The association of Optic Neuritis & Atrophy
with Diseases of the Brain & Spinal Cord

A Thesis by

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The very frequent association of Optic Neuritis with tumours of the Brain & Tubercular Meningitis together, though less frequently, with other intra-cranial diseases; while the fact that Primary Optic Atrophy is very commonly found in association with Chronic Spinal diseases, make the recognition of these diseases of the Optic nerve of very great importance in the diagnosis of the Diseases of the Brain & Spinal Cord.

The exact connection between Optic Neuritis & intra-cranial disease has given rise to much discussion & many theories have been brought forward in the attempt to explain it. The very frequent association of Optic Neuritis with Cerebral tumours led observers to conclude that there was a connection between the increased intra-cranial tension from the presence of the growth & the Optic Neuritis & this led Von Graefe to suppose that the increased tension caused compression of the Cavernous Sinus & that the venous circulation of the retina was consequently obstructed, thus producing the Neuritis in a mechanical manner. This theory had to be abandoned when the free anastomoses between the orbital & Facial veins was discovered.
The almost constant occurrence of distension of the Optic Nerve sheath in Optic Neuritis (Berry, Dis. of Eye, p. 304), the free communication existing between the Subarachnoid space (where the cerebro-spinal fluid is mainly found) & the Ventricle of the Brain, & the fact that in Tumours & Tubercular Meningitis a considerable exudation of fluid is usually found in the 3rd Ventricle (Swanzy, Dis. of Eye, p. 433), led to the belief that the increased intra-cranial pressure drove the Subarachnoid fluid into the sub-cutaneous space of the Optic Nerve & so produced the distension of the nerve sheath. Schmidt-Rimpler believed that this distension of the Nerve sheath caused compression of the Optic papilla & so produced oedema & inflammation of it. (Berry, Dis. of Eye, p. 304).

Leber thinks "the products of tissue change of tumours" with inflammatory transudates mingle with the Cerebro-Spinal fluid & pass with it from the Optic nerve sheath into the lymph spaces of the Nerve & that these abnormal constituents of the fluid set up inflammation of the Nerve (Swanzy, Dis. of Eye, p. 433).

Galezowski believes the Optic Neuritis to be in all cases propagated by continuity of tissue i.e. he ascribes it to a Descending Neuritis (Jules, Dis. of Eye, Optic Neuritis).

Schmidt-Rimpler or Pressure theory

Hamilton (Pathology Vol. 2, part 2, p. 712) thinks the occurrence of Optic Neuritis with tumours situated in almost any part of the Brain, might be explainable.
were it due to a general cause such as increased pressure of the cerebro-spinal fluid, but, as he remarks further on, it cannot be always due to such pressure, seeing there are cases, where, with a tumour in a remote part of the Brain, the Neuritis is confined to the eye of the same side.

Gowers (quoted by Berry p.305) absolutely denies that distension of the Nerve sheath has any influence in causing the production of the Neuritis & adds that cases occur in which there is no distension of the sheath present & that its presence depends on an excess of Subarachnoid fluid.

Beevor (Dis. of Nervous System p.259) holds that increased intra-cranial pressure has evidently something to do with the production of Optic Neuritis, from the rapid way in which the Neuritis subsides in some cases after simple trephining, while removal of the tumour, when possible, lessens the Neuritis even more completely than trephining (Quain's Diet. of Medicine. Vol 2. p.263).

Netleship (Dis. of Eye 1898. p.224) thinks the subsiding of the Neuritis after trephining, is strong evidence in favour of the Pressure theory.

Berry (loc.cit) thinks that the only weak point in the pressure theory is the doubt - which
which Deutshmann's experiments strongly suggest; if the accumulated fluid round the neck of the Papilla can really exert sufficient pressure to cause the Neuritis he thinks therefore that Leber's theory is the preferable of the two.

The Descending Neuritis theory

Hamilton (Pathology, Vol. 2, p.p. 690-712) after demonstrating that the Optic Nerves are directly or indirectly connected with almost every part of the Cerebrum, argues that a chronic Cerebritis might very readily pass downwards from various localities in the Brain to the trunk of the Optic Nerve; that, in the case of tumours of the Brain at least, the Optic Neuritis may be simply an extension downwards of the diffuse sclerosis of the Brain, which he shows (p. 577) almost always accompanies these tumours.

