows microscopic evidence of lipemia. Approximately six percent of fat must be present in the blood before the lipemic fundus is recognizable as such. No disc changes appear. This condition occurs in the young and only during diabetic acidosis or coma. All evidence of lipemia rapidly disappears, and the lipemic fundus soon turns to normal upon the administration of insulin. The sweet odor of acetone, and other signs of acidosis,

invariably accompany the lipemic fundus. There is little danger of confusion with the retinitis of leukemia, which differs also in showing papillary and peripapillary edema, hemorrhages, and often broad white lines along side the vessels. (7)

(C) The Nephritic Fundus

Fundus lesions of renal disease are associated with evidence of arterio sclerosis. Though this is in the main true, certain qualifications should be noted. In degenerative lesions or nephroses no fundus changes are found. The focal nephritides, such as may be met with in sub acute bacterial endocarditis, puerperal infections etc., sometimes show a few white areas of degeneration and hemorrhages, usually with a white center. In not more than ten percent of cases of acute diffuse glomerulo nephritis a papilledema and retinitis, with "cotton wool" exudates and hemorrhages, may occur in the retina. These heal completely. Chorio retinitis and the macular star are absent. In the sub chronic stage of nephritis (parenchymatous nephritis) eye-ground changes are seldom seen unless the blood pressure is unusually high. Hemorrhages, a retinal edema, and rarely a papilledema may occur. (7)

The fundus changes in the nephritis of pregnancy may be very severe and often permanent. Clifton M. Miller states that the albuminuric neuro-retinitis of pregnancy usually recovers full vision. (24) The changes are similar to those seen in acute glomerulo nephritis but as a rule are more extensive. The arteries are often contracted and

a neuritic atrophy may follow. The grade of edema may be so great as to produce a detachment of the retina, and chorio retinitis with pigmentation may occur. The prognosis and retinal detachment is not wholly bad in these cases as opposed to that occurring in rare cases of acute glomerulonephritis. Reattachment is sometimes seen, but if it does not occur soon, further degenerative changes are inevitable, and vision may be much reduced, especially if the macular region is involved. Therapeutic abortion or induction of premature labor must be carefully considered. Since the retinitis usually occurs in the later months of pregnancy a viable child may be expected. If early fundus changes only are present, these may be favorably influenced by such procedure, but late changes are not. (7)

Other eye diseases, especially the fundus changes of chronic nephritis, are unfavorably influenced by pregnancy, and therapeutic abortion is indicated not only from the ocular but also from the renal standpoint. As to the likelihood of the recurrence of retinitis in subsequent pregnancies, opinion is divided. It now seems probably from recent evidence that the renal injury will recur in perhaps seven out of ten cases and in some of these fundus changes may be expected to develop. Such patients should be advised against pregnancy. (7)

In chronic glomerulonephritis the development of retinal changes is of evil omen, indicating usually death within one or two years. The retinal vascular sclerosis in chronic nephritis has been thought by many to be secondary to the nephritis. This may be regarded as improbable

from a pathological standpoint, and it is wholly contrary to the history of renal disease. The advance is rapid, however, following the development of the retinitis. The disc and the fundus usually are pale, due to the associated anemia. Papilledema and "cotton wool exudates" are rare, but dense white "snow banks" may surround the disc and appear elsewhere in the fundus. These absorb and leave fine white dots in the retina which, in the macular region, tend to arrange themselves in a star shaped or fan like manner. Flame shaped hemorrhages occur in the nerve fibre layer, and exudate and hemorrhages in the deeper layers of the retina. Later varying degrees of chorio retinitis with exudates, pigmentation and depigmentation appear. With such fundic changes an advanced degree of renal insufficiency is present. It would seem that renal insufficiency is an essential feature in the development of this picture, since it also appears in the late stages of the subacute progressive form where vascular changes are not so marked but renal insufficiency is an outstanding feature of the patient's condition. (7)

