ated eyes. Most frequently they are multiple, miliary in size, and situated on the smaller retinal arteries; but sometimes a single large aneurism may form on one of the large arteries. An arterio-venous aneurism has been known to occur as the result of an injury. Treatment is of no avail.

Sclerosis of the retinal vessels probably always occurs where there is general arteriosclerosis, but the alterations in the retinal vessels are rarely sufficiently obvious to attract attention on ophthalmoscopic examination, owing, no doubt, to the fact that the vessels are much smaller than those in which marked atheromatous changes are apt to occur. Both the veins and the arteries may show white borders, due to an increase of connective tissue in their walls, and sometimes constrictions and spindle-shaped thickenings. Often, however, the first evidence of disease of the retinal vessels is the occurrence of retinal hemorrhages. In syphilis changes are met with in the retinal arteries similar to those seen in cerebral syphilis, so that they are of diagnostic significance as regards the latter. Owing to obliterating endarteritis, the arteries appear as thin white bands, and there may be hemorrhagic infarcts. The veins are broad and dark colored. Vision is unaffected for a long time.

Retinitis.—This term strictly should signify inflammation of the retina, but as a matter of fact most of the retinal conditions to which it is applied are not of an inflammatory nature, but are due either to degenerative or to atrophic changes, or they are dependent upon obstructive œdema and hemorrhage. In fact, there is probably only one condition, suppurative retinitis, in which the retina is actively inflamed. When retinitis occurs in association with neuritis the condition is spoken of as neuro-retinitis. In not a few cases retinitis is secondary to optic neuritis, the swelling of the disc interfering to such an extent with the venous outgo as to lead to œdema and hemorrhage. On the other hand, in many general diseases, neuritis and retinitis may be produced independently, either one or the other predominating. The chief varieties of retinitis are as follows:

Suppurative Retinitis.—This most commonly occurs as the result of penetrating wounds of the globe or following operations, particularly those for the removal of cataracts, and almost always results in or forms a part of a general panophthalmitis. It is usually due to micro-organisms which have been introduced into the eye, but a comparatively mild form of it can be produced by chemical irritation due to the disintegration of a foreign body, especially if the latter contains copper. The condition may also be metastatic in origin, particularly in puerperal septicæmia and in the acute infectious diseases of children. In these metastatic cases the inflammation may be confined throughout to the vitreous chamber, and thus, in children, it may result in one of the conditions which gives the clinical picture known as *pseudo-glioma*. Contrary to what has been generally believed, in panophthalmitis it is the retina, not the choroid, from which the purulent exudation mainly arises. In a large number of cases of panophthalmitis examined microscopically by the writer, the retina has invariably been found densely infiltrated with pus cells, while the choroid showed scarcely any purulent infiltration. It might be thought that the pus cells in the retina came there from the choroid, but they can be seen in the act of emigrating from the retinal vessels around which, too, they are most abundantly collected. The choroid seems to play the part of an abscess wall, and is congested, more or less œdematous, and infiltrated with lymphoid and plasma cells. The choroid also early gives rise to a formation of granulation tissue. In the cases diagnosed clinically as metastatic choroiditis the condition is usually that of metastatic retinitis, although the micro-organisms no doubt often reach the eye through the choroidal vessels. If seen sufficiently early, the retina in these cases is found to be hazy and covered with hemorrhages, but the vitreous humor soon becomes so cloudy that the later stages of the process cannot be followed by means of the ophthalmoscope. Suppurative retinitis from any cause may pursue either an acute or a chronic course, and ultimately results in phthisis bulbi. The treatment is that suitable for panophthalmitis, and is of little avail. Recently the introduction of powdered iodoform in the vitreous chamber has been tried, sometimes, it is claimed, with successful results.

Retinitis Septica (Roth).—In pyæmia and septicæmia the retina frequently shows hemorrhages and white spots not unlike those seen in albuminuric retinitis. There are no signs of active inflammation and no pain. Vision is not much affected and the prognosis is favorable so far as the eye is concerned. Roth believes the condition is not due to the presence of micro-organisms in the retina, but to toxic substances circulating in the blood produced by the septic processes elsewhere. Some observers claim that the hemorrhages are due to the lodgment of septic emboli in the retinal vessels, but the absence of inflammatory symptoms and the mild course pursued by the affection are decidedly against this view.

Retinitis Simplex, Serous Retinitis, Retinal Œdema.—Under certain conditions not understood, the retina becomes hyperæmic and shows a haziness evidently due to œdema, which either may be diffuse or may occur in circumscribed patches. This mild form of retinitis is supposed to result in some instances from eye strain. It is also said to be an early manifestation of sympathetic ophthalmia. Vision may be considerably reduced and there may be megalopsia, micropsia, and metamorphopsia. Under complete rest the condition entirely disappears. A special variety known as *commotio retinæ* is due to a blow upon the eye. This also clears up, usually in about three days, with complete restoration of vision. (Plate L., Fig. 3.)

