

THE CAUSATION AND TREATMENT OF MINERS' NYSTAGMUS

WITH NOTES ON 28 CASES.

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Thesis submitted for the M.D. Glasgow

by

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Introduction.

The particular form of Nystagmus known as Miner's Nystagmus has sprung into special prominence during the last seven years. Barely fifty years since it was first described it has become a serious factor in the economy of the mining industry and many attempts have been made to describe it's causation, prevention, and treatment. It has become very much more common during the last twenty-five years owing, in part, to the rapid extension of mining and also in my opinion to the fact that almost the whole of this extension has been in the shape of deep mines where it is necessary to work with lamps which sacrifice efficiency of illumination to safety. I hope in subsequent pages to show that the disease has become much more frequent as the use of the safety lamp has become commoner and also that it is at the present time principally met with in miners who work with lamps rather than in those who use the more effective candle.

It has been alleged that the increase dates from the time when Miner's Nystagmus was scheduled under the Workmen's Compensation Act, 1907. On this point it is permissible to state that having been in a position to observe cases since 1895, my experience is as follows: There is no increase in the actual number

of cases coming under my notice since 1907, except that increase which is proportionate to the number of men employed. The difference lies in the fact that in the pre-compensation days, men suffering from Nystagmus worked until they were compelled by the severity of the symptoms to cease. The average miner detested the thought of surface work for two reasons (1) because he did not relish the very material reduction of wages, and (2) because he did not like the climatic condition of surface work. For these reasons he persisted in working until absolutely disabled. His nystagmus came under the notice of the Colliery Surgeon, either because it had become so bad as to seriously hamper him in his work or because in consulting the doctor for some other condition the symptoms were noticed in the course of the examination. I have known scores of men who previous to 1907 alternated pit work and surface work for years owing to the presence of nystagmus which got rather worse under the former and somewhat better under the latter condition until a stage was at length reached when work of any sort became for a time impossible. The miner of the present day is, however, circumstanced quite differently. He has come to understand what the "dancing of the light" means, he knows that every day he neglects its treatment it increases in severity, decreases

his earning capacity and prejudices his early recovery. He immediately consults someone with the result that he is taken from the pit and placed under treatment.

Many more cases are therefore brought to the notice of mineowners, doctors, and ophthalmic surgeons.

Court in certain statistics prepared for the Derbyshire miners' association stated that 20% of men working in the mines of the Derbyshire coalfield had to a greater or less degree Miners' Nystagmus. These figures have been contested but from actual observation of the men's eyes while they were at work at the coal face I have no doubt that they are well within the truth.

I have personal knowledge at the present moment of many men at work in coalmines who have severe nystagmus, who refuse to leave their work, and who dread lest their masters compel them to do so. It is, therefore, neither correct nor fair to say that the Compensation Act is responsible for the enormous increase in Miners' nystagmus during the last five years. It is more correct to state that the number of cases observed and recorded has materially increased and that the disease has become one of the greatest economic importance. It is not comparable to certain other industrial diseases which involve

great risk of life to the workman, and which have demanded the attention of the State, e.g. lead poisoning in leadglazers, phosphorus poisoning; but the enormous amount of money paid by the owners in compensation to nystagmus patients and the very considerable loss to the suffering workmen in difference between wages and compensation make it a matter of the greatest national moment that the etiology, prophylaxis and treatment of this disease shall be discussed by every observer who has the opportunity of seeing numerous cases.

The fact also that conditions of work in mines as regards illumination, posture, etc. vary so greatly in different parts of the kingdom makes it essential that the experience of surgeons in those varying parts should be recorded in order that some way in the multitude of counsels should be found to lessen the tendency of the miner to this disease and to devise its effective therapeusis.

Having been acting for sixteen years as surgeon to collieries in the South Staffordshire coalfield employing 3,000 men, I have had ample material for observation and I propose to discuss in the present paper recent developments in connection with nystagmus basing the work on my own experience of cases.

Miners Nystagmus occurs only in the coal miner and

it does not appear until he has worked for some years in the pit. Precocious cases are generally severe (Pohl) Metal miners do not suffer from the disease although they perform work similar in character to the collier. (Nuel. and Romiee) It is not present in boiler makers who often work in a dim light and in cramped positions (Delantsheere) nor has any case as yet been found in persons working in photographic plate factories who are for a long time in a feeble monochromatic light or when orthochromatic plates are being made, in complete darkness. (Coppez) (Peters).

In 1872 Schroter in Germany drew attention to the disease and Alf. Graefe published his observations on several of his cases.

Snell, in 1875, first mentioned the disease in England and he subsequently wrote several monographs on the subject. Since then numerous observers have recorded cases and there have been many theories as to it's causation.

In England, Snell, Taylor, Oglesby, Sykes, and Priestly Smith, are amongst the chief of those who have written on the subject, while on the continent, Dransart, Noel, Nedin, and Watlont have been the principal observers.

Before proceeding to discuss the various theories of the causation of Miners Nystagnus I propose to set

out the recent ideas of the pathology of Nystagmus generally and the classification of the varying forms of that condition and also to describe briefly the conditions of work in mines in the South Staffordshire Coalfield.

Nystagmus is an involuntary oscillation of the eyeballs varying in character, rapidity and sweep, due to clonic spasm of the muscles of the eyeballs produced by various conditions.

Nystagmus may be classified according to the character of the oscillations or according to the conditions under which it occurs into

(1) Searching Nystagmus which occurs in congenital blindness and is slow and sweeping in character.

It is caused by loss of central fixation.

(2) Pseudo nystagmus; oscillations in a series of jerks. This occurs in Friedrichs ataxia, multiple cerebro spinal sclerosis and occasionally in normal individuals. It does not occur in the primary position of the eye but corresponds to an intentional tremor.

It is seen only when the eyes are near their limit of movement in any direction and consists of a series of jerks in which the eyes are carried beyond the point of fixation but in returning do not re-pass it.

(3) True nystagmus is divided into Horizontal, rotatory, vertical, mixed (a combination of the horizontal and vertical) and converging. Horizontal is the

most common; mixed and converging are rare. Any of these conditions may be unilateral (rarely) or dissociated.

By the second method it is classified as Congenital, Occupational, Nystagmus due to organic disease, labyrinthine, and toxic.

Congenital nystagmus is brought about by conditions which prevent entirely or in part the access of light to the retina before the child has learned to fix an image. Such conditions are, opacities of the cornea from ophthalmia neonatorum, congenital cataract, retrobulbar neuritis, haemorrhage or disease of the retina and albinism. Errors of refraction are rarely the cause. In congenital Nystagmus there is no perception of the oscillation on the part of the patients. In most cases of Nystagmus other than congenital such perception exists but not in all. The most common form of occupational nystagmus is that found among miners.

In nystagmus caused by organic nervous disease lesions have been found in the pons, cerebellum, corpora quadrigemina, peduncles and the optic thalami, i.e. a subtentorial lesion.

There are three principal theories as to the mechanism of the production of Nystagmus.

