I hereby certify that this thesis was written by me, and that it is original, and that the conclusions were arrived at, from personal observation and visits paid to the pits, and that no book was consulted further than the articles referred to, in this paper.

The description of the pits, method of working, position of miner, at work, lamps etc, is also from personal observation, verified by colliery officials and reference to the following books, Practical Coal mining by Cockie, Coal mining by Peel and Coal mining by Henry Davies, from which some of the illustrations are taken.

John Jones, M.B., Ch.B.
Hendre, Shergele.

I was unable to send this in before, having only passed my B.C. last year.
Miners Hystagmus.

Its

Etiology, Pathology,

Symptoms and Treatment.
The following paper is a report of my experience of Miners Hystagmus, during some years practice in a large Colliery District in South Wales. My attention was first drawn to this subject in 1890, owing to its frequency amongst the miners, and the controversy amongst Medical Men as regards its causation.

I paid particular attention to this subject, and in order to thoroughly understand it, I paid a great many visits to the pits, in order to see the method of working, position of miners at work, lighting, ventilation, etc, and adopted the positions myself and worked for many hours on many occasions in various parts of the pit. I also made extensive inquiries among Agents, Colliery Managers, Friends, and the Colliers themselves. It became known amongst the Colliers that I was interested in this disease, and having written to several Medical Friends in the vicinity for permission to see any cases of this disease which they met.
with, I was thus enabled to see a great many more cases than I would otherwise have had the opportunity of seeing.

**History.**

The earliest mention of this disease is made by Decordié in the year 1861, in a paper which was published in the Archives of the Belgian Academy of Medicine. It is a paper dealing with dysstagnus generally, and in it he refers to two cases occurring in miners, which had come under his notice. He thought that alcoholic excesses and anaemia were the causes of this disease.

Since then the subject has attracted considerable attention and has been investigated by many medical men, more especially by Bieden in Germany, Swell in England, and Drausart in France.

**Symptoms.**

One of the first things which attracted my attention in a miner suffering from well-marked
Hystagmus, was the peculiar way in which he entered the Consulting Room.

The head was thrown back, and slightly flexed to one side, and the eyes looking below the horizontal line. I had often noticed some of the miners when on the street, walking in this peculiar way, and wondered what could be the cause of it.

One day a patient walked in, in this peculiar way.

This was the first patient who came to consult me for Hystagmus.

On asking him the reason for the peculiar way he held his head, he informed me, that he could see better in that position, and that it gave the eyes relief.

This is generally taken advantage of, by a collier suffering from this disease, when at work, he gets on his knees, and looks downwards and experiences great relief.

On asking the patient what he is complaining of, the answer generally is, that he can't see to work, as the
lamps dance, and his sight gets blurred, and that he can't fix his gaze on anything for any length of time. The gaslight dances when he is above ground, the words dance and become blurred when reading at night, especially when near a strong light. He also complains of pain in the eyes, giddiness in varying degrees, and in more severe cases, pain in the head and vomiting. The worst time of day for them above ground is towards evening, or between the two lights, as they generally express it, and at night when walking the street, coming suddenly to the glare of a lighted shop window, or a street lamp, or passing from a strong light into the dark, when they complain of the objects dancing, together with giddiness. In several of my cases, the patients complained that after going to bed at night, and putting the light out, they felt the bed turning, and as if it was sinking. In one case R. 24 years of age,
when put to stand upright in the military position, and told to close his eyes, he swayed and fell backwards. This was only the case when this man resumed work after a very severe attack of Typhoid Fever. During the questioning, one generally notices the eyeballs oscillating, some with great rapidity, but the movements vary greatly. They may be from 50 to a 100 or more a minute.

These movements are rotary, horizontal, and vertical, but the horizontal and vertical are not so pronounced as the rotary, and sometimes may be absent, or apparently so.

The movements are always present in both eyes, but may be more evident in one than the other.

It has been stated that the movements have been met with in one eye only, but in all my cases the movements were quite appreciable, or could be made so in both eyes.

In patients who come to consult a medical man about this disease,
The movements are generally very evident and they have had to leave work in consequence of it, but in other cases the movements are not so evident, but may be made so, by some of the following tests:

1. Ask the man to look obliquely upwards.
2. Ask him to look down and then suddenly upwards.
3. To fix his eyes on a strong light, or peep near a strong light, with the book above the level of the eyes.
4. May be more distinct by looking to one side or the other.