Albuminuric Retinitis.—In some cases of Bright's disease the retina shows changes which are met with under almost no other conditions, and which therefore may be regarded as practically characteristic of renal disease. Such plainly marked cases of albuminuric retinitis, as they are named, occur in only a small per cent. (about seven per cent.) of patients suffering from Bright's disease. On the other hand, if carefully searched for, less characteristic retinal changes—such, for instance, as alterations in the vessels and hemorrhages—will be found sooner or later in probably one-fourth of these patients. Typical albuminuric retinitis may occur in any form of renal disease, whether acute or chronic, but it is met with by far the most frequently in chronic interstitial nephritis and least often in amyloid disease of the kidneys. It is rarely limited to one eye, though the retinal changes may differ considerably in the two eyes, both in extent and in character. While the retinal affection appears only in cases of renal disease which have lasted some time, yet not infrequently it is by means of the ophthalmoscope that the serious condition of the kidneys is first discovered. The most characteristic feature of the affection is the presence of a "star-shaped figure in the macula," consisting of a greater or less number of white striæ which radiate from the centre of the macula, frequently, however, without completely encircling it. The fovea is usually not involved and stands out as a clear red spot. Other changes almost always present are hemorrhages, œdema, and irregular white patches of various sizes. The latter have ill-defined edges and are situated in the inner layers of the retina, often obscuring the vessels that cross them. The arteries are narrowed and frequently show white borders, while the veins are broad and tortuous. The narrowing of the arteries is not uniform, so that the same artery may show variations in width along its course. The arteries are also somewhat tortuous, and the light streaks in their centres are much brighter than in the case of normal arteries. When an artery crosses a vein the latter sometimes appears pale for a short distance on each side of the artery, due no doubt to compression. Optic neuritis is commonly present, and in some cases is the most prominent feature. In other cases hemorrhages predominate, while in still others the most striking change is that due to œdema. As just noted, the appearances may be quite different in the two eyes. Thus in one eye the principal change may consist in the

star-shaped figure about the macula, while in the other this may be absent and the retina covered with hemorrhages. If at any time there has been severe optic neuritis the retina and optic nerve ultimately undergo atrophy. Rarely the retina shows folds or even complete separation, the latter most often in the albuminuria of pregnancy. (Plate L., Figs. 4 and 5.)

The retinal condition most likely to be mistaken for albuminuric retinitis is that which results from a high grade of optic neuritis, especially that associated with brain tumor. In this the star-shaped figure may be present in a perfectly typical form, so that if at the same time there should be a trace of albumin in the urine and the general symptoms of brain tumor should not be plainly marked, the diagnosis might be difficult. In such cases, however, sight is almost always lost, whereas in albuminuric retinitis complete loss of vision rarely occurs. It should be remembered, too, that a high grade of optic neuritis does not occur in Bright's disease except in advanced cases in which the diagnosis is plain. Finally, renal disease could be excluded in most cases by a microscopic examination of the urine. In lead poisoning, too, the retina may present appearances identical with those seen in albuminuric retinitis (*saturnine retinitis*), but it is not certain that they are not due in reality to kidney lesions produced by the lead.

Anatomically the most important lesion in albuminuric retinitis, and one that gives the key to the other changes, is a widespread endarteritis and hyaline degeneration of the vessels. This is, of course, not limited to the retinal vessels, but it produces more serious damage in the retina than in the other structures of the eye. The atheromatous condition of the vessels associated with the general high arterial pressure results in numerous hemorrhages, while the insufficient blood supply leads to degenerative changes in the retinal tissue. Most of the white patches seen by the ophthalmoscope are produced in this way, but some of them are left by retinal hemorrhages that have undergone absorption. The degenerated areas show fatty degeneration of the retinal tissue, including the ganglion cells, nerve fibres, and fibres of Müller, and contain fibrin and granular detritus. Proliferation and migration of the cells of the pigment layer occur in the later stages. The degenerative changes make their first appearance at the macula because here the vessels are least numerous, but the fovea centralis ordinarily escapes, since it is well nourished by the choriocapillaris behind it. The star-shaped figure is said to owe its form to the radial arrangement of the fibres of Müller about the macula, though the degenerative changes are not limited to them. It seems to the writer more likely that its form is determined by the radial arrangement of the vessels in this region. The retina in general is apt to show marked œdema, usually in association with a high grade of optic neuritis, though the retinal œdema is sometimes quite marked where there is very little swelling of the disc. The cause of the optic neuritis is obscure; some observers attribute it to cerebral disturbances secondary to the renal disease. In addition to the other changes, the retina may show a certain amount of round-cell infiltration and hyperplasia of its connective tissue.