Duchenne; This observer's explanation is that in any system of antagonized muscles the retardation of

nerve impulses to one or a pair of muscles of the system will produce the phenomena of Nystagmus.

Willbrand states that there is a want of harmony between the centre for common reflex action of the eyeballs and the centres for volitional impulses.

Gower's theory is based on Sherrington's experiments. The latter observer found that after cutting off the voluntary impulse from the brain to the spinal centre by severing the cord the following phenomena occurred. The stimulations of, say, the nerves of the extensors of a joint produced an alternate extension and flexion which continued for some time. He showed that the ceasing of the first extension was due to an inhibition of the spinal centre by an afferent impulse from the opponents, by dividing the nerve of these muscles and stimulating the central end. The contraction of the extensors ceased at once. He held that the centripetal impulse was originated by the tension exerted on nerve muscle spindles of the flexors.

Gower thus applied these facts. He assumed the presence in the mid brain of a centre which combines and coordinates the action of the ocular muscles and has also a muscle reflex action. The centre controls in health the equilibrium of the antagonistic ocular muscles but its stability is easily upset by

various influences. When the balance is lost the muscle reflex action tends to commence.

Allowing the possibility of such influences being diminution of light in congenital cataract, excess of same in albinos, disease of neighbouring nerve centres in cerebrospinal sclerosis, muscular as in occupational nystagmus or labyrinthine or toxic a very reasonable hypothesis is obtained by this theory. The criticism has been made that a rapidity of three hundred and fifty oscillations per minute does not give time for complicated nerve reaction, but I submit that there are numerous reflex actions that occur with great rapidity even in health, e.g. accommodation of eye for near objects, fixing of objects in motion by eye, and accommodation of ear for variation of sound.

The movements of the ocular muscles are regulated by nervous centre of different rank (Fuchs). The lowest centres are the nuclei in the central grey matter which adjoin the ventricles, and from which the trunks of the nerves themselves arise.

The nuclei lie one beneath the other, and are connected by transverse fibres which run from the nuclei of one side to those of the other, and by longitudinal fibres which join the proximal to the distal nuclei. From the nuclei fibres extend to and from the centres for the voluntary associated movements of the eyes. The angular gyrus is believed to be the centre for

reflex or involuntary associated movements, the centres for willed movements of the eyes being situated further forward in the cortex.

It has been found that in the floor of the fourth ventricle, the nuclei of origin of those muscles which act synergetically are close together, the nuclei for the pupil, for accommodation and for convergence (internal recti); the nuclei for the superior rectus and inferior oblique (subserving elevation of the eye) and the nuclei for the inferior rectus and trochlearis (subserving depression of the eye) (Bernheimer's experiments on Monkeys Fuchs).

It has just been stated that in the nystagmus of gross nervous disease the lesion is found in the mid brain, corpora quadrigemina pons or cerebellum, and it has never been recorded as resulting from cortical disease (except indirectly by pressure) or from disease of the nuclei of the cranial nerves. It may be therefore concluded that there is a centre in the mid brain which controls the equilibration of the eyeball and that this centre must be in close association with the centres for the maintenance of equilibrium of the body.

Disease, functional or organic, which interferes with this centre or with its connection with the nuclear centres leaves the latter in a condition of instability ready to respond by reflex action to external stimuli.

A brief description of the conditions and methods of work in mines of the South Staffordshire Coalfield will now be given.

Both methods of illumination are used, the proportion of stalls lighted by safety lamps to those using candles or other naked lights being, the former 73.3% and latter 26.7%.

The underground workers may be divided into two classes (1) coal getters (2) Hauliers datallers and officials who do not actually get coal but assist in keeping the mine in working order and bringing the mineral to the pitmouth.

Of class (1) there are several subdivisions, the stallman may get the coal in various ways.

Holing. He has to remove by the direct action of the pick, the more or less thin layer of dirt or rock that lies above or below the seam of coal. If at the top, the process is called bannocking, if at the bottom the term used is under holing. To hole, the miner has to assume various positions, viz. lying on one side, sitting in the semi sartorial position with one foot extended, standing with body bent (as in the commencement of bannocking).

Rating. The men have to remove from the coal face, usually without previous holing, the coal in large lumps by the aid of a pick or dresser. In this work

the amount of constraint of position depends on the height of the roof.

The holer works in a very constrained position of body and he works very hard. Any one who has seen him at work will agree that the greatest possible muscular effort has to be put into every blow struck. The same applies in somewhat less degree to raters although there are plenty of old colliers who prefer the former work to the latter. The lamp in either case is compelled by law to be placed in a safe position and it is impossible with the lights in use for the holer to see to the depth of his work, which extends to 6ft. or more.

Loaders. These men fill the tubs or trams with the coal which they lift from the floor. This is exceedingly laborious work as the lumps of coal to be raised are very big and heavy. The men are constrained as to position by the lowness of the roof. They are better lit than the holer as they can place the light hanging on a tree or prop close to their work. They also assist in putting up timber to keep the place safe.

Datallers repair the road Hauliers, drive horses and look after passage of tubs from the coal face to the pit bottom.

Firemen or deputies explore the mineworkings for

Causation.

The theories as to the causation of Miner's Nystagmus fall naturally into two groups:

(1) Myopathic or Peripheral.

(2) Neuropathic or Central.

In any discussion of these the place of honour must be given to the work of the late Mr. Simeon Snell of Sheffield in his numerous writings on the subject, even though one may quarrell with some of his statements as to facts and differ from all his conclusions. It was he who, as it were, 'paved the way' for all the subsequent investigators.

Snell's first opinions, afterwards somewhat modified, were expressed thus, "The disease occurs chiefly, if not entirely in those colliers who are obliged to do their work in the pit whilst lying on one of their sides." (Lancet 1875, Vol. 2, p.81.)

Later, however, Mr. Snell's experience increased and he was compelled to modify that statement thus "Further experience and a fuller acquaintance with the working of coalmines has shown me that, in other workers than those working on their sides (holing), an attitude is assumed necessitating a somewhat analagous position of the head and eyes". He says also "Starting with the original discovery that the colliers who suffered were engaged in a particular kind of work, further investi-

gation has indicated that around this is to be found the prime essential cause of Miner's Nystagmus.

His explanation of the pathology was that the affection is a myopathic disease, a local affection, the result of prolonged strain in an unusual and constrained position for long and frequently recurring periods bringing about chronic fatigue and consequent atony of the ocular muscles, and as a result oscillation of the globes.

In other words, his position was that the condition necessary for the production of Miner's Nystagmus was work in such a position that the eyes were compelled to be set for long periods in an obliquely upward direction. It was "another instance of muscular disability induced by overwork and similar in this respect to writers pianist's and other occupation neuroses."

Mr. Snell adduced many cases in support of his conclusions which he adhered to without modification to the end and it cannot be gainsaid that his figures proved beyond a doubt what has been verified by subsequent experience by many observers, viz. that the disease occurs with much greater frequency in holers than in any other class of coalworkers.