Ocular fundus changes are observed in only 15% to 25% of chronic nephritides, according to J.W.Jervey, and even when demonstrable, though they may be suggestive, can hardly ever be said to be characteristic. Observers in this field are not trying to find what fundus phenomena can be shown to be characteristic of a specific disease (for there are none) ; but rather what fundus changes may be found in the eye coincident with certain general diseases. The

modern consensus of opinion appears to be that in all of these diseases the eye-ground lesions are not due to the specific toxins in any case, but directly to the morbid vascular condition accompanying it. These vascular changes, usually arterio sclerotic, are in no sense peculiar to ^{or} / characteristic of any of these diseases. (15)

The retinitis for example described above occurring in cases of chronic nephritis, even the stellate form of exudates about the macula, is not properly though generally called an "albuminuric retinitis". The nephritis, or albuminuria, is not causative of the retinitis. If it were, one would expect to find this retinitis in all cases of albuminuria. It is not so found, and one can be quite sure that the eye-ground changes are due to the physical condition of the vessels occurring in some cases of nephritis. Even the one time supposedly typical retinitides seen in some cases of diabetes and nephritis, occur in each other, in hypertension, in arterio sclerosis, in other diseases, and have been observed when no general disease of any kind could be shown to exist. (15)

On the other hand, Sir John Herbert Parsons, in the last edition of his "Diseases of the Eye" says, "albuminuric neuro-retinitis, in its most typical form presents an ophthalmoscopic picture which is almost pathognomonic, being simulated only in some cases of intra-cranial tumour." This "form" one may reflect, is not so often encountered. His words a little later on may be of more weighty import, namely: "The urine should be examined in every case of retinitis". A little later he admits that this typical "form" - - - "may occur without signs of definite nephritis, and somewhat similar

appearances are met with in glycosuria and leukemia. Rarely a star at the macula, with or without slight papillitis, has been met with in young persons with anemia or chlorosis, or without discoverable cause". (26)

It is true, however, that simple hypertension and general arterio sclerosis can often be strongly suspected early in the disease, when other signs may escape the examiner, and the ophthalmoscope reveals certain changes. One must not forget that these conditions are not confined to middle and old age, but are frequently found in young adult life. It is also true that a chronic nephritis is first discovered by the ophthalmoscope. (15)

In the Practical Medicine Series (1928, Eye page 138) we find the following: "Probably most of our ideas regarding the significance of retinal changes are based upon a study of the fully established typical appearing fundus picture in the advanced arterio sclerotic or nephritis. Such cases, usually hospitalized, include hyper tension with a break down in cardiac renal function; and these with little or no rise in tension, the decrescent arterio sclerotic. With a fairly accurate notion of the retinal the prognosis of each case dependent on other data, the presence or absence of retinal change does not entail such large measure of importance---- the renal case without retinitis may offer the same prognosis as the one with retinitis. Of much more importance perhaps is the prehospital group, seen by ophthalmologist and internist alike, where often an isolated sign, such as compression of a retinal vein

by an artery, serves to focus his attention on the cardiovascular system."

It is well to remember, and generally accepted as true, that an advanced chronic nephritis showing gross degenerative changes in the ocular fundus, will likely succumb to the disease, as stated previously, within a couple of years or so of the onset of the failing vision. It should not be forgotten however that this prognostic rule is not to be applied to cases of acute nephritis or albuminuria of pregnancy, for in these cases recovery is apt to occur. It is well to remember also that increase in retinal sclerosis is apt to be proportionate to the severity of systolic pressure, except, of course, where a failing heart shows a lowered tension. (15)

(D) The Fundus of Malignant Hypertension

Closely allied to the fundus changes of chronic nephritis are those described by Keith and Wagener in malignant hypertension, or by Foster Moore as arterio sclerotic retinitis. Volhard and Fahr described them from the renal view point in the so called "combination form" of arterio sclerosis plus nephritis. Keith's work shows that the injury is more widespread than a renal vascular disease, and that such patients may suffer more from the cerebral and cardiac complications than the renal element. Proof that a patient with a typical fundus has a satisfactory renal function is not to be taken as indicating a good prognosis. Such patients usually die in a relatively short time of other causes, as from cerebral or cardiac failure, or more typically, of a simultaneous failure of all three. (7)

A physician is sometimes placed in a dilemma. He may find a slight or moderate retinal sclerosis where blood pressure is normal for the aged group, and there is neither subjective nor other objective signs of cardio vascular disease. He may wonder if the state of the retinal vessels corresponds to that of the cerebral when those of the retina are but moderately sclerosed. It may be said that the likeness, if any exists, holds only for advanced states of disease. The immediate importance of such a finding should not be over emphasized, but is of value as an isolated finding in that it focuses attention of a potential weakness.