Juler (Dis. of Eye. Optic Neuritis) from the microscopic examination of a large number of cases, concludes that the Optic Neuritis in Cerebral disease is always the result of a descending Neuritis. He gives a list of observers, who, after numerous similar investigations, come to the same conclusion.
Nettleship (p. 224) gives similar testimony to Jules in favour of descending neuritis.

Gowers (quoted by Berry p. 305) says "In a large number of cases of neuritis there is distinct evidence of a descending inflammation" and lays stress on the fact that when optic neuritis occurs in meningitis, such descending inflammation is invariable.

Jeaffreson (Lancet 26:490 p. 891) states that the direct extension of the inflammation from the site of the tumour can usually be made out in the nerve, even where there is no direct extension, new foci of inflammation frequently develop in the meninges at the base in the neighbourhood of the chiasma and optic tracts, thus, even in cerebellar tumours, it is not uncommon to find patches of meningitis most frequently in the anterior part of the base of the brain.

Edmunds & Lawford (Trans. Ophthal. Soc. 1883, iii p. 138) on this point, state that the optic neuritis in cerebral tumours seems often to be caused by secondary meningitis set up by the growth.

The actual demonstration by so many investigators of the existence of inflammatory
changes along the Nerve from the Optic Papilla to the inflammatory focus in the Brain, not only in Meningitis but also in remotely situated tumours, proves, to my mind, that Optic Neuritis, in many cases at least, arises from a descending inflammation, but that the latter is invariably the cause of the Neuritis, there is not sufficient evidence, in my opinion, to justify such a conclusion. Although Lowers lays stress on the fact that Optic Neuritis in cases of Meningitis is invariably due to a descending inflammation, this forward as an argument in favour of the Papillitis being always due to such descending inflammation in Cerebral cases, yet there is a strong objection to his argument in the fact that Optic Neuritis occurs less frequently in cases of Meningitis than in tumours, whereas, were a descending inflammation invariably the Cause of the Neuritis one would, I think, naturally expect to find that the relative frequency of the occurrence of Optic Neuritis in these two varieties of intra-cranial disease would be just the reverse of what, as a matter of fact, really occurs.
Increased intra-cranial pressure as a possible cause of the Optic Neuritis has one or two strong points in its favour, e.g. such a general cause would very satisfactorily account for the occurrence of Optic Neuritis in association with a small growth in a distant part of the brain. The effect of trephining on the inflamed papilla seems to me to leave no room for doubt that the increased intra-cranial pressure exerts some influence on the course of the inflammation — intensifying or at least prolonging the condition and perhaps even, under certain circumstances, giving rise to it.

A very serious objection to the pressure theory however is the fact that Optic Neuritis confined to one eye has been observed in a few cases of Cerebral disease. It is just possible that one or other of the explanations given by Berry may satisfactorily account for these unusual undoubtedly rare cases. He suggests that these unilateral cases may be quite independent of the Cerebral disease, or that some structural abnormality may prevent the distension of the sheath of the Optic Nerve on one side or finally that they may be due to a descending
Neuritis. (Berry p. 305). When one considers that only a few cases of unilateral Neuritis have been met with in Cerebral disease, I do not think there is much improbability that one of these explanations may satisfactorily account for them. Although it is universally admitted that distension of the Optic Nerve sheath almost always occurs in Cerebral cases, it is an open question whether the fluid can exert a sufficient amount of pressure to mechanically produce the Neuritis. It is within the range of possibility that Leber may be correct in assuming that the Neuritis is due to irritation set up in the Nerve by the fluid, not to pressure exerted by it. The objection to this is that the fluid has not been proved to possess a distinctly irritating nature.