Dransart, (Annales d'Oculistique 1877, Vol. 2, p. 128, 1882 Vol. 2, p. 150) who conducted in France

similar and synchronous investigations, agrees with Snell's observations and conclusions. He says "The myopathy has its principal seat in the superior rectus and inferior oblique. It occasions a weakness in these muscles. The pair of elevators not being able to overcome its antagonist by a single effort attempts it by a series of little successive and rapid contractions. This explains the vertical oscillations. The horizontal ones are explained by the impotence of the internal rectus."

Zieminski (Rec. d'Ophthalm. 1889 p.637) also supports Snell in his view that the condition is due to the miners being forced to look obliquely either to the right or left. He says that the first prime cause of the affection is the particular work that the hewers have to do in holding the coal in a stretched position of head and eyes. It would appear that Snell started with the idea firmly rooted in his mind that position was the prime cause. Hence, his original declaration that holers were alone affected. When workers of other classes, loaders, datallers, firemen and even an engine-driver were brought to him affected by the condition he was compelled to modify his data but refused to alter his conclusions. He explained their occurrence by saying that in their work they

assumed a position, as to their head and eyes, analagous to that of the holer.

But in all cases cases the sustained oblique position of the eyes is a very debatable point. Mr. Snell publishes photographs of miners in various positions as near as possible as at work. He found it impracticable to obtain photographs showing the position of the head and eyes of the miner while actually holing. He, therefore, asked certain miners to assume the ordinary position of labour in a studio and the photograph was taken.

I submit that as evidence they are worthless. Romlee accused him of having forged them. This was as unjust as it was untrue, but I certainly am of opinion that the eye position of a miner at his work and the eye position of the same man posed for the camera would be in all probability be two very different things. It is also impossible to see the position of the eyes of a holer when he is at work. I say this advisedly having been in the pit workings on numberless occasions. He is lying under or on the top of a seam of coal, the light by which your observations are made is negligible, it is quite impracticable to put your head in such a position as to observe his eyes while he is at work. The only way to get at the truth is for the observer to do half an

hour's holing himself. This was impracticable so one had recourse to fixing up a passable imitation of a "hole" with the assistance of practical colliers and with the aid of darkness, a pick, and a safety lamp trying for oneself the effect of the position upon the eyes.

My experience is that in the stretched out position, lying on the side there is the less need to look obliquely. The eyes look straight or nearly straight at the point where the pick is going to hit. If anything, there is a slight raising of the eyes but very little. In hannocking before the hole is sufficient to allow the body to lie on the coal there is an inclination of the head required and some obliquity of eyes.

In this connection there follows the fact of the presence of the condition in others than holers, a fact which Mr. Snell admitted, alleging, however, that in all such cases there is a position of the head and eyes analagous to that of holing. In the course of certain remarks made by him at a meeting of the Ophthalmological Society in reply to a paper read by Mr. T. Thompson he instances the case of a man recovered from the symptoms of Nystagnus who was able without prejudice to his eyes to work down the pit. "He had even done coalgetting (getting coal down with a pick)" that being ~~works~~ Mr. Snell implied, where no

obliquity of vision was necessary.

Now, in this district there is a seam of coal which in mining parlance "will not standing holing." It would be unsafe and unprofitable to hole it and it is got by a process called "rating". The miner with a pick or dresser levers the coal from the face without any preliminary undercutting whatever. I give in my account of cases particulars of 9 men affected who have worked for years in rating stalls (Nos. 5, 7, 13, 14, 15, 17, 20, 24, 25.) and of these 6 declare that they have never done any holing in their lives, (Nos. 7, 16, 17, 20, 24, 25). They all say, however, that the work is just as arduous and just as dangerous as holing and in fact there are many old colliers who prefer the latter.

Mr. Snell also contended that the fillers who suffered all did holing at intervals.

The following cases are quoted in contradiction of that statement.

Case No. 17. This man is a loader in a rating stall where no holing is done. He also states in terms that he has never done any holing in his life.

Case No. 24. This man has not done any holing in his life.

See also Case No. 25.

See also Case No. 9. This man had been a holer for

25 years. Three years ago he ceased holing and commenced to datall. Six months ago he became affected with Miners' Nystagmus.

(It should be stated that the cases outlined in this paper are not arbitrarily selected. They are chosen for the simple reason that they are at the present time under my observation).

Snell also supports his theory that the condition is caused by overuse of the elevators, in the following way. "In the affected miners the ocular movements are increased by raising the eyes above the horizontal line. They are stilled by lowering the eyes below the same. In fact miners seek relief by doing the latter."

See case W.B., No. 18. This man has been a holer for 35 years. He has holed principally on his side but in all positions. For 35 years he has fulfilled the conditions laid down by Mr. Snell for the production of oscillation when looking upward and obliquely upward. Yet we find that this man can only get relief from his symptoms by looking directly or obliquely upward. The moment he looks below the horizontal line his eyeballs oscillate at an enormous rate.

With these facts in my mind adduced from cases under present and constant observation I am just as convinced that position is not, as Mr. Snell ^{was} ~~says~~ that ~~is~~ is, the essential factor in the production of Miners Nystagmus.

With regard to Mr. Snell's cases of compositors suffering from occupational nystagmus in which he alleges the condition to be analagous and caused by the analagous position of the eyes of those workers it is doubtful if the nystagmoid movements observed in them were strictly comparible to true miners nystagmus.

Snell's first four cases may here be examined critically.

1. A weakly neurasthenic youth was well one day on leaving the works, next day found that "his eyes were all of a dazzling sensation, objects appeared to be moving up and down." The oxcillations were vertical and jerky with some twitching of the eyelids. The nystagmus disappeared after rest and he returned to work in two months. The essential differences between this case and a case of miners' nystagmus are as follows: The movements developed after the man had been at his work for only a few months; miners' nystagmus only appears after years of work in a pit. The movements were absent after a night's rest; miners' nystagmus often appears for the first time when the miner descends the pit at the beginning of his day's work, and rest for a day or two often makes the oscillations for a time worse. Again, the movements disappeared after two months' rest. Miners' nystagmus often takes years to cure and is sometimes incurable. The movements also were not ^lrythmical as in miners'

nystagmus but were jerky as in the pseudo nystagmus of certain organic conditions.

Snell's second case was one of asthenopia and not of nystagmus.

The third case had ciliary spasm and asthenopia due to hyperopia. All his cases were of a similar character and were conditions of asthenopia with nystagmoid movements but with no true Nystagmus. Further, if extreme elevation of the eyes for long and frequently recurring periods is alone sufficient to produce Nystagmus I should expect with Mr. Jeaffreson the condition to occur in men engaged in ceiling decoration, whitewashing and other occupations involving such a position. It is, however, not found in these men.

It might also be argued that the constant use of certain muscles would be more likely to result in their hypertrophy than in their atony and that it is just as easy to say that a nerve centre is fatigued as that a muscle is fatigued and, in this case I think, much more feasible.

The opinions of recent observers on the Position theory is of interest.

Tatham Thompson states that in the district of South Wales where his experience has been obtained, there are two seams of coal worked under very different conditions and he gives the result of his observation as follows:

In the House coal seam which is worked by holing and with naked lights Miners' Nystagnus is uncommon.