These movements may sometimes be detected in patients who have come to consult you about some other affection, but who have not had to leave work in consequence, but on inquiry it is generally found that they have noticed the dancing lights, but it has not seriously inconvenienced them.

These movements are stopped even in very severe cases, by looking below the horizontal line, and great relief is experienced as before stated.
and this is taken advantage of by colliers suffering from this disease, when at work, by getting up and looking downwards.

Hypermetropia, Hyopia, or Astigmatism present in some cases.

The field of vision is generally normal. Errors of refraction are sometimes met with.

Sense of colour normal.

Causes.

Several causes have been mentioned as producing dystagmus.

1) Alcoholic excesses and anaemia.

2) Deleterious gases disengaged in coal pits.

3) Being of an epileptiform character.

4) Due to central lesion.

5) Safety lamps and the improper illumination of the pits.

6) Feculent position of the miner at work.

First cause

Alcoholic excesses and anaemia.

If these caused it, all colliers suffering from anaemia and alcoholic excesses would suffer.
from Dystagmus, which they do not, and one will find a great many more anaemic, colliers, and heavier drinkers, than the majority of those affected with Dystagmus, but I am of opinion that anaemia and alcoholic excesses aid the production of Dystagmus, or aggravate it when present, due to reducing the tone of the system, as I noticed that several of my patients complained of these symptoms, after resuming work, after an attack of Typhoid Fever, who had been entirely free from them, or very slightly inconvenienced by them, previous to that.

(2) Deleterious gases.
Air is vitiated, or rendered impure, in mine workings, by the breathing of men and horses, the combustion of lights, the use of explosives, the various gases given off from the strata, watery vapour, coal dust and underground or gob fires.
The chief vitiating agents are the gases given off and the following gases are the chief compound gases.
found in mines:
1. Barluretted Hydrogen & H₂ or marsh gas, firedamp, or simply gas.
2. Carbon Dioxide, CO₂ or Choke damp, black damp or stythe.
3. Carbon Monoxide, CO or white damp, or sweat damp.
4. Sulphuretted Hydrogen, H₂S or Stink damp.

Dr. Hay'smith in a report in the British Medical Journal 1888 Vol III page 222 says "that the air of twenty years ago was very bad, when properly directed currents of ventilation were almost unknown, but in these days the air is generally good, and ventilation is efficiently carried out." In the same paper he states "that the conditions connected with the miners occupation are as favourable to health as those in the occupation of any other workman.

Since then things have very much improved, as regards the ventilation of pits, but it is unnecessary to enter into the methods of ventilation further than to state the amount.
of air allowed and given per man. It has been ascertained that an average man requires about 500 cubic inches of air per minute, when at rest, and 1500 cubic inches when exerting himself in walking. Labour in a coal mine is more violent exercise than ordinary walking, therefore the quantity required per man is increased to 1728 cubic inches, or 1 cubic foot per minute.

A horse requires about 6 times the quantity, and an ordinary safety lamp about one half.

The amount of gas varies so largely, that it is impossible to calculate the quantity of air required to keep the mine in a safe condition.

It has been found in practice that 100 cubic feet of air per minute per person employed in mines which are free from gases is sufficient for all purposes.

The quantity in mines in which gases are given off in moderate quantities is 260 cubic feet per
minute, and in very fiery mines from 300 to 500 cubic feet per minute per person employed.
From the above it will be seen that ventilation is very efficiently carried out, and that the miners get plenty of air, and that the air in the coal pits today is very much better than some years ago, but still hydrocyanic has not decreased, as it should have done if caused by deleterious air.
(3) Being of an epileptic form character.
(4) Due to central lesion.
Here are as a rule no symptoms to indicate any central lesion.
The quick and complete disappearance of the symptoms with rest and tonics point to a local condition and not due to central lesion.
Dr. Snell read a paper before the Ophthalmological Society in 1884 in which he says, "I have been nothing to lead to a supposition that the affection was dependent on central lesion. I have never seen a case that raised such a question. Here has never been any Optic neuritis,
and the nervous symptoms, when present are readily enough explained by the ocular conditions."

This was the conclusion I had come to, as I have never seen anything to lead me to think that it was due to a central lesion.

(3) Safety lamps and the improper illumination of the pit.

This is the cause that the collier ascribes the disease to.

"The lamps has caused it" is the invariable answer of a collier, when asked what he thinks is the cause of it.