On the whole, the weight of evidence, I think, points decidedly in favour of the Optic Neuritis in intra-cranial disease being due, in many cases at least, to a descending inflammation starting from the inflammatory focus in the Brain, or from Secondary Meningitis set up in some cases by growths— the inflammation extending either along the trunk of the
nerve or its sheath, down to the Optic Papilla, & there giving rise to the characteristic Ophthalmoscopic appearances. At the same time I consider that the increased intra-cranial pressure undoubtedly has a distinct influence on the course of the Papillitis, but, that it is capable of giving rise to it, is, in the present state of knowledge of the subject, open to doubt.

The intra-cranial diseases causing Optic Neuritis.
The commonest cause of Optic Neuritis is undoubtedly a tumour of some sort in the Brain. The Neuritis is found in at least $\frac{1}{3}$ of these cases at some period of the disease & occurs more frequently with a growth at the base than the convexity of the Brain (analysis of cases. Nettleship p. 419).

Tubercular Meningitis is the next most common cause of the Neuritis, (Quain, Diet? in Medicine) well marked in at least a half of the cases (analysis of cases. Nettleship p. 420).

Meningitis of the convexity seldom causes Optic Neuritis, but Treves says it is more common in traumatic cases than those of the convexity not following an injury (Treves System of Surgery Vol. 2. p. 130.) Optic Neuritis is said also to occur more frequently in traumatic Abscess of the Brain than in Abscess not following an injury (Quain's Diet? in Medicine). Berry
has examined a number of cases where purulent inflammation has spread from the middle ear to the brain and has never found Optic Neuritis. He therefore concludes that it is very rare in these cases (Berry). Well marked Optic Neuritis occurs occasionally in Cerebritis—where no coarse disease is seen but widely diffused microscopic inflammatory changes are present—but a localised Cerebritis—not resulting in an abscess, has usually no ophthalmoscopic changes (Quain, loc.cit). Cerebral diseases in which there is neither inflammation nor tissue growth e.g. Intracranial aneurisms very rarely cause Optic Neuritis whilst it is rarely ever seen in cases of Cerebral haemorrhage (Nettershhip p.229). Softening from Thrombois or Embolism & Cerebral cysts are also very rarely accompanied by Optic Neuritis (Swanzy, Optic Neuritis) whilst it is never present in uncomplicated Oldema of the Brain (Greene's System of Surgery Vol.2 p.205). In Idiopathic Epilepsy where attacks recur with great severity for several days, slight Optic Neuritis may occur but subsides when the attacks are over & in Chorea a similar Neuritis may occur, especially in Hypermetropes which likewise passes off when the Chorea subsides. (Quain's Diet, loc.cit).
But Optic Neuritis is occasionally seen in lesions of the Spinal cord, thus it has been observed in Myelitis, though such cases are extremely rare (Bramwell Dis of Spinal cord p.247) & very rarely also, it occurs in Spinal Meningitis, Cerebro-Spinal Meningitis, Multiple Sclerosis & General Paralysis of the Insane. Optic Neuritis is rare after Spinal injuries, according to Thorburn whose conclusions after recent investigations Brichsen gives in full (Brichsen's Surgery 10th Ed. Vol.1 p.800).

The occurrence of Optic Neuritis in other diseases not belonging to the Central Nervous System - such as Bright's disease, Anemia, Lead poisoning &c has of course to be remembered.