In the Steam coal which is worked without holing but with safety lamps, Miners' Nystagnus is common.

To be in any way conclusive as regards the position theory this test should be applied under equal illuminative conditions. To my mind it does, however, go far to prove the relatively greater importance of illumination over position in causation.

Jeaffreson (B.M.J. 1887 Vol. II p. 109) states that Miners' Nystagnus is common in Durham where no holing is done.

A. G. Reid of Nottingham (Miners Nystag. Brain XXIX p. 4363) records that in the Yorkshire district of Hickelton Main where no holing is done he found Miners' Nystagnus common.

Harrison Butler (Ophthal. Vol. 7, No. 8) admits that it is more common in holers but gives cases which have done no holing for years.

J. Court in the pamphlet referred to previously, attaches no importance to position although he admits the large percentage of cases in holers whole and part time. "Position has very little if anything to do with it."

H. S. Elworthy writes that the Ebbw Vale colliers work in the upright position and that hauliers,

timberers and repairers get the disease.

From these it will appear that the earlier investigators favour the myopathic theory and that more recent observers in the light of further experience and with more clinical material are inclined to consider that position is of little account and that the cause must be sought elsewhere than in the ocular muscles.

Just as the supporters of the myopathic theory pin their faith to position as the principal or only cause of Miners' Nystagmus, so some exponents of the neuro-pathic view regard illumination as the all important factor in it's causation, and the explanation of how the deficient illumination produces the phenomena are various. Snell, the greatest protagonist of the position theory refuses to attach any importance to illumination as a cause and Court who takes the antithetic position asserts that bad light is the cause and the only cause of the condition.

Court expresses this firm conviction in the following words: "Inquiry has satisfactorily convinced me that it is the want of a good light that is the only cause of the mischief." The figures which he gives in support of this statement here follow in brief.

No. of men working with safety lamps.....	524.
No. of names of Miners Nystagmus.....	164.

No. of men working with torchlight.....231.
 No. of men suffering with Miners Nystagmus
 who had always used torches..... 0.
 No. of torchlight workers suffering who
 had previously used lamps..... 6.
 No. of men working with candles.....342.
 No. of men suffering who had always used
 candles..... 3.
 No. of candle workers who had previously
 used lamps..... 23.

These figures obtained by inspection of men actually at work, confirmed by my own experience hereinafter given, are to me absolute proof that the quality of illumination is a very considerable factor in the causation of the disease. They do not however justify the extreme view that it is the one and only cause.

Nuel says, "The frequency of Miners' Nystagmus varies in inverse ratio to the illumination of the mine."

Harrison Butler states, "There is no doubt that Miners' Nystagmus is far more common in safety lamp mines than in candle mines."

Romée of Liege says that the incidence of Miners' Nystagmus in Belgium where the Muessler lamp (44 C.P.) is used is greater than in Germany where the Westphalian lamp (.66 C.P.) is used. He also states that the introduction of the Wolf lamp (.87 C.P.) into certain

mines has reduced the amount of Miners Nystagmus by 50%.

The mines in this district (part of the Cannock Chase area) have both methods of illumination in common use. Each pit has it's candle stalls and it's lamp stalls.

I am not permitted to give actual figures as to number of miners suffering from Nystagmus but it is sufficient to say that the proportion of miners working in lamplit stalls is 73.3%. Of the cases of Nystagmus under compensation during the last two years these stalls provided 94%.

In the cases recorded by me in this paper there is not a single case of a man who has worked entirely with naked lights. On the other hand, there are one or two which invite comment.

Case No. 20. The man had no trouble with his eyes until he began to work with lamps eight years ago.

Case No. 21. This miner worked with lamps and candles alternately until eight months ago when he had to work entirely with the former. He immediately began to be affected and in a short time got so bad as to be incapacitated.

Case No. 23. He worked with candles till four years ago. At that time an explosion occurred and to conform with the Mines regulation act the district was put on lamps. He became affected with the condition

two years ago. This man is 52 years old. He worked with candles for thirty-six years without trouble, four years of lamps was sufficient to disable him.

Case No. 24. A.Y. worked with candles for nineteen years. He had an illness and was absent for sixteen weeks (pneumonia). On his return he was sent to a fresh job in a lamp lit district, and developed the condition in a few months. The influence of the illness on commencement of the symptoms will be considered later.

In this connection it may also be stated that the increase in the incidence of Nystagmus of the last thirty years has been parallel with the increase in the number of deep mines where the difficulty of ventilation and the presence of gas makes the use of lamps necessary.

The difference in the respective illuminating powers of the lamp and candles is considerable.

Taking standard candle as unit the candle in common use in this district is .58 C.P. *The usual lamp is .5 C.P.*

This difference is considerably increased in several ways, (1) by the deposit of dust outside and soot inside the glass chimney, (2) the shadow cast by the heavy bonnet of the lamp, (3) the fact that the miner is compelled to place his safety lamp out of the reach of his pick. He puts his candle where he likes.

Snell's reiterated contention that Miners' Nystagmus occurs in men working with candles and that miners already affected received no benefit on being removed to candle mines is not germane to the point. One is not concerned to argue that the candle is an efficient light, but that the worse the light whatever it be, the more the Nystagmus, and that therefore illumination is a considerable factor in it's causation.

Nuel's Theory.

In the pages devoted to the classification of Nystagmus is mentioned congenital or infantile Nystagmus.

To produce Nystagmus in infancy it is necessary for certain influences to prevent the formation, on either macula, of images which are clearer and more capable of accurate perception than those formed on other parts of the retina. At the age of a few weeks, differentiation of retinal perception takes place; after which the child learns that by fixing the macula upon the object of vision it gets a much clearer image. The differentiation at this age is very slight but the macula is already actually the most acutely perceptive part of the retina and the centres have learned to fix the eyeballs in such a position that the image may fall on these spots.

Retro bulbar inflammation of the optic nerve, possibly so slight as to involve only the central fibres, choroido-retinitis involving the macula, severe

congenital cataracts and corneal opacities, the result of ophthalmia neonatorum may prevent the formation of retinal images.

The miner works in a very bad light. He is constantly gazing at unrelieved black, sometimes dead black and sometimes bright. According to Nuel he sees, under these conditions, not with his cones but with his rods and these are in greatly diminished numbers at the macula, so much so that the visual acuity of the rods is at a maximum in a band surrounding the fovea at a distance of from 15 to 20 degrees from it. In this ring the visual acuity is everywhere of the same value. In a good light we fix with the fovea but in the defective lights of the mine the miner can fix at any point on this perifoveal ring. He has no retinal directing point and the necessity for accurate central fixation is absent.

Nuel with Reid contends that these conditions are analagous to the conditions producing Infantile Nystagmus before the specialization of the macula. Are they analagous? The infant has not learned to fix objects. The miner has. People who have become blind in adult life or after learning to fix, do not get nystagmus. There must be a point in the gradually darkening process that occurs in certain conditions, producing total blindness in adults, when the amount of light admitted is the same as that of a miner in a dark pit. Then why no true nystagmus in the

latter?

Peters Theory.