The disturbance of vision usually is slight when compared to the extensive retinal changes, and in the milder forms vision may be entirely unaffected. The fact that the fovea centralis is but seldom affected accounts for the almost constant preservation of central vision. Complete blindness is rare, and when it occurs it is usually the result of secondary atrophy of the optic nerve and retina or is due to separation of the latter. It should be remembered, however, that in Bright's disease, whether or not there is retinitis, attacks of blindness, *uræmic amaurosis*, may come on within a few hours as the result of uræmic poisoning, though they are more common in acute nephritis than in the chronic forms of renal disease. Here the blindness in all probability is due to the action of the uræmic poison upon the brain itself, the pupils in most cases still reacting to light. It is associated with other uræmic symptoms and disappears when the uræmia is overcome.

The prognosis of albuminuric retinitis depends chiefly upon that of the renal disease, and since the retinal affection occurs only in advanced stages of the latter, it is almost always bad. Conversely, the prognosis of the renal disease, and hence the prognosis in regard to life, is particularly bad when albuminuric retinitis has made its appearance. The prognosis in regard to sight is of little importance, because the patients seldom live long enough for the visual disturbance to become of serious moment, death usually occurring well within a year, rarely later than two years, after the discovery of the retinal disorder. The nephritis associated with pregnancy is an important exception to this rule, complete recovery being of frequent occurrence after it. Recovery also sometimes follows the nephritis which accompanies the acute infectious diseases. In these cases the retinal disease ceases to progress, and many of the retinal alterations disappear. The star figure at the macula, however, seldom entirely disappears.

Aside from the measures usually employed in severe cases of nephritis there is no treatment that will benefit the retinal disease in any way. It sometimes happens, however, that the retinitis may undergo decided improvement under treatment directed toward the kidneys and yet death ensue in the usual short time. In the albuminuric retinitis of pregnancy, especially if it appears early, the induction of abortion is often advisable.

Diabetic Retinitis, Glycosuric Retinitis.—This affection is certainly rare, though just how rare is not definitely known. It is a late manifestation of the general disease, and according to Hirschberg it is always present in diabetes which has existed for twelve years. In some instances the retinal changes are no doubt due, in part at least, to an accompanying interstitial nephritis; but it is generally believed that they may be entirely independent of kidney lesions, and there is no question but that in typical cases they differ decidedly from those seen in typical albuminuric retinitis. The affection is probably confined to diabetes mellitus, though it is claimed that diabetes insipidus has produced it. It is likely that the retinal changes that have been seen in supposed cases of diabetes insipidus have not been due to the latter disease, but that the polyuria and the retinitis have independently been due to a tumor of the brain. It is possible, too, that the polyuria of chronic Bright's disease may have been mistaken for that of diabetes insipidus.

In the form of retinitis most characteristic of diabetes, *central punctate retinitis of Hirschberg*, the retina shows great numbers of small bright shining spots, sometimes irregular in shape, which are most numerous near the disc and in the macular region, without, however, having a stellate arrangement. Scattered more generally over the fundus there are many punctate hemorrhages. Neither the retina nor the disc shows evidences of œdema, and the retinal vessels are apparently normal. Larger white spots are also occasionally seen. Sometimes in diabetes the white spots are entirely absent and the retina shows only various kinds of hemorrhages. This condition is the *hemorrhagic diabetic retinitis* of Hirschberg, though why it should receive the name retinitis is not evident. In diabetic albuminuric retinitis the changes characteristic of nephritis are associated with those of diabetic retinitis. Albuminuric retinitis may also occur alone in diabetic patients.

Diabetic retinitis is always sooner or later binocular. Vision is apt to be considerably impaired, especially central vision, and there may be contraction of the peripheral field. It is difficult to say in a given case, however, whether or not the disturbance of vision is due to the retinal changes, since amblyopia is common in diabetes even when the ophthalmoscopic examination is negative. In some cases the disturbance of vision is very slight. Not infrequently vitreous opacities due to hemorrhages occur and may produce total blindness, and glaucoma secondary to hemorrhage is also met with. Total blindness, however, is rare in diabetic retinitis.

The prognosis of the retinal affection is bad, the latter seldom showing improvement under treatment, and occurring as it does in the later stages of the general disease, diabetic retinitis is of evil significance in regard to the duration of life. This is particularly true of the hemorrhagic form, since a tendency toward hemorrhage on the part of the cerebral vessels is indicated. The treatment is that suitable for the general disease.

Leukæmic Retinitis.—In all severe cases of leukæmia the retina presents an abnormal appearance, but actual retinitis is relatively uncommon. The fundus is apt to appear light yellow in color owing to the altered color of the blood in the choroidal vessels, but where the choroid is highly pigmented this may not be noted. The arteries are pale and sometimes small; the veins are dilated, frequently tortuous, and their walls may appear thickened owing to infiltration with white cells. Retinal hemorrhages are extremely common, in fact, they are the most constant ocular lesion met with in leukæmia. In addition to these changes other lesions sufficiently marked to warrant the name of retinitis sometimes occur. These are confined almost entirely to the spleno-myelogenous type of leukæmia, and consist of haziness of the retina and the presence of white spots with red borders. The latter are most numerous at the periphery and in the macular region, and are due to collections of white cells in the centres of hemorrhages. Though not often seen, they are highly characteristic of leukæmia. Other white spots, due to degeneration, also occur. The disc may be practically unaffected, or it may be greatly swollen owing to œdema and to infiltration with cells. Both eyes are almost always affected, though in different degrees. The impairment of vision depends upon the position and number of the white patches and hemorrhages; a hemorrhage in the macular region will of course cause loss of central vision. This may be of the subhyaloid variety, however, and afterward clear up. A large hemorrhage into the vitreous humor may cause permanent loss of sight and in some cases glaucoma. Albuminuric retinitis may occur as a complication. The prognosis is hopeless as regards both the general and the local affection.