Some points in the diagnosis of Optic Neuritis. It is extremely important from the standpoint of diagnosis, to note that Optic Neuritis, even of the most intense kind, may be present without the slightest defect of sight i.e. central & peripheral vision for both form & colour may be perfect & that this absence of subjective sensations sometimes lasts for months (Berry loc.cit) that as a rule, sight is seldom much affected until Papillitis has existed for some time.
may never be affected at all, should the
morbid process cease before the nerve elements of
the inflamed part are pressed on or altered (Juler
loc.cit). This frequent recurrence of Optic Neuritis
without visual defect was first brought to the
notice of the profession by Hughlings Jackson
its discovery has been of inestimable benefit
in practical medicine. Previously, physicians
were not in the habit of using the Ophthalmoscope
unless the vision was impaired, by which time
frequently enough the inflammatory swelling of
the papilla had passed off & atrophic changes
had commenced. (Quain's Dict., vol 2, p. 263), hence
one of the most important signs of intra-cranial
disease was very often not utilised. In addition
to this loss, the cause of the consecutive
Optic Atrophy was for long a puzzle & this was
not solved till the use of the Ophthalmoscope
was practised in all intra-cranial cases
without regard to the state of vision.
But in addition to this remarkable want of
visual defect which might lead one astray
there are some appearances of the disc which
are apt to be misleading to those who have
not had much practise in the use of the Ophthalmoscope
Optic Neuritis may be so slight that the appearances barely exceed the normal (Swanzy, p. 43). Such slight cases might very easily be overlooked especially in restless or delirious children; indeed under such trying circumstances it is very difficult to make a satisfactory examination & I failed in a recent case of suspected meningitis to see the disc even. A very strong light thrown on the Retina makes the disc look less vascular than it really is & the indirect method of examination gives a pinker hue to the discs of fair people than they really possess (Brown on the Ophthalmoscope p. 87) hence mistakes may readily be made in the estimation of the vascularity of the disc unless as weak a light as is consistent with a clear view of the fundus & the direct method be used. I have seen a high physiological complication of the papilla in several instances diagnosed as "Hyperemia Of the disc" at Moorfields hospital by those not accustomed to the use of the Ophthalmoscope & I made the same mistake myself at first, and before I was aware to the fact that however full of blood the disc may be, its margin is always recognisable in the direct image in the very red
normal disc, & in cases of simple hyperemia.

Hypermetropic & Hypermetropic astigmatism may almost always do produce an increased amount of vascularity of the disc, but it may go further & produce a distinct tho' slight Neuritis (Optie) or a condition indistinguishable from it (Jeaffresson 'Sct. 26.4.'90 p. 891) & (Swanzy p 84).

This Hypermetropic condition of the disc might lead one to come to false conclusions in a case where one was on the outlook for a genuine inflammation of the disc. Hence the diagnosis of a slight Neuritis in patients who are hypermetropic requires some care, & especially to note if there is any swelling of the papilla, seeing that there is no real swelling but only a slight mistiness such as is seen when viewing an object slightly out of focus, (Jeaffresson loc.cit) in these apparent cases of Neuritis in Hypermetropes.

It is extremely important to note that Optic Neuritis in intra-cranial disease is practically always bilateral, although one eye may be affected for a time before the other begins. It is very rare indeed
for one eye only to be affected, a single Optic Neuritis being almost certainly due to a lesion of the Optic Nerve in front of the Chiasma (Quain's Diet. Diseases of the Optic Nerve) & generally resulting from disease of the Orbit or Retina or a local affection of the trunk of the nerve e.g. Retroocular Neuritis.

Some points regarding the occurrence of Optic Neuritis in various intra-cranial diseases

**Intra-cranial tumours**

Oster (Practice of Medicine p.186) states that the very frequent association of Optic Neuritis with tumours of the Brain makes its recognition a factor of the highest importance in the diagnosis of such diseases. Swampy (p.432) says that when the Neuritis is of the intense kind (Choked disc) with signs of great obstruction to the Retinal circulation, a tumour is usually present. Taylor (Practice of Medicine) thinks that Optic Neuritis is of great value in the diagnosis of Cerebral lesions in association with other symptoms & that it at least excludes haemorrhage & embolism in which
diseases it very rarely occurs. Beevor (Diseases of the Nervous System p. 259) is of the opinion that Optic Neuritis is more likely to be caused by a rapid than a slow growing tumour, he states that the quick onset of the Neuritis & the degree of swelling are indications of the rate of growth, rather than of the size of the tumour. Berry (p. 306) quotes Gower's statement that "if the Cerebral disease be acute, the accompanying Neuritis is always acute, whereas a chronic Brain disease may set up either an Acute or Chronic Neuritis" hence a Chronic Optic Neuritis signifies a Chronic Brain disease, while an Acute Neuritis may be due either to an Acute or Chronic Brain disease. Shaw (Disq. Syst. p. 87) states that the course of the Optic Neuritis may throw light on that of the intra-cranial dis- if the Neuritis advances rapidly, the cause is probably doing the same, whereas if it subsides before reaching an advanced stage, the probability is
that the growth of the tumour has ceased. Where vomiting is a prominent symptom the Optic Neuritis is intensified by it in whatever disease it occurs in (Jeafferson, Lancet, loc. cit.). Unfortunately Optic Neuritis not uncommonly sets in at no long interval before death in cases of Cerebral tumour (Nettership p.419) & in these cases its diagnostic value would be of little use.