He has "heard" that an incipient attack may be warded off by holding the head backward. The reason for this is obvious. The man gets relief not because his head is held back, but because holding his head back makes him carry his eyes below the central point which in most cases, steadies the eyes.

Case No. 18. already referred to. This man, of course, gets relief by holding his head forward for the converse reason. Peters asserts also that certain stimulations of the semi-circular canals will produce nystagmus and incoordination of muscular action in the body by action on the equilibration centres.

The experiments of Barany will throw some light on this point. That observer conducted some experiments by stimulating the semi-circular canals in two ways. He acted on the horizontal canals by the rotary test, twisting the subject round and round with the head erect. ^{He affected superior canals by the Caloric Test i.e. by pouring hot or cold water into the ears.} He found that the former produced horizontal nystagmus and the latter (with hot water) vertical nystagmus. Cold water used instead of hot affected both horizontal and superior. The Nystagmus, however, was not at all like the ordinary Nystagmus. It consisted, not of regular oscillatory movements, but of two movements, a quick and a slow component, the nystagmus being increased by the patient

directing his eyes towards the quick component and diminished or stopped by the opposite. The two conditions are not, therefore, in any way analagous as Peters would persuade us and I cannot admit that Miners' Nystagmus is in any way of aural origin.

Bell Taylor's Theory.

This observer agrees with Snell in considering the condition to be a purely muscular one. As this point of view has already been discussed, and will be further referred to, it will suffice here to quote Dr. Taylor's description in his own words.

He says "It is analagous to that rare condition known as auctioneers spasm or to writers, cramp, or to a similar affection of gastrocnemic muscles observed in ballet dancers who run and pirouette on tip toe, until they are attacked by cramp, spasm and uncontrollable motions whenever they attempt to dance at all." (B.M.J.1887, vol. 2, p. 483.)

Oglesby's Theory.

This observer believes Nystagmus to be induced in the miner by venous engorgement of the medulla.

Jeaffreson's Theory.

Curiously enough, this observer believes it is caused by anaemia of that part of the brain. The latter's explanation of his theory is very ingenious. His argument is that the miner in the posture assumed at work, holds his head in such a position as to inter-

ferre with the supply of blood to the base of the brain.

"The position in which the miner works is one which produces a condition of cerebral anaemia generally, but chiefly of those parts which derive their supply from the basilar arteries. This area comprises the posterior or occipital lobes which, by consent of the most competent localists, are now recognised as the highest visual centres."

One would object to this that all miners do not work in the position described by Jeaffreson and also that there are other classes of workers who stimulate this position who do not get occupational nystagmus. The latest ideas of the blood supply of the brain are of interest in this connection. The brain vessels are not supplied with vaso motor nerves. Intra cranial space is invariable and any alteration in the supply takes place in this way: The arteries are enlarged at the expense of the veins by a general vaso-constriction taking place in the body and the rate of flow through the cerebral arteries being increased. In sleep when arterial tension through the body is lowered the rate of flow is decreased. In brain work when an extra supply is needed it is procured by a general vaso-constriction. In arduous bodily labour there is a vaso dilator action in many of the muscles of the body and it might possibly be conceived that a resulting lessening of the flow of blood through the intracranial

arteries takes place. That the anaemia thus resulting or produced in the way that Jefferson describes is sufficient to bring about the phenomena of Nystagmus is hardly believable. A general anaemia or even an anaemia produced by compression of the basillar arteries would produce effects upon other centres, for example there would be involved the central nuclei of the other cranial nerves producing spasm of the eyelids, spasm of the tongue, and of the muscles of the face generally and these results would be the rule instead of the exception. The centres for heart and respiration would be affected producing syncope and possibly Cheyne Stokes Respiration. One would expect also if this theory were true, to find nystagmus after an attack of syncope. As a matter of fact, this is never seen. As will be seen in the section on Innervation all these centres are in juxta position and anaemia produced in any way could not be selective so as to seriously affect some and leave others alone.

Summary and Conclusions.

In endeavouring to find an explanation of the phenomena of Miners' Nystagmus which is reasonable, and which will account for all the facts, it is necessary to assume the existence, in the mid-brain, of a central coordinating mechanism.

As a matter of fact, our knowledge of the function of many portions of the brain is very incomplete and are, for the most part, a matter of speculation and analogy. It must, therefore, be understood that the use of certain expressions such as "disturbance of the coordinating centres" is based on certain assumptions which, although they are feasible are at present incapable of direct proof.

I submit that the Nystagmus of Miners is brought about by a central failure and I believe that there are two main factors in the production of this centre, failure, each of which is a necessary complement of the other. I place them in what I consider to be their order of importance.

(1) Frequent and long sustained effort at a laborious and a most nerve racking occupation, producing a condition of general nervous instability.

(2) Defective illumination, producing a disturbing effect upon the centres governing ALL the external ocular muscles by the condition of high tension in

which it causes all those muscles to be kept.

The miner when at work is for long periods at a time in a condition of the greatest muscular and nervous tension. He is always in a more or less cramped position surrounded by dangers which keep the nervous system in a state of hypertension, conscious or subconscious. He is breathing air deficient in oxygen. When after long continued effort he is, frequently, to be seen in a condition of general muscular tremor.

he rises and stretches out his body as far as the low roof will allow.

He has been staring at a black surface quite close to his eyes. He has been straining his ciliary muscle in attempting to sharpen the dark objects in his view. The external ocular muscles are strained in converging to focus for near objects, they are in a constant state of activity in throwing the eyes about in the way all miners may be seen to do, in all directions, and they participate in the general results of the physical efforts. Thus the general muscular strain at which he works, throwing every ounce of energy which he possesses into his labour, all his nerve capacity into every blow, involves every muscle of the body including the external ocular muscles which are subjected to the additional strain produced in the manner described by defective light; all the co-ordinating centres are as it were in a state of exaltation, a condition of instability.

The co-ordinating centre which governs the extremely complex movement of the antagonistic ocular muscles (the most complex and therefore the most easily disturbed system of antagonistic muscles in the body) participates in the general disturbance and in consequence of it's complexity and delicacy, sooner or later fails to return to it's balance and remains disturbed when the nervous and muscular strain has ceased and the other muscle governing centres have recovered their equilibrium.

In certain bad cases of Miners' Nystagmus (as Snell also found) there are tremors of the muscles of the face and neck showing that the disturbance of co-ordination has been so great as to leave permanent loss of equilibrium in the more stable centres.

That Nystagmus can be produced by nervous exhaustion alone is proved by the condition occurring in epileptics after an attack. After the clonic spasms in a severe seizure, when the nerve centres must be in a state of extreme fatigue, there can be observed a distinct nystagmus. This, I think bears out the contention, to some extent, that Nerve exhaustion is a factor in the production of Miners' Nystagmus.

There is also the fact that ^{but} ~~de~~ liberating conditions predispose to the disease and at times actually determine an attack.