In order to understand this point, I examined and experimented with several lamps, amongst them the following: The Davy, Blauny, Stephenson, Blauny modified, Innesler, Innesler and the Hepplewhite-Gray.

The Davy lamp.

In this lamp the flame is surrounded by a cylinder of fine wire gauge, about 1/2 inches in diameter, 6 in high and has 784 apertures to the square inch formed by the crossing of 28 parallel wires about 1/50 in in diameter.
This diminishes the illuminating power of the lamp very much, and brings it down below one-twelfth of the illuminating power of a standard candle.

The course of air is indicated by arrows in the figure. The Clanny.
In this lamp the flame is surrounded by a short thick glass cylinder surmounted by a gauge. The fresh air enters above the glass and gets mixed with the products of combustion before it reaches the flame. For this reason the light given off is not quite as good as might be expected, but owing to the absence of gauge around the flame, it gives a superior light to the Davy.

This lamp differs very materially from the Davy and Blauny. The gauge cylinder is made of full length as in the Davy, but of much larger diameter, and inside of it is placed a glass cylinder reaching
nearly to the top of the gauge cylinder. The top of the glass is covered with a perforated copper cap. The feed air enters through very small holes in the bottom rim of the lamp frame, and frequently they become clogged with coal dust. It causes excellent combustion, but as the light has to pass through both glass and gauge, it is very dim on the outside.

The three lamps now described, are never used now, as they do not comply with the Coal Mines Regulation act, as they cannot be safely carried against the air current ordinarily prevailing in that part of the mine in which they are ordinarily used, even if such current should be inflammable.

They have been described as they were the only lamps in use many years ago, and to compare their illuminating power with the lamps in use at present. The lamps in present use, are most of them modifications of the original Davy, Blauny or Stephenson, and
amongst those most generally adopted, are the Blauny modified, Inarsaut, Innesen and Hepplewhite-Grey.

The Blauny modified, or Bounded Blauny, this is the same as the Blauny with the exception that the gauge part is covered with sheet iron or copper to protect the gauge and in strong currents of air keeps the flame from flickering and it thus gives a much steadier flame than the Blauny.

Small holes for the passage of the feed air are made, at the bottom of the shield.

This lamp has been almost entirely displaced by the Inarsaut.

The Inarsaut, is another improvement of the Blauny.
The improvements are chiefly two:

namely, instead of one gauge cylinder,

there are two and sometimes three, one

within the other and they are covered

with a bonnet.

The gauges fit closely one within the

other at their bases on the top of the

glass cylinder, and gradually incline

from each other towards the top.

The wick used is flat and is placed

to burn higher than in the Blanzy.

The feed air passes through apertures

in the frame of the lamp and then

through the gauges and descends to

the flame.

The lamp being considered very safe

is the lamp principally used.

The Mueseler.
This is a blanney lamp with two additions, namely a diaphragm of gauge and a conical, metal funnel. The diaphragm is placed on top of the glass cylinder and supports the conical funnel to which it is attached. The funnel is placed in the centre of the lamp a little above the flame, and is about one inch in diameter at the base, and three-eights of an inch at the top.

The air to feed the flame passes through the lower portion of the gauge cylinder, then through the diaphragm down to the flame. The products of combustion pass up the conical chimney and then through the top of the gauge.

This lamp gives a very good light, but is extinguished if slightly tilted, and generally when placed amongst gas. It is the only one used in Belgium.

Hepplewhite-Gray.

This lamp is principally used by officials. The feed air enters the lamp at the top, thru tubes a., and gets to the flame through gauge. ring b.,
the products of combustion pass out through gauge e, the outlet of which is restricted at d, in order to keep the upper portion of the lamp filled with the products of combustion.

This lamp is used by officials on account of the advantage gained by having the air inlet at the top of the lamp, which enables them to detect a very thin layer of gas. It has a conical glass, which enables the proof to be inspected more easily, as the light is not obstructed by projecting bonnet and flange, as is the case in most lamps. The illuminating power is about the same as the Marsant and Runeseler.
Taking the illuminating power of a standard candle as 1, the Davy and Stephenson has only 0.18, the Blauny 0.20 whereas the Marseau, Dueseler, and Hepplewhite-Gray have an illuminating power of from 0.43 to 0.75, according to the condition of the atmosphere.

Besides safety lamps, candles, and small oil lamps, usually attached to the cap, are used in the naked light pits.

The candles generally in use are 18 to the lb. and 16 to the lb.