(15)

It has been pointed out by de Schweinitz that certain early signs of vascular hypertension can often be seen in the eye grounds, namely, a corkscrew like appearance of small terminal vessels usually about the macula; a slight humping of a vein as it passes over a tense artery and is so lifted out of the plane of its normal course; and moderate but distinct blurring of the optic disc. (9)

Other fundus changes that occur in hypertension especially as it advances, are hemorrhages of various shapes, sizes and numbers; patches of so-called "exudates" of whitish or yellowish appearance of every conceivable shape and number with edges either clear cut or ill defined and fading. There is a papillary hyperemia and mild edema. (15)

The arteries of the fundi are strongly contracted; arterio sclerosis is always a prominent feature. Intimal sclerosis is rare. (7)

With greater severity the area of the serous peripapillary edema extends outwards involving the macula. Exudates are still of the "cotton wool" variety. Later the hyperemia of the disc fades, the edematous area recedes from the periphery, punctate exudates appear, and a fine macular star develops. Vascular sclerosis becomes more marked. (7) Perivasculitis appears; light streaks along the sides of the vessels; the silver wire artery, broadened light streaks along the middle of the vessel. There is a definite picture of pressure as the sclerotic artery crosses the softer vein, often causing a slight venous bulging on the distal side of the point of pressure. In marked arterio venous compression the arteries cross the veins at right angles rather than at obtuse angles, as normally prevails. There is a thickening of the intima of the arteries, or endovasculitis, reducing the blood stream to a thin thread between two white walls. Even the lumen may be obliterated leaving the vessels lying like a white band in the retina. (15)

In The "exudates" spoken of are really not exudates at all, but transudates for the most part, perhaps fibrinous becoming hyaline, or composed of lipid or colloid material, or bunches of leucocytes, or cholesteroline crystals followed by absorption of retinal hemorrhages. At times tissue damages following hemorrhages may result in scars giving much this "exudate" appearance. (15) Many individuals do not know exactly what they mean when they speak of retinal exudates. John E. Weeks said in substance: "There is no such thing as exudative disease in the absence of vascular pathology". (38)

In the last stages of hypertension, secondary optic atrophy, macular star, punctate exudates, a few hemorrhages, and marked retinal arterio sclerosis and chorio retinitis are present. (15)

Vision, of course, is reduced. A sudden loss of vision in one eye often means a hemorrhage in the macula, embolus of the central retinal artery, and thrombosis of the central vein. In embolus of the central retinal artery, one finds the retina very anemic, and the arteries greatly reduced in size. In the region of the macula, one sees a cherry red spot which represents the color of the choroid, and it is seen in this area because of the absence of some retinal layers. Emboli are more commonly seen in the left eye and are found especially in heart lesions such as vegetations in endocarditis. Thrombosis of the central retinal vein or one of its branches produces stasis which results in extensive retinal hemorrhages. A secondary glaucoma is a frequent sequel to the condition, and the end result is usually atrophy of both retina and optic nerve. (12)

The final stage of malignant hypertension is seldom observed, as the patients usually die in the preceding stages. The picture differs from that of chronic nephritis in the contraction of the arteries, the degree of sclerosis, the well marked hyperemia of the disc and the papill edema, and the absence of the peripapillary "snow banks" of nephritis, together with the clinical evidence obtained from the history and physical examination of the patient. (12)

(E) The Fundus of Syphilitic Retinitis

Syphilis has an old reputation as the greatest of vascular damagers. It chiefly attacks definite parts of the system, and demonstrates that different toxins may have spots of predelection in the patient's body. Weigert stated that the vascular system, being a foreign body in the nervous system, in case of pathology of syphilis, was either the chief sufferer as from gumma, or escaped when the proper nervous tissue was damaged as in tabes dorsalis. Although syphilis seems to have a predilection for aorta and coronary arteries it does not behave in the same manner toward the retina. It is, however, one of the commonest causes of retinitis. (28)