Snell and all other observers are agreed that

debilitating influences may have some effect in predisposing to an attack of Nystagmus. This is certainly one of the first points that occurred to me when I began, 16 years ago, to notice the disease. Time after time I have known men who were absolutely free from any obvious signs of Nystagmus, begin to be troubled with the oscillations when they were laid aside by illness or accident and had not seen a mine for weeks. It is common enough to find a man, returning to work after an illness or injury, almost immediately, notice the symptoms. As an illustration of the former take Case No. 1. This man has been ill for some time with gastric catarrh. He declares that he only gets oscillations at all when his stomach symptoms are worse. He has not worked down a pit on account of his illness for six months.

As examples of the predisposing effects of injury and accident there are several instances in my account of cases, e.g., No. 5. Head Injury, No. 6. Severe injury involving General shock, No. 7. Injured knee and influenza synchronously, No. 8. Septic cellulitis of hand, No. 9. Injury to the eye, No. 11. Conjunctivitis, No. 13. Pleurisy with effusion, No. 14. Uraemic poisoning with Bright's Disease No. 15. Influenza, No. 17. want of proper sleep for a long period, No. 18. Alcoholic excess, No. 19. acute rheumatism.

No. 21. Impure air while at work, No. 22. Injury to hand, No. 23. Fractured ribs, No. 24. Pneumonia, No. 26. Amputation of fingers following injuries, No. 27. Boils with general debility, No. 28. Enteric fever.

Thus, in the 28 cases quoted in this paper there are 19 where there existed definite debilitating influences immediately or almost immediately preceding the onset of the symptoms. Anything which lowers the general health appear to predispose to the condition. Hokers who work harder than any other class of coal miners are more subject to the condition. Hauliers who work least hard, rarely affected. Firemen who have been known to suffer from the condition (but rarely) are subject to a great amount of worry and responsibility and have to peer into all the dark corners with the light lowered, to test for gas. Any one who is acquainted with the conditions of mining work knows that these men, although they are said to have less arduous work, have to descend the mine an hour before the bulk of men and they rush round a big district, at high speed, returning to the pit bottom exhausted, perspiring profusely, to stand, while the rank and file pass, in a biting draught.

The deficiency of Ventilation is a contributing factor as it acts, not only by decreasing in efficiency of illumination but also by lowering the vitality of the individual.

The effect of alcohol is interesting in this connection, I have several cases upon which I have been able to conduct numerous experiments concerning this. The temporary effect of a dose of alcohol is in many cases to cause all oscillations to cease. I can often accuse these men of having had an early morning drink with absolute certainty. When the stimulating effect has passed off, however, the oscillations are worse. In case No. 18, this is seen to a remarkable degree. The man's Nystagmus is very marked. The oscillations are very rapid and when he looks downward they are so bad as to render him to all intents and purposes blind. Give him a pint of ale and in 10 minutes all traces of oscillation have disappeared. Examine him two hours after, his objective symptoms are as bad as ever and his subjective ones are worse.

These two factors (frequent and long sustained effort) and ^{deficient} illumination will satisfactorily explain the causation of every case of Miners' Nystagmus.

All miners who get Nystagmus do not swing picks (Reid).

All miners who get Nystagmus do not ~~sit~~ work with the head on one side.

All miners who get Nystagmus do not work in the lateral recumbent position.

All miners who get Nystagmus do not sit on their haunches (Jeaffreson).

All miners who get Nystagmus do not work with lamps (Court), but they all without exception work more or less hard, at a hazardous and dangerous trade at high muscular and nervous tension and in a bad light.

Symptoms of Miners' Nystagmus.

The first sign according to my experience is that the affected man does not look straight at one on entering a well lit room or when met at the pit mouth after ascending the mine. Snell mentions that he holds his head on one side. In my experience this is only so in severe cases but in milder cases one notices that he rotates his head and looks sideways, not obliquely up or down.

If one meets the men under the condition above mentioned, viz. at the pit mouth, every man who looks so, will be found on examination to have Nystagmus in greater or less degree.

The eyes on inspection will be seen to be oscillating more or less quickly. Usually both eyes oscillate at the same speed and in the same way (bilateral) occasionally the eyes will be seen to differ as to the character, speed and amplitude of the oscillations (dissociated) rarely one eye only oscillates (unilateral). The movements may be horizontal, vertical, rotatory, or mixed, the former being much more and the third, next frequent. The ocular movements may

be induced or, if already present, increased in several ways.

By (usually) causing the miner to raise the eyes above the horizon.

By (rarely) causing the man to lower his eyes below the horizon, See Case No. 18.

By lowering the man's head between the observer's hands with closed eyes, rotating head from side to side, and then quickly raising the head, causing the patient to open the eyes and to quickly look upwards. I have found that this method will produce oscillations when, in slight cases, no other will do so.

By putting the patient in the dark room for a time.

By causing the man to exert himself in any way by merely bending or assuming the position of work (in severe cases) or by greater physical exertion such as digging in the garden, running for 200 yards (in slight or recovering cases), see case No. 20. where oscillations were produced after some months freedom while running for the doctor.

Associated with the ocular movements, will be seen in some bad cases, quivering movements of the eyelids and trembling of the hands, head, muscles of the face and head (very occasionally) and incomplete ptosis (very rarely).

Visual acuity is usually normal.

Errors of refraction are commonly present usually hyper-metropic. Many authors including Nuel Court and Dransart have said that haemeralopia is a symptom of the disease, Court found 127 out of 164 with this symptom. Dransart found 5% only. Romiee states that in several thousand cases he has not found one example of hemeralopia. According to my experience Dransart is more correct than the others. One occasionally sees a case where night blindness is present, but as a rule visual acuity is quite normal when the eyes are at rest. Courts figures are probably based on the statements of colliers suffering from Nystagmus who when asked if they see well in the dark, invariably answer in the negative. Their inability to see in the dark is not, however, the result of hemeralopia but is due to the fact that in the dark the oscillation of the eyeballs are induced and "everything dazzles."

It may be necessary in slight cases to use the ophthalmoscope to detect the oscillations. The projected light induces them, and one is able to appreciate the very slightest by watching the retinal vessels.

The subjective symptoms are as follows:

The patient complains of seeing very badly in the pit or on coming out of the pit at night. He cannot hit the wedge with the hammer. He stumbles against

things which he was formerly able to avoid. The lights oscillate before his eyes or dazzle. The dancing of the lights is usually accompanied by giddiness, but there is no inclination to vomit. Movement aggravates the symptoms. He cannot identify anyone as he walks. He has to stop still for a moment and steady himself. Headache is common.

Elworthy and Tomlin respectively give the average age at which the condition occurs, at $35\frac{1}{2}$ and $39\frac{1}{2}$ respectively. For my part I cannot see the slightest utility in averaging age. If one found that most cases were say, men over 60, there would be some good purpose served, but Miners' Nystagmus occurs at all ages and calculating averages gives no information and leads to nothing except possibly wrong conclusions.

Prophylaxis is of the greatest importance in this condition. I feel convinced that with suitable arrangements we can prevent such large numbers of miners acquiring this disease as do at present, and also prevent those who have the disease in slight degree, from getting so bad as to be incapacitated.