Taking the illuminating power of the standard candle as 1, the illuminating power of a candle, 18 lbs. the lb. varied from 0.34 to 0.73, and that of a candle 16 to the lb. 0.61 to 0.77, according to the condition of the atmosphere.

The electric light is now largely used for illuminating the headfeeds, engine-houses, and other surface works, also in sinking shafts, and at shaft bottoms, where the absence of fire makes it safe to do so.

The fixed electric light and the necessary
network of wires are, however, unsuitable and inapplicable to haulage roads and working places, but portable electric safety lamps complete in themselves, have been invented for use at the working place. Such lamps are in use at very few collieries, as they are more costly than ordinary safety lamps both in first cost and maintenance, and the light being produced in a vacuum they are entirely independent of the outside atmosphere, so they give no warning of the presence of firedamp or stythe, and on this account many object to their adoption and they are very little used.

Having described the methods of lighting coal pits, and the lamps most generally used, and their illuminating power, I will now proceed to discuss how the lamps might cause miners dyspepsia, and any reason for thinking that they are but a secondary or rather a minor consideration in causing dyspepsia and not the sole cause as has been ascribed.
When I first saw this disease, I was inclined to think that it was caused solely by the lamps, from constantly hearing the usual answer of the colliers "the lamp has caused it", and that being the accepted cause by medical men. How can lamps cause hysteragnus? By insufficient light and strain of the eyes. The extra strain on the eyes required to see to perform the work, causes atony of the muscles of the eyeballs. 

On asking the colliers why he thought the lamps were the cause, of it, the answer generally was that he thought it was the poor light glistening on the various surfaces of the coal which produced the dancing.

About this time W. J. aged 34 came to me complaining of the dancing lights. He had been working in the Fenshe pit for 24 years, and had always used the safety lamp. He had been suffering from this complaint for three months, but it was not severe enough to cause him to leave his work till now.
He was rather an anaemic looking man, and not very strong, having had a severe attack of typhoid fever some months previously.

Ordered the patient complete rest and gave him tonics. He was idle five weeks, during which he rapidly improved, till at the end of this time the symptoms had completely disappeared.

He resumed work, but in a week's time, he had to leave again.

He was idle this time for a month, before he resumed work, but he had to leave it a second time.

When he recovered, I recommended him to get something to do on the top, which he succeeded in doing, and he was able to continue working without any inconvenience.

K. V. aged 31 years had been working in a coal pit for 20 years and had always used a safety lamp.

He came complaining of the lamp dancing, and was on that account unable to follow his occupation.

He had observed this for some weeks but it was not severe enough to cause
him to leave work till now. He complained of the lights dancing, could not walk the streets at night, when the lamps and shop windows were lighted, owing to the dancing of the lights.

He also complains of giddiness. He is a pale, anaemic looking man, and takes long bouts of drinking. Ordered him complete rest and tonics. He was idle seven weeks, before the symptoms disappeared, and he was able to resume his occupation.

He had to leave it again in five weeks owing to a recurrence of the symptoms. He was idle this time for 24 weeks owing to a very severe attack of Typhoid Fever. He was not at all strong when he resumed his occupation, but the dyspeptic symptoms had disappeared some weeks before.

I advised him not to follow his old occupation, but he would not follow my advice, as he could not get as much wages on the top of the pit as underground.

So he resumed work, but in three weeks.
was obliged, to leave it, with the additional symptoms of feeling the bed turning round and as if it was sinking, when the lamp was put out at night, and falling backwards when placed in the military position and told to close his eyes.

He was away from work this time for 13 weeks before symptoms completely disappeared.

He did not attempt to follow his old occupation, but got something to do on top, where he was able to work with comfort and without a recurrence of the symptoms.

Several other cases after two or three trials to resume their old occupations and faring, I found were very much benefited, and the symptoms disappeared, and did not recur when the men worked in the open air.

This seemed to prove that the lamps and vitiated air were the causes of dysastmas.

I determined to pay a visit to one of the files, as my knowledge of the internal arrangements and the method
of working a coal pit were very limited at this time.

Having obtained permission I went down and had a walk round and decided to experiment with the lamp to see the effect it had upon my eyes, being Astigmatic in one eye and Hyperopic in both.

I stayed down for some hours and did odd jobs.

I found it a very trying experience, and that my eyes were much fatigued and were painful for some time afterwards.