Syphilitic Retinitis is far less common than syphilitic chorioretinitis (see Vol. III., p. 64), but still it does occur. It is met with in both acquired and congenital syphilis, though in the latter only the final stages are seen. In the acquired form it may develop four to six months after the primary infection. The retina shows a grayish-white opacity which is most marked near the vessels, and along the latter small white spots are frequently seen. The vessels themselves are apparently not much affected, the arteries are somewhat thinner, and the veins thicker than normal. Dust-like opacities are almost always present in the posterior part of the vitreous humor, and may persist after the retinal affection is cured. Hemorrhages are rare. Microscopically the important changes found have been diffuse round-cell infiltration of the retina, endarteritis of its vessels, and nodular collections of round cells in the choroid. No distinct gummatous formations have been observed in the retina, but the nodules in the choroid are said to resemble gummata. Proliferation and migration of the cells of the pigment epithelium have been noted. An early subjective symptom of the disease is a constant shimmering of light, due, according to Hirschberg, to insufficient blood supply to the retina. Visual acuity is much reduced and there is frequently night blindness. Ring scotomata are sometimes detected. The retina and with it the optic nerve ultimately may undergo atrophy. The prognosis and treatment are similar to those of syphilitic chorioretinitis.

Relapsing Syphilitic Central Retinitis.—This is an extremely rare affection, first described by von Graefe, characterized by repeated sudden attacks of marked impairment of vision. At first the vision returns to normal during the intervals, but finally it becomes permanently impaired. The retina shows slight dimness in the macula around which fine dots are frequently seen, and in the later stages of the disease pigmentary changes occur in the macular region. Reduction in central visual acuity usually persists even after prolonged antisyphilitic treatment, owing to the structural alterations in the retina.

Retinitis Proliferans (Manz).—In this disease masses of connective tissue arise from the retina and extend out into the vitreous humor. They are usually attached near the disc, rarely directly to the latter. There is little doubt that the condition is brought about through the organization of retinal hemorrhages. The progress of the disease is slow, but it usually leads to total blindness. Iridocyclitis or separation of the retina may occur, and the globe finally undergoes atrophic changes. It is said that mercurial inunctions and potassium iodide are of benefit.

Retinitis Punctata Albescens (Mooren).—As indicated by the name, in this affection the retina is studded over with numerous small white spots which are most numerous around the disc and in the macula; the fovea, however, usually escapes. Central vision is reduced and there are sometimes night blindness and contraction of the peripheral field. The disease is extremely rare and occurs in young persons.

Consanguinity in the parents seems to be an important factor in its occurrence and several members of the same family may be attacked. Aside from the ophthalmoscopic picture, it is thus very similar to retinitis pigmentosa.

Retinitis Circinata (Fuchs), a very rare disease of unknown etiology, always occurring in elderly persons, is characterized by the presence of a number of small white spots situated around the macula in the form of a more or less complete circle, with a diameter two or three times that of the disc. Within the circle, but not quite reaching its circumference, the macula shows a grayish opacity. The white spots lie deeper than the retinal vessels and sometimes are slightly pigmented. Small retinal hemorrhages occasionally occur, especially in cases of long standing. Along with these changes there are diminution in central vision, limitation of the visual field, and a small central scotoma. Vision gradually becomes more and more defective, but absolute blindness does not occur. The affection may be either monocular or binocular. According to Fuchs, the spots sometimes disappear, but the disease is not benefited by treatment.

Retinitis Striata (Nagel), another very rare affection of the retina, owes its name to the presence in the retina of gray stripes situated in front of the pigment layer, but behind the vessels. The stripes vary in width, but may be three or four times as wide as a vein. They may run from the disc like radii, or they may have no special arrangement. In addition to these striæ the retina may show pigmentary changes. The disease appears at an early age, runs a chronic course, and although there is some reduction in visual acuity, blindness does not generally result. The etiology and pathology of the affection are unknown, though some observers hold the view that the stripes are due to metamorphosis of hemorrhages, as in the case of angioid streaks in the retina. L. Caspar maintains that they are the result of a retinal separation that has undergone spontaneous cure. Treatment is of no avail.

Retinitis from exposure to bright light is sometimes met with, occurring most often as the result of exposure of the retina to sunlight during an eclipse (*solar retinitis*), or less frequently to exposure to an electric arc light. There is produced a central scotoma which may or may not persist, and, later on, pigmentary changes may be seen in the macula.