It is the consensus of opinion that the first thing to be done is to improve the illumination of the pit. (The Home Office has, during the last month, realised the importance of this reform and

the medical advisers of the Government are at present engaged in investigations with a view to improve the illumination of mines. (British Medical Journal, April 1912).). The men themselves recognise this and are anxious for improved lamps. In certain parts of Australia there is a regulation in force, set forth in the judgement of the court of arbitration, that no lamp shall be supplied to any miner that is of less than 5 C.P. unless an extra amount of $1\frac{1}{2}$ per ton be paid for getting the coal. In America and Australia (I have interviewed numerous miners from both of these continents) the lamps are much better than in this country, and I am assured that the incidence of Miners' Nystagmus is less. I have written for, but have been unfortunately unable to obtain in time for the purposes of this paper, the actual figures as to C.P. and as far as possible the proportion of men suffering from the disorder.

The lamps should be at least 2 C.P., (anything above this is impracticable,) when clean. They should be very thoroughly cleansed and the wicks attended to after every time they are used. The oil provided should be of the very best quality. If possible a fresh lamp should be given to every miner who is engaged at the coal face, at half day time.

Many colliery lamp houses are insufficiently

staffed and not efficiently supervised. What should be one of the most important parts of the works is frequently grossly neglected and often, after a short day's work, and on the night shift, lamps are served out that have been perfunctorily filled and never cleaned at all.

The lamps should be provided with a shield so that one man in following another in or out of the workings may not be dazzled by his predecessor's lamp.

The men should be periodically inspected by the colliery surgeon. Only those engaged in actual arduous work at the coal face need be examined.

The man who blinks on coming to the light or who exhibits the curious sideway look described in a previous section should be carefully examined.

If he have Miners' Nystagmus badly he should be at once taken from the pit and treated as herein-after described.

If he is not a bad case, but has obvious ocular oscillations under one of the various tests described, he should be treated for his general condition, immediately given work involving less eye strain, less worry and less muscular and nervous tension. This need not necessarily be out of the pit. He need not cease work he is best at work.

When no obvious eye tremor is seen he should be examined by the aid of the ophthalmoscope, in order to detect the slight movements which indicate the commencements of the mischief. These should have their labour to some extent lightened, less RESPONSIBLE work and the best light possible.

The man who comes for treatment when he has nystagmus badly is a heart breaking proposition. Elworthy gives four or five months as a common length of time for recovery to take place. I regret to say that my experience is not so fortunate as his, I find that many cases take years to recover and recur at the least return to the old conditions.

Strychnine and Potassium Bromide are the only drugs that I have found of any service. Iron has been found to give results by some observers and Quinine has also been given. The following are necessary concomitants:

Fresh air and exercise,

Total abstinence from alcohol,

Stoppage of smoking,

Freedom from excitements of over-exertion,

Errors of refraction should be corrected

APPENDIX.

List of 28 Cases of Miners' Nystagmus.

Case I.

H.B. aged 40, worked in mine for 25 years as a dataller and road repairer. Six months ago became ill with Gastritis and has never been able to work in the mine since. He notices a definite though slight oscillation of the eyeballs whenever his stomach symptoms are worse. He is neurotic.

Slight lateral nystagmus seen with the naked eye only once out of fourteen successive daily examinations.

Case II.

D.D. aged 54, worked in pit 45 years, mostly with lamps, not with candles for 1 month before date of symptoms.

Nature of work, bannocking. This man never has to assume the lateral recumbent posture.

Usual symptoms, Rotatory Nystagmus.

Case III.

G.G. aged 57, worked in pit 45 years, lamps; last 20 years.

Nature of work, bannocking. This man, however, has to do some holing where he had to assume the

lateral recumbent posture. He has been under treatment fifteen months and has still bad Nystagmus. Usual Symptoms, Rotatory Nystagmus.

Case IV.

W.D. aged 32, worked in pit 19 years, lamps for greater part of time and with lamps continuously for last 2½ years.

Nature of work, bannocking. When hole is far enough under he gets into the lateral recumbent position.

Usual symptoms, Lateral Nystagmus, very rapid.

Case VI

E.A. aged 55, worked in pit 45 years, last 20 years entirely with lamps. Nature of work, he is in a rating stall and never has to do any holing at all, has done none for 10 years.

Onset of symptoms, two years ago immediately following an injury to hand sustained in the work.

Usual symptoms, Lateral Nystagmus.

Case VI.

J.B. aged 40, worked in pit 27 years, lamps for last 10 years with exception of a period of 10 months, two years ago. Nature of work, bannocking; never had to lie down.

Onset of symptoms, had a severe injury involving three weeks in bed, in which I attended him. There

was no obvious Nystagmus then. Immediately he commenced work oscillations of the eyeballs began.

Usual symptoms, Lateral Nystagmus.

N.B. This man has worked for some years in mines of North America. He states that he had to work very much longer hours there (in non-union mines) but that the lamps were very much better. He never saw any lamps in this country to equal them. (I am endeavouring to get particulars of these lamps from address supplied by him).

Case VII.

G.H.C. aged 26 years, worked in pit 13 years, lamps for last ten.

Nature of work. Is in a rating stall. Has never had to do any holing in his life.

onset of symptoms. Nine months ago had an injured knee and influenza simultaneously. Noticed a week after returning to work "the dazzling of the lights."

Usual symptoms. Slight lateral Nystagmus.

Case VIII.

J.P. aged 40, worked in pit for 24 years, lamps for eighteen.

Nature of work. Is a holer; undercutting.

Onset of symptoms. Three years ago had sciatica, two years ago had septic hand, is somewhat indefinite

as to when he first noticed the symptoms, but says it was two or three years ago, and that it has rapidly got worse.

Usual symptoms. Rotatory Nystagmus.

Case IX.

A.B. aged 62 years, worked in pit 56 years, for last 25 years with lamps.

Nature of work. Has been a holer for 35 years during which time he declares he never had a symptom of Nystagmus. He became a dataller three years ago. He had a blow on the eye in September last and immediately after noticed the dazzling of the lights.

There is no doubt that up to quite recently this man had no trouble with his eyes as I know him to be the most successful poacher of the district within the last twelve months, and an excellent shot.

Usual symptoms. Lateral Nystagmus, very rapid.

Case X.

J.M. aged 33, worked in pit 21 years invariably with lamps.

Nature of work. Heave up doggie, i.e. a haulier who has to keep the endless rope running, restore derailed trams, keep drivers and boys in order, a very hustling occupation.

Onset of symptoms. December 31st last.

Usual symptoms. Slight Rotatory Nystagmus.

Case XI.

T.C. aged 45, worked in pit 35 years, last 20 with lamps.

Nature of work. A fireman or deputy for last 15 years.

Onset of symptoms. Two and a half years ago had an attack of conjunctivitis, after which he found the lights began to dazzle.

Usual symptoms. Lateral Nystagmus (slight).

Case XII.

J.P. aged 55 years, worked in pit 41 years, with all kinds of lights, for last four years with lamps only.

Nature of work. Bannocking, does not have to lie down.

Onset of Symptoms. Has had no illness first noticed the symptoms three months ago.