The ocular manifestations of syphilis are manifold. Not only is the anterior half of the globe attacked, but its ravages in the retina, choroid, and optic nerve may be seen with the ophthalmoscope. These changes, from a diagnostic standpoint, may not be so important as they were in the days prior to the use of serological tests, but they may be of great service. Serological tests are not infallible, and by piling up of clinical symptoms, one may be able to make a positive diagnosis of syphilis in spite of serological findings. The ophthalmoscope frequently shows at least one important clinical picture. (24)

Syphilitic retinitis is usually secondary accompanying disease of the choroid. It may be primary, in which form a prominent sign is syphilitic endarteritis. There are

dust-like opacities in the vitreous, especially the posterior part. The retina is cloudy in the region of the disc, which may be hyperemic. White spots may be seen in the macular region, and yellow or white spots bounded by pigment, at the periphery of the fundus. The vessels may be degenerated with whitish exudations along their course. Hemorrhages are rare.

The subjective symptoms are defective central vision, night blindness, irregular and concentric contraction of the field, with or without central, paracentral, or ring scotomata, and metamorphosis.

There is little organization at the sites of inflammatory deposits, but there may be a marked tendency to the formation of new blood vessels. These are not only in the retina, but may extend into the vitreous forming convoluted coils. They are held together by a small amount of delicate connective tissue, and are commonest on or near the disc.

The disease usually occurs, in acquired syphilis, one or two years after infection. Both eyes are involved, but not necessarily simultaneously. The macular area may be rarely affected, showing gray or yellow deposits, or numerous small yellow spots or dots of pigment. This form has a tendency to relapse.

Retinitis is seen in congenital syphilis. Here the retina shows a dusty or peppery discreet pigmentation at the periphery, associated with a tigroid condition of the fundus. It is distinguishable from the normal condition by the greater amount of pigment. Black and white spots resembling pepper and salt, may be thickly strewn. In

definite forms there may be an anterior retinitis, or yellow-red and black spots at the periphery. Larger gray or white patches may be seen. The condition seen in the acquired form may be fully developed.

If the diagnosis of syphilis is not made from these observations, at least the Wassermann test should be applied.

(26)

(F) Diseases of the Optic Nerve

1. Optic Atrophy.

Optic Atrophy is a degeneration of the optic nerve. It may be either primary or secondary. The former is seen in syphilis, following injury to the nerve in basal skull fractures involving the orbit, and in tumors of the hypophysis which produce compression atrophy. Optic atrophy may occur without previous evidence of severe local inflammation but associated with general disease usually of the central nervous system, or without discoverable cause. In such cases the nerve head is atrophic while the rest of the fundus is practically normal. Secondary atrophy, on the other hand, follows optic neuritis, retinal and choroidal disease, or pathology in the vascular tissues of the eye. The pathology will be seen, not only in the disc but also in the fundus. (12)

In general, the disc is pale, which should be distinguished from physiologic cupping, and the blood vessels are changed.

In primary atrophy the disc is gray, white, or bluish. The lamina cribrosa is seen. The edges are sharp, and the

retina is normal. There is atrophic cupping shown by slight bending of the vessels. The vessels are only slightly contracted. Its chief cause is tabes, and it may be the first sign.

In secondary atrophy there is greater pallor, and the vessels are more contracted, and almost disappear. This is seen in severe cases of disease of retinal blood vessels. It may be caused by compression of the optic nerves, chiasma, or tracts by tumors, aneurysm, hydrocephalus etc. It may follow rupture of the nerve, compression by blood clot, oxycephaly, etc., without previous neuritis. (26)

2. Papillitis and Papilledema.

Papillitis occurs as a part of a neuro-retinitis, and as a result of intra-cranial disease. The pathology of the two conditions is different, but the ophthalmoscopic features are the same.