Snow blindness, which results from long exposure of the eyes to the brilliant light reflected from large expanses of snow, is not dependent, as might be thought, upon retinal changes, but it is due to the photophobia and blepharospasm resulting from a peculiar form of conjunctivitis. It is said, however, that sometimes the retina may be hyperæmic, and that there may be some actual diminution in visual acuity.

Amaurotic Family Idiocy (Tay).—In this very rare disease the retina presents an appearance as striking as it is

characteristic. There is a grayish-white patch in the macular region, about twice the size of the disc, the centre of which is occupied by a small red spot similar to that seen in embolism of the central artery. Otherwise the fundus appears normal. The disease makes its appearance within the first year of life, both eyes being affected in the same way and the child showing marked symptoms of idiocy. It occurs almost exclusively in children of Hebrew parentage, usually attacking several children of the same family. Optic atrophy followed by blindness gradually ensues, and death inevitably occurs within a very short time, most often before the child reaches the age of two years. Anatomically the chief lesion found is an extensive degeneration of the cells of the cerebral cortex. According to Holden, there is a similar degeneration of the large ganglion cells of the retina, which, he thinks, gives the explanation of the ophthalmoscopic findings, since these cells are absent in the fovea and most numerous in the macula surrounding it.

Retinal atrophy is the final outcome of embolism of the central artery, thrombosis of the central vein, and of the severe form of retinitis. It also occurs as the result of separation of the retina and in the late stages of glaucoma. It is characterized particularly by marked thinning of the vessels, which sometimes become almost invisible, and by secondary atrophy of the disc, the latter taking on a pale dirty gray color and presenting an atrophic excavation. Pigmentary changes not infrequently take place in the retina. An apparently idiopathic form of retinal atrophy is that known as *chorioretinitis pigmentosa* (see Vol. III., p. 69), or more commonly as *retinitis pigmentosa*.

Separation of the Retina, Amotio Retinæ.—Normally the pigment epithelium of the retina is adherent to the choroid, but not to the rest of the retina, the latter simply being held in contact with it by the pressure of the vitreous humor. In so-called detachments of the retina the pigment layer is, in general, always left behind and the condition should therefore be spoken of as a separation, not as a detachment, although the latter is the term almost universally used. In enucleated eyes, these two portions of the retina separate with the greatest ease, and indeed it is a difficult matter to obtain histological specimens of the retina with the pigment layer *in situ*. Notwithstanding this fact, however, separation of the retina, though not rare, seldom occurs except under conditions which in themselves are of a most serious nature. Thus the most common conditions which lead to it are advanced myopia, severe injuries, especially if accompanied by loss of vitreous humor, iridocyclitis, choroiditis, intra-ocular tumors, and hemorrhage. Idiopathic separation (that is, separation of the retina without obvious cause) does occur, however, and is most common in youth and in old age. An important though uncommon cause for retinal separation is albuminuric retinitis, especially that associated with pregnancy. (Plate L., Fig. 6.)

The large majority of separations are found below, though in many cases they no doubt started elsewhere and sank downward, the retina becoming reapplied at the site of the original separation. Owing probably to the position of the disc, separations are less frequent on the nasal than on the temporal side. Localized separations at the macula are rare. The best ophthalmoscopic view of a retinal separation is to be obtained by the indirect method, though it is advisable also to make use of the direct method, holding the instrument some distance from the eye of the patient. In large separations that have come far forward the retina can often be seen by oblique illumination alone without the aid of an ophthalmoscope. The retina, if the separation is recent, projects forward into the vitreous humor as a tremulous, translucent, gray membrane, showing a greater or less number of folds over which the blood-vessels are seen to take a tortuous course. The latter lose their light streaks and appear smaller and also much darker than normal owing to the reflection of light from the choroid behind. Ordinarily if the media are clear the condition is readily recognized, but when the separation is flat and extensive the diagnosis is sometimes difficult. If the separation continues to increase, as is usually the case, it ultimately becomes total, the retina remaining attached at the disc and ora serrata only, and forming a plaited funnel behind the lens. Most often, however, it cannot be seen with the ophthalmoscope at this stage owing to lenticular or vitreous opacities. In the case of intra-ocular tumors, distinction should be made between an actual separation of the retina and the lifting up of the latter, due to the growth of the tumor beneath it. While the retina is attached to the tumor it is of course not tremulous, shows no folds, and the color of the tumor may be recognized through it. Even very small tumors, however, may early cause complete separation of the retina, and when this takes place the separated retina differs in no way from that which occurs under other conditions. The portion of the retina first to become separated is usually that covering the tumor, but not infrequently this portion of the retina never becomes separated and is overgrown and destroyed by the tumor cells. Even when this is the case, the remaining portion of the retina usually undergoes separation.

The apparent color of the separated retina depends upon that of the subretinal fluid; if the latter is tinged with blood, the retina takes on a greenish color. Owing to degenerative changes, the retina very soon becomes opaque, but it finally becomes translucent again when atrophy sets in. Quite frequently ruptures can be detected in separated retinæ.