Optic Neuritis has no localising value & neither the position, size, or nature of the growth seem to influence the Neuritis in any considerable degree. (Quain's Dictionary, Ophthalmoscope in Medicine)

Dr. Hyphling's Jackson says that convulsions beginning unilaterally associated with double Optic Neuritis, are generally due to a Guma on the surface of the cortical area of the Brain (Taylor, Practice of Medicine p.287).

Optic Neuritis does not occur with tumours of the Corpus Callosum, nor, as a rule, with tumours of the Optic Thalami (Quain's Diet. of Tumours of the Brain).
Optic Neuritis has not been found with tumours of the Medulla Oblongata (Jackson Trans. Ophthal. Soc. vol i p.79). Probably it only occurs with tumours of the Medulla where these are sufficiently large to implicate the Pons (Taylor Pract. of Med. p.287).

Tumours of the Cortical Motor Area do not commonly cause Optic Neuritis while it is very frequent & severe in tumours of the Cerebellum (Edmonds & Lawford Trans. Ophth. Soc. vol iv p.185).

Tubercular Meningitis

Osler (Pract. of Med. p.264) states, that of 26 cases of Tubercular Meningitis studied by Garlick, in six the Optic Neuritis was of diagnostic value, while tubercles of the Choroid were present in one only of the cases (whole twenty six).

Taylor (Pract. of Med. Tubercular meningitis) says the value of Optic Neuritis in the diagnosis of Tubercular Meningitis has been somewhat diminished by the statement that it occurs in a certain proportion of cases of Typhoid fever, but that as it is
as a rule absent absent in the latter affection, he says he would still be influenced in his diagnosis by the presence of Optic Neuritis. Bristow (Pract. of Med. Tuberc. Meningitis) looks upon the occurrence of Optic Neuritis as a valuable diagnostic sign in an obscure case of Tubercular Meningitis. Beevor (loc. cit. p. 221) also looks upon the presence of Optic Neuritis as a useful help in the diagnosis of this disease, while it is said that Optic Neuritis usually occurs too late to be of diagnostic importance. (Quain's Diet. Ophthalmoscope in Med.) Shaw (Dis. of Eye p. 86) says Optic Neuritis in children is generally due to Tubercular Meningitis.

I think the value of Optic Neuritis would be greater in this disease, were one able always to make a satisfactory examination of the disc, as a slight Neuritis, which may not greatly exceed the normal, might very readily escape detection, when one is dealing with a restless or delirious child.
It is important to note that in certain cases of Bright's disease, Optic Neuritis may not only be present, but the inflammation of the papilla may be in excess of the surrounding Retinal changes so that the ophthalmoscopic appearances might readily be ascribed to Cerebral disease - the more so that it is often conjoined with headache & other evidences of Cerebral disease (Quain's Diet. Ophthalm. med), but pronounced Optic Neuritis without further Retinal Changes is in favour of Cerebral tumours while albuminuria speaks of Renal disease but does not exclude a co-existing Cerebral tumour (Taylor. p. 237; & J. Smith's Dis. Child. p. 803).

Optic Neuritis, on the other hand, due to Cerebral disease, may simulate Albuminuric Retinitis i.e. the Neuritis may be accompanied by white spots in the Retina & a stellate arrangement of white dots about the Macula Lutea - the whole producing a picture which cannot be distinguished from Albuminuric Retinitis (Gower's Diet. of Med. Dis. of Optic Nerves & Swanz. loc. cit. p. 431). One could not say
with absolute certainty, from the ophthalmoscopic appearances merely, whether the appearances changes were due to renal disease or to some intracranial affection. As a rule however, in these cases of Cerebral disease simulating renal cases, there is no albumen & the white deposits are not often arranged quite the same as in Albuminuric Retinitis while the inflammation of the disc is greater than one usually finds in renal disease (Nettleship p. 229).