In papillitis the nerve head is blurred at the edges, toward the nasal side at first, and later all around. The arteries are small and veins distended. In the early stages the disc is usually redder than normal, but the color of the disc may not be taken as the criterion of abnormality. Later the edges are blurred more and the disc looks larger. Exudates cover the vessels in places. The papilla gets paler. It shows radial streaks and small hemorrhages. The disc is then so definitely swollen as to be measurable.

In the optic neuritis of neuro-retinitis the disc is swollen two or three diopters; the disc is redder due to dilated capillaries; the veins are only moderately tortuous

and distended. The intra-cranial disease of an inflammatory nature such as meningitis will show these conditions except that there is very little retinitis. More commonly there is an intense edema giving rise to papilledema or "choked disc" with no true inflammation. The swelling may be eight or ten diopters. The veins are greatly distended and tortuous, and vessels are partly hidden by white exudates. Hemorrhages may occur on the swollen papilla and at its edges.

It is usually impossible to distinguish between the two forms. In neuro-retinitis the swelling may be great, while the appearances due to intra-cranial disease may simulate neuro-retinitis of renal disease, including the star figure at the macula. The star figure is more fan shaped, is seen in severe cases only, and so is common with cerebellar tumors. Decompression may cause it to disappear.

In both, the condition is generally bilateral though not necessarily equal. The amount of swelling may be of slight value in locating intra-cranial disease. In frontal tumors and otitis media the swelling is usually greatest on the side of the lesion. The time of onset of papilledema is more important, as the side first affected may indicate the location. The swelling may be less on the side first affected due to subsidence associated with commencing atrophy.

Unilateral papilledema suggests a tumor of the opposite olfactory lobe or orbital surface of the frontal lobe,

or of the pituitary body. Unilateral papillitis is found in early stages of papilledema from intra-cranial causes, in orbital diseases as tumors of the optic nerve or orbit, cellulitis of the orbit, and hemorrhage into the sheath of the optic nerve.

Diagnosis, though easy in severe cases, is difficult in slight cases. The color of the disc is of little value. The edges of the disc, if distinct, show no neuritis. If blurred, rule out the effect of astigmatism. In absence of exudate and hemorrhages, at least two diopters of swelling should be demonstrated before a diagnosis of papillitis is made. The patient should be observed at intervals. (26)

According to Marcus Gunn, de Schweinitz, and Halloway, the following stages may be seen in the development of papilledema: (i) Increased redness of the disc, blurring of upper and lower margins, progression of blurring to nasal edges, leaving temporal margins clear. (ii) Increased edema of nerve head, filling in of the physiological cup, temporal margin involvement of the disc, spread of edema into the retina, and uneven distention and darkening of the retinal veins. (iii) Great increase of edema, elevation and enlargement of nerve head, vascular striation of the swollen tissue and striae of edema in the form of lines in the swollen retina between the disc and macula, and marked distention of the retinal veins, and retinal hemorrhages. (iv) The disc increases in prominence, assuming a mound shape, losing its reddish color and becoming opaque, exudation in

and on the swollen disc and surrounding retina, and elaboration of the retinal hemorrhages in size and number. (v) The vascularity of the papilledema subsides with greater pallor, and prominence may sink, the retinal arteries appear to contract with a thickening of their perivascular lymph-sheaths, and there are spots of degeneration of the retina, especially in the macula. This passes into the stage of papillic atrophy. (26)

VI. SUMMARY

In this presentation it has not been my purpose to cover the entire field of ophthalmoscopic examination, but rather to point out, that, to the general practitioner the eye-grounds are ^{an} important consideration in making a diagnosis or prognosis relative to certain diseases with which he is often confronted. With this in mind, an attempt has made to set forth the preceding material with the idea that is of immediate interest to the general practitioner, because it pertains to diseases which he may treat or should diagnose.

Whether the general practitioner makes use of the ophthalmoscope or not, he will usually admit its value. N. Pines ranks the instrument equally in value to the sphygmomanometer. When life and death are under consideration and all human knowledge and the achievements of modern science are to be utilized to help him, the medical advisor has a wide range of duty and responsibility. Let him remember then the importance of his position when consulted as a physician, recalling that when Thales was asked what was difficult, he said, "To know one's self" and what was easy, "To advise another".

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