The tension of the eye as a rule is diminished and the anterior chamber is deep, the iris frequently showing iridodonesis. Where the separation is due to an intra-ocular growth, the tension is almost always increased, or at least not diminished, a fact of great diagnostic importance. Liquefaction of the vitreous humor in association with vitreous opacities is common, and in old cases cataract and a low grade of iritis are apt to occur.

The separated retina frequently is œdematous and shows hyperplasia. Calcification, more rarely ossification, may occur, and cholesterin crystals may form in it. Pigmentary changes and hemorrhages are not often seen. Rarely cysts are formed. The blood-vessels remain pervious for a considerable length of time, but many of them finally show sclerosis and thrombosis. The nervous elements of the retina atrophy, and the layer of rods and cones soon undergoes maceration owing to the lack of the nourishment normally furnished by the choroid.

The manner in which separation of the retina is brought about is apparent in a large number of cases, but in an equally large number it is a matter of dispute. Cyclitis produces separation by the contraction of exudates that have been poured in the vitreous chamber. Choroiditis may produce it in a similar manner, or by giving rise to exudates which collect in front of the rods and cones. Traumatic separations are produced in several ways. When occurring immediately or soon after an injury or operation they are usually due to hemorrhage or to the loss of vitreous humor, which by lowering the intra-ocular tension allows serum to collect behind the retina. In other cases the retina is ruptured by the injury and the vitreous humor passes behind it through the rupture. The separations that occur some time after the injury are due to the traumatic cyclitis and choroiditis that have been set up. Foreign bodies in the vitreous chamber may cause separation of the retina if they produce a severe inflammatory reaction; but, on the other hand, they may remain attached to the retina for years without separation resulting. Finally, spontaneous subretinal hemorrhages from any cause, glaucoma for instance, may produce separation of the retina.

To explain other cases of separation a number of theories have been advanced. In myopia it seems clear that the elongation of the eyeball plays the chief rôle, but the exact way in which it does so is not certainly known. Iwanoff found that in myopic eyes the vitreous body became separated from the retina posteriorly, and that the preretinal space thus formed was filled with serum; but he failed to explain satisfactorily how this led

to retinal separation. De Wecker suggested that the latter was due to spontaneous rupture, permitting the serous fluid to find its way behind the retina. Leber and Nordensen maintain that in the large majority of cases retinal separation is due to a fibrillar condition of the vitreous body leading to its shrinkage and hence to traction upon the retina. The peculiar condition of the vitreous body is said to be dependent upon a chronic choroiditis. Suddenly developing separations, according to this theory, are due to rupture of the retina resulting from the traction. Raehlman, however, has called attention to the fact that the fibrillar condition of the vitreous body, noted by Leber and Nordensen, may be secondary to the separation, and that separations may occur when the vitreous body is perfectly fluid. He holds the view that a process of diffusion plays the most important part in the production of retinal separations. According to his diffusion theory, an albuminous exudate first collects behind the retina, and then fluid passes by diffusion from the vitreous body through the retina, gradually increasing the amount of fluid behind the latter, and separating the retina more and more from the choroid. It seems almost self-evident that separation of the retina having once begun, the process of diffusion must play an important part in carrying it on to completion.

Among the early subjective symptoms of retinal separation are photopsiæ, chromatopsiæ, and metamorphopsia, followed by the appearance of a dark cloud which obscures part of the visual field and produces a positive scotoma. Vision at the macula is maintained so long as the separation has not involved this region, but it is apt to be impaired in any case. The separated retina may retain light perception for a short time, and if it soon becomes reapplied, it may completely resume its function. Thus the macula may be separated at first and then become reapplied to the choroid and regain its function as the separation sinks lower down. But the prognosis in retinal separations is very unfavorable, though in rare instances a spontaneous cure has resulted. Small separations occurring after an injury or as the result of retinitis, such as albuminuric retinitis, offer the best prognosis so far as the separation itself is concerned. Usually the separation increases until it is complete and there is absolute blindness. The prognosis is particularly unfavorable in myopic cases because there is no way in which we may combat the myopia. Idiopathic separation also has a highly unfavorable prognosis.

Until recently the method of *treatment* considered most satisfactory was rest in bed and the administration of diuretics, diaphoretics, and purgatives, in the hope of causing absorption of the subretinal fluid; but of late much more brilliant results have been obtained by repeated subconjunctival injections of normal or physiological saline solutions. Unfortunately, however, even after this method of treatment recurrences are common. Many surgical measures have been tried, but with indifferent success; incising the retina, withdrawing the subretinal fluid by means of a syringe, and injecting iodine with the purpose of setting up an adhesive inflammation, have all been recommended, but it is likely that they will be generally replaced by the method of subconjunctival injections.