Usual signs. Lateral Nystagmus.

Case XIII.

J.J. aged 41 years, worked in pit for 27 years, lamps for last 17 years.

Nature of work. Rating, no holing whatever.

Onset of symptoms. This man never had any symptoms until he had an attack of pleurisy with effusion six months ago.

Ordinary symptoms, lateral Nystagmus.

Case XIV.

W.B. aged 55, worked in pit for four years mostly with naked light but for last two years with lamps.

Nature of work. Rating, no holing.

Onset of symptoms. Up till two years ago had no symptoms. At that time he had acute Brights and uraemic poisoning. When he started to work after recovery the usual symptoms of Nystagmus appeared. Lateral Nystagmus.

Case XV.

W.P. aged 38 years, worked in mine, 25 years for last 17 with lamps.

Nature of work. Rating, has done no holing for ten years.

Onset of Symptoms. Had a severe attack of influenza eleven months ago, first noticed symptoms six months ago.

Usual Symptoms. Rotatory Nystagmus.

Case XVI.

W.J.D. aged 30 years, worked in pit 19 years always with lamps.

Nature of work. Loader, never done any holing or coal getting in his life.

Onset of symptoms. He had no debilitating illness. First noticed symptoms twelve months ago.

Usual signs. Lateral Nystagmus.

Case XVII.

F.P. aged 24 years, worked in mine 11 years, all the time with lamps.

Nature of work. Loader in a rating stall, where no

holing whatever is done. He has never done any holing in his life.

Onset of symptoms. In the earlier part of the winter both his children had whooping cough and he got very little rest. He noticed the symptoms first about six weeks ago. (February 1912).

Usual symptoms. Lateral Nystagmus.

Case XVIII.

W.B. aged 55 years, worked with lamps for last 17 years.

Nature of work. Has been a holer for 30 years, has worked in all positions, but mainly in the lateral recumbent position.

Onset of symptoms. Three years ago first noticed that oscillation of objects was taking place. Had been "on the beer" for some months, having nine gallons every ^{week} Monday, which he drank himself in addition to sundry odd drinks at various times on his way from work and at night.

This man has all the usual signs and symptoms with one important exception. The only position in which he can steady his eyes is in raising them directly or obliquely upwards. The oscillations are induced the moment he looks downwards.

Usual Symptoms. Rotatory and very rapid.

Case XIX.

S.R. aged 53 years, worked in mine for 44 years,

with all kinds of lights for last three years with safety lamps.

Nature of work. Holing in all positions, lying, sitting, and standing, also practical man at all kinds of pit work.

Onset of symptoms. States that he has never noticed any oscillations of objects in his life, until within the last three months. He has done no work for four months as he is at present recovering from a severe attack of acute rheumatism with endocarditis, and it is while attending him for this condition that I have observed that he has pronounced Nystagmus.

Usual symptoms. Lateral Nystagmus.

Case XX.

S.D. aged 30, worked in pit for 17 years, lamps for last eight years.

Nature of work. Rating. Never did any holing in his life.

Onset of symptoms. Had no debilitating condition, first noticed them two years ago.

Usual symptoms. Lateral Nystagmus.

N.B. This man has been at play for eighteen months. His master will not allow him to descend the pit until he has been well for some time. He has had no oscillations whatever for two months until one day when he was sent by a neighbour at 5 a.m. to get the

doctor. He ran all the way and on arrival at the doctor's he had distinct and obvious Nystagmus.

Case XXI.

J.D. aged 28 years, worked in mine 8 years with lamps and candles, for at least 8 months entirely with lamps.

Nature of work. Bannocking. No work in the lateral recumbent position.

Onset of symptoms. Had none until six months ago. He was put into a fresh stall about ten months ago, where the air was very bad.

Right eye Horizontal rapid.

Left eye rotatory Slow. (Dissociated).

Case XXII.

J.C. aged 38 years, worked in mine 24 years with lamps for last 10 years.

Nature of work. Coal hewer, mostly undercutting, sitting and lateral recumbent position.

Onset of symptoms. These followed a severe injury to the hand sustained two years ago. Oscillations commenced soon after starting to work.

Usual symptoms. Horizontal Nystagmus.

Case XXIII.

W.R. aged 52 years, worked in mine 40 years. Up till four years ago always worked with candles, until there was an explosion and the district was "put ^{on} ~~in~~ lamps" and has worked with lamps ever since.

Nature of work. Holer mostly undercutting.

Onset of symptoms. On Christmas 1910 fell on a chair and broke two ribs, first noticed oscillations eight months ago.

Usual symptoms. Vertical Nystagmus Bilateral.

Considerable muscular tremor of the face and lids.

Case XXIV.

A.Y. aged 34 years, worked in mine for 21 years. Up to 1910 always with candles.

Nature of work. Rating, never done any holing in his life.

Onset of symptoms. In 1910 had pneumonia which incapacitated him for sixteen weeks. When he started he was put to "rate" in a lamp stall and noticed the first symptoms two weeks later.

Usual symptoms. Rotatory Nystagmus.

Case XXV.

A.I. aged 30, worked in mine for 15 years with lamps always.

Nature of occupation. Loader in rating stall, never done any holing in his life.

Onset of symptoms. Twelve months ago had severe injury to hand, necessitating amputation of two fingers. Noticed nystagmus on his return to work.

Usual symptoms. Horizontal Nystagmus.

Case XXVI.

N.C. aged 32 worked in pit 20 years.

Nature of work. Stalling in a holing stall had to do holing frequently.

Onset of symptoms. Had an injury to back which disabled him for five weeks. Some months after he noticed the dazzling of the lights. He was at play for seven months and went back to work with definite Nystagmus still present. He was put to work at my request in a candle lit stall at holing, but in an easy place. He has continued to work without intermission and his oscillations have gradually got less until they are now only seen with the ophthalmoscope.

Usual symptoms. Lateral Nystagmus.

Case XXVII.

W.P. aged 39, worked in pit 28 years.

Nature of work. Staller in holing stall.

Onset of symptoms. Bad boils with general debility, followed by Nystagmus, noticed four months after.

This man, like Case No. 26, was sent to work with well defined nystagmus in an easy stall to do bottom holing (lateral recumbent position) and he has improved ever since. He is, however, in a candle lit place.

Usual symptoms. Rotatory Nystagmus.

Case XXVIII.

R.E. aged 34, worked in pit 21 years, nearly all the time with lamps.

Nature of work. Loader and driver. Never did

any holing in his life.

Onset of symptoms. Had typhoid fever about two years ago and when he started work, symptoms of nystagmus developed. He has never played. He has, on my recommendation, been put on a job at looking after the ropes of the main road. He is better after one year at this, but is still troubled with oscillations at times, especially when he feels out of sorts.

Usual symptoms. Vertical Nystagmus.

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Hauliers.



Drilling.



Bannocking or top-holing—1st Stage.



Bannocking or top-holing—2nd Stage.



Datalling (Timber Drawing).



Man on left of picture is raking.
Man on right is loading.



Bottom-Holing—1st Stage.



Bottom-Holing—2nd Stage.