I then used the lamp to read with at night in my rooms, for some hours, but did not think the feeling of discomfort was worse underground than in my rooms.

Having now obtained permission to visit the pit whenever I liked, I went down on many occasions, and used the lamp and tried myself, and used it for the same length of time in my rooms, and came to the conclusion that the fatigue of the eyes was no worse underground than
in any rooms, and failed to see the reason how and why the lamps should cause the peculiar movements of the eyeballs.
During my visits to the pits I was struck by the small number of men who had consulted me for dystagmus, in comparison to the number that were working there, and considered it very strange, that if the lamps were the cause of it, why more of the men, if not all, especially the older men, were not affected with dystagmus, seeing that they all worked, with the same kind of lamp, or two varieties of equal illuminating power.

Studying the movements of the eye, I had come to the conclusion that all the muscles of the eye were not equally affected, but particular muscles were affected in causing these movements. Although the sufferers from dystagmus were benefited, and the symptoms did not return, when they worked above ground, I began to doubt, that the lamps were the principal cause.
About this time, a collier came to see
complaining of dizziness. He had noticed the dancing of the lamp, complained of headache, and giddiness for some time, and the symptoms had been gradually getting worse, till at last he had to leave his occupation. I ordered him complete rest and tonics. In a month's time, the symptoms disappeared, and he resumed his old employment, but was obliged to leave it in a few days. I then recommended him to get a place on top, but in a few days he returned saying he could not get a place on top, but could get one underground, as a labourer. I gave him permission to try, but told him that I was afraid his eyes would get bad again.

He called upon me, in a month's time and much to my surprise I found he had been able to work in comfort. This increased my doubts as regards the lamp theory, and I decided, that any new cases of dizziness that consulted me, and when the symptoms had disappeared, should try some.
work underground to see if they could follow some occupation with the use of the lamp, or whether this case was peculiar.

While in this undecided frame of mind as regards the real cause of dystagnus, I had occasion one day to go instead of a brother practitioner to a candle lighted pit (some photographs of which accompany this paper) in the district which he attended, to see a man who had been injured.

After attending to the man, I began to make inquiries as this was my first visit to a candle lighted pit, and much to my surprise I found some men working there who showed unmistakable signs of suffering from dystagnus.

This puzzled me considerably, and I asked the men who suffered from dystagnus in that particular part of the pit to call upon me.

That evening two of them came.

R. I aged 34, had worked in a coal pit for 25 years, and had done all kinds of work from a flapper upwards.
He had noticed the symptoms off and on, for some time, and had been greatly inconvenienced by them, but could not say that he had actually had to leave work on account of it, but on closer questioning he declared, "that when he felt out of sorts, or could not see to work, he would chuck work for a few days, and go to the seaside, for a holiday, or have a spree to clear his system." It was evident, this man had had to leave work on account of the movements of the eyeballs. He was of a roving disposition and had been working in several pits in America.

On inquiry I found he had only been working in this candle lighted pit for six years, and for nine years previous to this he had been working in a lamp lighted pit, and for the remaining ten years he had worked alternately at both lamp and candle lighted pits. I was aged 42 years had been working in a coal mine since he was eleven years of age. He had noticed the lamps dancing, felt giddy at times
and found it very trying and difficult to follow his occupation, and had had to leave work on two or three occasions on account of it.

He had done various kinds of work in the pit and on further inquiry I found he had also been working in a lamp lighted pit.

I was extremely disappointed on hearing this, as I thought I had found a proof that the lamps were not the cause of hysteragnus, but the fact that both these men had been working in a lamp lighted pit, and their strong denunciation of the lamp as the cause of it, did not uphold my idea.

However some time after this two other men from the same pit presented themselves for treatment for hysteragnus.