Simple Anemia is sometimes associated with Optic Neuritis & the latter may even be of the intense kind & so frequently met with in tumours (Quain's dict. Ophthal. Thirce in med.) the ophthalmoscopic appearances may simulate those of intracranial growths & the simile may be carried further by the presence of head symptoms in Anemia such as headache, vertigo & which are found in cases of tumour also, but the other symptoms of Anemia & the submissiveness of the Neuritis under judicious treatment with iron serve to distinguish between them.
Optic Neuritis, sometimes of considerable degree, occasionally occurs in Lead poisoning. Beevor (Dis of Nervous System p. 394) says it occurs in the early stages of "Cerebral" cases & that when it occurs later it is then associated with renal disease.

Nettleship believes the Optic Neuritis is not due to the kidney disease induced by the lead but is due in some more direct manner to the influence of the metal (Nettleship p. 406).

Many observers on the other hand deny the existence of a specific lead neuritis & hold that it is to be referred to albuminuria, to effusion into the ventricles of the Brain or to suppression of Menstruation (Swanzy p. 436). These cases of lead poisoning with Optic Neuritis might be confounded with Cerebral tumour on account of the head symptoms which may be present such as headache, convulsions, delirium & but the blue line on the gums, the history of exposure to the metal, the intestinal colic & wrist-drop would be sufficient to point out the real nature of the case.
It is of great importance from a diagnostic point to note that Optic Neuritis may occur in cases of Mastoid suppuration where there is an entire absence of either Meningitis or abscess (Cerebral). (Brocken 10th Ed. Vol. 2. p. 583). This has been proved by post-mortem examination or by recovery after simple trephining of the Mastoid cells (Taylor's medicine, p. 279). This fact is a particularly important one to keep in mind in the diagnosis of cases of Otitis associated with double Optic Neuritis, acute head pains, pyrexia, as the case, instead of being, as one would naturally suspect, one of Meningitis or Cerebral abscess, might be due to simple suppuration of the Mastoid cells.

Hence Taylor (loc. cit.) remarks that Optic Neuritis is not conclusive evidence of Meningitis in the very cases where Meningitis is probable enough and where the importance of getting at a right diagnosis is considerable, namely in Chronic Otitis. The same reasoning would apply to in the diagnosis
of Abscess of the Brain under similar conditions namely, a Chronic Otitis, Optic Neuritis, Head symptoms, for, although Optic Neuritis is found less frequently in cases of Abscess of the Brain than in Meningitis, still it does occur in a considerable number of cases of the former disease, and one is confronted with the same difficulty as regards the differential diagnosis.

Again, as Optic Neuritis is never present in uncomplicated Oedema of the Brain while it may be present in Cerebral Abscess or Meningo-encephalitis, the Papillitis may thus help the to separate the first from the other two diseases (Trevet's Syst of Surgery, Vol. 2, p. 205).

Paralytic phenomena, associated with Optic Neuritis, does not exclusively indicate Cerebral disease seeing that they both occasionally occur in cases of Acute Myelitis, Lead poisoning etc.

Although Optic Neuritis cannot be regarded then as pathognomonic of an intra-
cranial lesion, yet its presence must often be looked upon as of great diagnostic importance when other symptoms point to such a lesion, but its absence does not negative the diagnosis where other characteristic symptoms are present, as Optic Neuritis is not invariably present in any Cerebral affection, moreover may only develop towards the termination of an illness when its diagnostic value is of little practical use.

Unfortunately, Optic Neuritis, when present, is of no value as a localising agent and very little as a differentiating one, for, although the very intense form, with signs of great obstruction to the Retinal circulation, generally indicates a Cerebral tumour, while the mere presence of the neuritis generally negatives the existence of intracranial Aneurism, haemorrhage, embolism or thrombosis, yet, as a rule, the character or course of the inflammation, gives no assistance in deciding the nature of the intracranial disease.
Some points in the diagnosis of Optic Atrophy.