Subretinal Cysticercus.—The cysticercus has been found as a parasite within or beneath the retina, but the condition is an extremely rare one, especially in this country. At first the retinal separation produced is localized over the parasite, and the movements of the latter can sometimes be observed under it. The vitreous humor soon becomes cloudy and the retinal separation becomes total, producing complete blindness, and the eye finally undergoes atrophic changes. Sometimes the parasite works its way through the retina into the vitreous humor. Drugs given with the object of killing the parasite have always proved ineffectual. When the attempt is made sufficiently early, the entozoon may be successfully removed by operation with preservation of sight.

Tumors of the Retina. (See Vol. IV., p. 112.)

Frederick Herman Verhoeff.

RETROPERITONEAL TUMORS.—This subject has received its full share of attention during the past decade and with satisfactory results. That it is still at the present time a subject of much thought and earnest research cannot be denied. Thus far, investigations go to show that in the past there have been much confusion in the pathology of these growths, many errors in diagnosis, and not a very satisfactory record regarding operative interference. Like many other problems in this great field of surgery, an early, careful study of the case, a judicious weighing of all symptoms, subjective and objective, an experienced touch, no haste, are doing much to place on a more secure basis of classification these rare growths. Careful workers in the pathology of these tumors are doing much to clear up doubtful points, and establish on a more secure basis their true nature. Operating surgeons, when the tumor has obtained full size, have not found the work of removal at all encouraging, yet it is plainly to be observed that when the growth has been reached early, a fair percentage of recoveries has been secured.

A careful study of retroperitoneal tumors shows that many of them are of a mixed variety, containing the elements of both lipoma and myxoma, tissues which are, histologically, very closely associated.

Both of these tissues are found normally in the retroperitoneum, and doubtless many of these growths arise, under suitable conditions, from congenital neoplasms. These tumors are sometimes active in their growth, often become cystic, and at times reach immense proportions. Cases are reported of tumors of this kind weighing eighty pounds. The distribution of the elements is very diverse. The fat may be regularly distributed throughout the tumor or may occur as islands located here and there. These growths are very often œdematous, and by chemical analysis present a large percentage of mucin. The microscope, besides revealing the usual elements of lipoma and myxoma, very often reveals a numerous round-celled infiltration in the stroma of the growth, pointing to a sarcomatous element in their character. While not presenting all the features of active malignancy that carcinoma and sarcoma do, yet they often show a marked tendency to recur locally when removed.

Clinical histories and pathological research both show that tumors containing embryonal elements are very apt to be malignant; indeed, it may truly be said that they are always so.

The tumors found in the kidneys of young children are, for the most part, mixed tumors, chiefly myosarcomata. Many are surely congenital, and are an example of a new growth developing from embryonal tissue. They have, by Grawitz, recently been compared to a series of embryonal growths which spring from the suprarenal capsules, and have the appearance of adipose tissue, but are usually sarcomatous. (Orth, "Pathologische Diagnostik.")

Even though the tumor may not at first present the condition of true malignancy, yet the operative surgeon has learned to know that the semi-malignant growth is very apt to return either in the cicatrix or in the neighboring connective tissues, and to involve important structures, such as the large secreting glands or the lymphatics.

A careful investigation of the reported cases, together with an examination of all accessible works on pathology, impresses one with the belief that the most frequent origin of these growths is in the connective tissue of the capsular envelope of the kidney; the next most frequent seat being the suprarenal capsules.

Mr. Hulke, of Middlesex Hospital, reports a case of myxoma which enveloped the left kidney and upon which he operated. A median section was made through the tumor when it presented itself. The incision was continued through the posterior blade of the peritoneum, just beyond the descending colon. The tumor proved to be a myxoma, and, although the patient recovered from the operation, the growth returned locally. The kidney was not involved by the tumor, and could have been enucleated.

The growths embraced in this class are peculiar in several respects. None can be said to be absolutely benign, even those which are made up entirely of the histological elements of either lipoma, fibroma, or myxoma, and notwithstanding the fact that they do not tend to the formation of metastases or to the infiltration of immediately surrounding tissues. It is true that they show no great tendency to recurrence when completely removed, yet from the great size to which they develop, and from their tendency to undergo degenerative changes, they cannot be classed as innocent growths.

The late Dr. John Homans, of Boston, has called attention in two papers to the reported cases of pure lipoma, among which were some on which he had himself operated.

Subserous lipomas rarely of themselves reach a large size. However, those going out from the peritoneum may be of sixty pounds' weight. Lipomas are usually slow-growing, the subserous particularly so. Subcutaneous lipomas sometimes grow rapidly after remaining stationary for years. Lipomas seldom change to other varieties, but they may primarily be mixed in character —myxolipomas.

The character of the latter group can never be determined with certainty without careful microscopical examination, as many growths having the appearance of lipomatous tissue often have the elements of myxoma and sarcoma as well. They may reach great size, but show no disposition to return after removal.

Sir Spencer Wells reports, in his first edition of "Abdominal Surgery," a case in which the removal of such a growth was undertaken, with fatal results.

Sarcomas, either in typical form or in combination with myxomatous, lymphomatous, or fibromatous tissue, also occur, and have been observed quite often. Many of the tumors which have been described as sarcomas of the mesentery were doubtless retroperitoneal sarcomas, arising at the root of the mesentery and presenting themselves anteriorly, after separating its folds.