Mere pallor of the disc is not sufficient for the diagnosis, thus in cases of extreme general Anemia the discs are pale & might be mistaken for cases of Atrophy. Again great pallor of the disc sometimes occurs from consolidated excuded matter after Neuritis where the latter has been completely recovered from (Bixler loc.cit. Optic Neuritis). A similar pale intransparent disc is sometimes due to the presence of Myeline in the nerve fibres of the disc (Bixler p.312), this condition may affect the whole disc & may be practically limited to it (Nettleship p.203). A white disc may also be due to a physiological excavation apparently reaching the margin of the disc all round (Swanzky p.85), while Nettleship (loc.cit. p.232) states that considerable pallor of the discs which it may be impossible to distinguish from true atrophy is sometimes seen with excellent central vision but generally with some field defect.

I think therefore that Jeafferson (Lancet 1890 p.952) is justified in saying "Few
would diagnose incipient Atrophy from an examination of the disc alone, unless the case was fairly advanced, without calling to their aid the examination of the functional activity of the eye to Form Light Colour, both Central & Peripheral. He considers that the perimeter is of as much service here as the Ophthalmoscope. I do not consider that one could diagnose a case with certainty with the Ophthalmoscope alone unless there was, besides the pallor, some diminution of the pig of the Retinal vessels & perhaps an atrophic excavation of the disc.

The Diseases causing Optic Atrophy

Double Optic Atrophy as regards causation might be placed into groups as follows:

1. Where the atrophy is the result of a Neuritis—this may be quite evident from the Ophthalmoscopic examination, but if not, Cerebral symptoms may be present or a history of such may be got leaving no doubt as to the consecutive nature of the atrophy (Nettleship p.228).

2. If none of the above are in evidence, one may find signs of Chronic Spinal disease.

3. No cause can be found—some of these are known to be & probably many of them are
Pre-ataxic i.e. ataxic symptoms develop eventually. (Hydrocephalus at a late stage often, & a tumour occasionally, cause double Optic Atrophy by pressure on the Chiasma without setting up a previous Neuritis).

The history of Cerebral disease may be misleading to one not much accustomed to the use of the Ophthalmoscope as in the following case:

Four years ago I attended a lady in Sillicolphy who was attacked by Influenza. On the second day of her illness she became delirious & within forty eight hours from the commencement of the illness she was unconscious. Dr. Cunningham of Alloa saw the patient with me & we both considered that the case was one of Inflammation of the Brain substance rather than of the Meninges on account of the symptoms being profound & depressing rather than irritative in character. We did not examine the case ophthalmoscopically. The patient eventually recovered & about a year ago I had occasion to examine her eyes when I found undoubted Optic Atrophy in her left eye, with very deficient central vision but
with little peripheral defect. The right eye was apparently quite healthy.

The fact that I had attended the patient previously for inflammation of the brain as well as the evidence at the time of the ophthalmoscopic examination of mental derangement—doubtless the result of the cerebral trouble—led me to conclude that the Optic Atrophy was the result of a Papillitis which had been present during her previous illness, but after further study of the case I found that the left eye had been defective as far back as the patient could remember, so that this statement together with the unilateral nature of the affection & the fact that there were no signs with the Ophthalmoscope pointing to a previous Papillitis compelled me to abandon my former conclusion as erroneous & to recognise that the Optic Atrophy in this case must be due to some cause, quite independent of the cerebral disease from which the patient had suffered.
Double Primary Optic Atrophy in the vast majority of cases is due undoubtedly to Chronic Spinal Diseases especially Locomotor Ataxia. Statistics vary as to the percentage. Uhthoff puts it at 83%. Nettleship found undoubted Spinal symptoms in fifty eight of a series of seventy six consecutive cases of Primary Atrophy or fully 75%. In other ten of the cases such diseases were more or less probable - this would raise the percentage to about 90% which Berry (loc.cit. p.315) thinks is not far off the mark.

Some points regarding the occurrence of Primary Optic Atrophy in various Spinal diseases. It is most important to note that Optic Atrophy in Spinal disease is nearly always double, but one eye may be affected before the other begins - the interval may be months or even years, an interval of from one to two years is not very rare (Nettleship p.236) - so that one might see the case before the second eye had become affected.

The eye symptoms in connection with Spinal
Lesions are often of importance from a diagnostic point of view, as showing the eventually slow degenerative nature of the disease, even when, as sometimes happens at the time of first examination the symptoms from the side of the cord are acute (Berry p.316).

Optic atrophy is not met with in affections of the nuclei of some of the cranial nerves & atrophic changes in the disc are not marked when due to disease in one visual centre (Berry Optic Atrophy) while, in a considerable number of cases of General Paralysis of the Insane Optic Atrophy is found, but generally in cases which are complicated by marked ataxic symptoms (Nettleship p.421). In Cerebro-Spinal Sclerosis both Optic Neuritis & Atrophy may occur but they are rare late symptoms (Bramwell Dis. of Spinal cord. p.265-7) & when the atrophy of the disc is seen in this disease, it is most frequently associated with other paralysis of cranial nerves e.g. the 6th, 7th & (Berry p.316). In Lateral Sclerosis changes in the fundus are, as a rule, absent.
Loeomotor Ataxia

Primary Optic Atrophy occurs as a symptom in probably 15% of the cases, while the proportion of cases in which Loeomotor Ataxia is the cause of the Atrophy is about 50% (Shaw Dis. of Eye p. 87). The atrophy is not the result of any extension upwards of the disease in the posterior columns. It may occur when this has hardly begun, or even years before the slightest symptom of Tabes has appeared. It is apparently an associated degeneration (Quain's Diet. Ophthalmoscope in Med). Nettleship considers that the absence of pre-atrophic amblyopia affords strong clinical evidence of the peripheral ventricle isolated nature of the degeneration which, in cases of Tabes, leads to progressive atrophy of the Optic Nerves.

Bramwell (Dis. of Spinal cord pp. 230-234) says, that, as Optic Atrophy may be the first symptom of the disease, its true character may be easily overlooked, & he thinks that Loeomotor Ataxia should always be suspected when dimness of vision & Optic Atrophy are present without any obvious cause, & further that it is particularly important to observe
the state of the Optic discs in supposed cases of Locomotor Ataxia.

Benedikt of Vienna first pointed out a remarkable antagonism between Atrophy of the disc & other symptoms of Tabes Dorsalis. (Swanzy loc. cit. p. 444).

When Optic Atrophy develops early in Locomotor Ataxia it leads to blindness, ataxia rarely, if ever supervenes. Charcot lays considerable stress on the antagonism between the ocular symptoms & the ataxia & Déjerine assured Osler (Pract. of Med. p. 742) that of the enormous tabetic material at the Bicêtre, in not a single instance in which Optic Atrophy had come on early & progressed to blindness, was the patient ataxic, although there were cases which had had the lightning pains & lesions of the Optic Nerves for twenty-five years.

Swanzy (loc. cit. p. 444) says that frequently, in these cases of early Optic Atrophy, when the blindness has advanced, the pains too become less severe, while if the amaurosis do not come on until the ataxia be well developed, no improvement in the latter is likely to be noted.

When one considers that double Optic Atrophy, -
which is not the result of a preceding Papillitis - is due in
the vast majority of cases, to the same causes which give
rise to degenerative changes in the sensory tracts of the
Brain & Spinal cord - that probably not more than 10%
of all such double Atrophies fail to be so accounted for - I
think one is justified in looking upon the presence of
these affections of the Optic Nerve, as very important symp-
toms of Chronic Diseases of the Spinal cord especially of
Locomotor Ataxia. Indeed the presence of double Optic Atrophy
with no changes in the fundus pointing to a previous Papillitis &
with a negative history of Cerebral symptoms, would lead one to search for signs of Spinal disease & even
were no such signs present, one would still be justified
I think, in suspecting Locomotor Ataxia to be the cause
of the atrophy, seeing that pre-ataxic Optic atrophy is
well known to be one of the ways in which that disease begins. Even were the atrophic changes confined to one
eye at the time of examination, the case might still
be one of atrophy preceding or accompanying Spinal
disease as an interval of months or years may separate
the onset of the disease in the two eyes.
Primary Optic Atrophy must therefore I think, be looked
upon as an important sign in the diagnosis of
Chronic Spinal disease & more especially of that form which
mainly affects the posterior columns of the cord - Locomotor Ataxia.