Carcinomas are very rare, and present the strongest type of malignancy. They are of the hard, solid variety, soon forming deep and firm attachments, and offering little to be hoped for from an operation.

Varieties such as fibroma and cystoma have been observed. It may be said of the latter, for the most part, that they either spring from the walls of the pelvis, or from the subperitoneal connective tissue of that region. Virchow looks upon this series of growths as being analogous to those tumors which arise from the deep tissues of the neck.

A few remarks may be made in regard to the starting-point and relations of all these growths. Those which spring from the walls of the pelvis encroach upon or involve the bladder, uterus, and rectum, very often presenting features which are exceedingly perplexing in diagnosis. The origin of a smaller number is reported respectively as from the retroperitoneal lymphatics, the bodies of the vertebræ and bones of the pelvis, and the root of the mesentery. In by far the greater proportion of the cases no exact origin is given; indeed, from the subsequent changes in anatomical relations, it would seem quite impossible to determine the exact point of origin of many of the very large retroperitoneal new growths. They have almost uniformly presented themselves in the line of the least resistance, that is, anteriorly. In my case, reported in the *American Journal of the Medical Sciences*, January, 1892, the tumor presented itself in the back—a condition which can be attributed to its origin from the extreme upper border of the kidney, where it was less completely bound down by the lumbar muscles and fascia. When the growths have reached a sufficient size to attract the attention of the patient, they are found presenting themselves at either side of the umbilicus, somewhere in the region of the lateral lines drawn in the arbitrary divisions of the abdomen into regions, although they may appear centrally. As the growths increase in size the viscera are displaced, not infrequently completely to the opposite side, although those growths which spring from the left kidney may have the descending colon externally. Owing to circulatory disturbances within them, and to their liability to a subsequent malignant infiltration, as well as to the development of cachectic conditions, they present, clinically, features which suggest a condition almost immediately hazardous to life.

As with any large abdominal growth, there is always a certain degree of encroachment upon the thorax and pressure upon other organs. In my second case, the tumor pushed the inferior border of the liver up to the fourth intercostal space, while the cæcum and ascending colon were displaced toward the left side of the abdomen.

Diagnosis.—Notwithstanding our constantly increasing experience in abdominal surgery, we must admit that an exact diagnosis as to the true nature of these growths is not always possible. Nor can it be said to be absolutely necessary, especially in the lesser and more movable varieties.

I cannot well imagine a more severe task for a writer than to attempt to outline the symptoms and diagnosis of a condition which, until the present time, has baffled, quite without exception, the skill of all who have met with it. Yet, recognizing the importance of the factor of exact diagnosis, especially in abdominal surgery, I wish to call attention to all such symptoms as may be associated with these growths, and, after carefully weighing them, put together what seems useful.

In the first place, there is not a single symptom that is pathognomonic, and we are dependent for diagnosis upon the process by exclusion. Diseases and neoplasms of the uterus and its appendages, of the liver and the gall bladder, of the spleen, pancreas, and kidney, are to be excluded, as well as aneurism of the aorta, tumors of the mesentery, and of the abdominal walls.

The sex of the patient or the history of the case may enable one to exclude the organs of generation at once, and bimanual examination will rarely fail to locate the uterus and its appendages and determine any pathological changes in them. Pelvic congenital cysts from the spinal cord or membranes should not be lost sight of. Subperitoneal fibroids are the only ones likely to be confounded with this condition; but then uterine fibromas are more easily movable within the abdomen, and their attachment to the uterus can be made out. Solid tumors of the ovary and broad ligament present greater difficulties, which at times cannot be surmounted.

Diseases of the liver, together with new growths of that organ, have very often been mistaken for retroperitoneal neoplasms. Hypertrophic cirrhosis, amyloid degeneration, hepatic abscess, hydatids, obstruction of the cystic duct, and distention of the gall bladder, together with carcinoma and sarcoma, present physical signs which may be confounded with retroperitoneal tumors. The history of the case, together with a painstaking weighing of general symptoms, will naturally assist in clearing a doubtful diagnosis.

Disturbances of biliary excretion may occur from pressure on the common duct by the tumor. Again, tumors of the liver always move synchronously with the respiration. Retroperitoneal ones do not, as a rule. Very often a line of resonance is found between liver and tumor, which at once shows that the growth is not connected with the former organ.

My own experience teaches me that growths connected with the spleen make the case at times very embarrassing.

It has been said that the differentiation from hypertrophy and tumors of the spleen presents less difficulty than does the differentiation from tumors of the liver. Here palpation and percussion will be quite sufficient, if employed to locate the spleen in its normal position. Tumors of the omentum lack the fixed position of these growths. The absence of digestive disturbances, with fatty stools, will serve to exclude the rare new growths of the pancreas.

As stated, many of these tumors have their origin in the capsule of the kidney, or in the connective tissues