R. R. aged 47 years had worked in a pit since the age of 12.

He complained of the lamp dancing, and could not see where the point of the pick hit, complained of headache and giddiness, could not walk the wheels at night, with any degree of
comfort as the lighted lamps and shop windows caused objects to dance, and his walk uncertain.
He complained of feeling sick at times. The movements of the eyes were very evident. He had noticed the symptoms for some time, but he had not been compelled to leave work on account of them before.
He had never been working in a lamp lighted pit, but had always worked in a candle lighted pit.
W.W. aged 35 had been working in a coal pit for 22 years.
This man complained of the usual symptoms, dancing of the lights, headache, giddiness, and being unable to see to follow his occupation.
The movements were very evident in this man also.
He also had always worked in a candle lighted pit, and never in a lamp lighted one.
In the meantime, several men who worked in the lamp lighted pit, came to consult me, for dyslagnum, and after the disappearance of the
symptoms, I advised to try and get
some work underground.
They followed my advice, and were
able to work in comfort.
This decided, one, and for the
following reasons:
(1) That all men engaged in the pits
were not equally affected, although
using the same kind of lamp, or
another variety which was of equal
illuminating power.
(2) That the lighting of the pits was
greatly improved, in fact was three
times better, than some years previous
to this, yet the men suffered from
hyptagnus.
(3) That all the muscles of the eyes,
were not equally affected, but
particular ones.
(4) That men who had always worked
in a candle lighted pit, and had
never worked in lamp lighted pits
suffered from hyptagnus.
(5) That the men were benefited, and
the symptoms did not recur by
change of work, not only above ground,
but equally so underground, although
I came to the conclusion that the lamps were not the principal cause of this disease, in fact, they had very little to do with causing this disease. Further than that, a poor light would aggravate or predispose to this disease rather than a good light.

The fact that men suffering from this disease were able to follow some other occupation underground with comfort, although using the same lamps, naturally led one to the conclusion that the work, and that some particular kind of work was the cause of dysbarismus.

On making more particular inquiries into the cases I had seen, I found as I expected, that with a few exceptions, which will be mentioned later on, all the men suffering from this disease were occupied in a particular kind of work, that they were the men who hewed the coal, the colliers proper, or as locally called in South Wales, “y dywion ar
of glo", which means "the men on the coal."

Having come to the conclusion that miners' hystagmus was not caused by alcoholic excesses and anaemia, deleterious gases disengaged in coal pits, nor being of a epileptic form character, nor due to Central lesion, or safety lamps, but was due to atony of particular muscles and with a few exceptions confined to a particular class of workmen I decided, to pay particular attention to them.

There was no book published on the subject which I could consult, to verify my conclusions.

Some time after this a medical friend called my attention to a paper on this subject by Dr. Snell in the Lancet 1845 vol 11 p 81 in which he states "that it seems to me that this disease occurs chiefly, if not entirely in those colliers who are obliged to do their work in the pit, whilst lying on their sides."

I was pleased to see this as it
entirely corroborated the opinion I had formed.

What is hystericalism?

Hystericalism is a local affection, and is the result of prolonged strain in an unusual and constrained position causing chronic fatigue of the ocular muscles inducing atony which causes the oscillation of the eyeballs.

It is a myopathic disease.

But Snell states that it is an instance of muscular disability induced by overwork, and that its pathology is similar in this respect to writers', pianists, and other forms of professional neuroses.

Dr. Bell Taylor in an article in the British Medical Journal 1887 vol 11 page 483 states "that it is analogous to that rare condition of the muscles of articulation known as anchovenezers' spasm, or so writers', pianists, and telegraphists' cramp, or to a similar affection of the gastrocnemius muscles occasionally 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. Dranseau states in the Annales d'Oculistique, 1877, Vol. II, page 128, 1882, Vol. II, page 150, "that the disorder was due to the fatigue induced in the elevator muscles in consequence of the cramped position of the uneven occasioning strain and a constant upward movement of the eyes. The myopathy will have its principal seat in the superior rectus and inferior oblique muscles, it occasions merely a weakness in these organs.

The pair of elevator having an acquired feebleness cannot overcome its antagonist by a single effort, it is obliged to attempt it several times by means of a series of little successive and rapid contractions. It then produces hysteragnus, or rather gives occasion to the vertical oscillations which are noticed in miners. Hysteragnus we have recourse to the
paresis of the internal recti and the accomodation. The impotence of the internal recti can suffice to explain the horizontal oscillations, they are produced by the same mechanism as the vertical ones. But the accomodation contributes to increase the muscular disorder by virtue of the relations which exist between convergence and accomodation, or in other words between the ciliary muscle and the internal recti."

In an article in the British Medical Journal of July 11th, 1891, Dr. Snell lays particular stress on the oblique direction of the gaze to the left or right, and states that the external rectus muscle was interested in Hyphiasis in the same degree as the internal rectus.

In a letter in the British Medical Journal of Aug 8th, 1891, Dr. Draencart agrees with this as he states, "I completely agree with the views of Simon Snell has expressed as to the upward, more or less oblique manner, a dever of coal throws..."
his eyes when at work, and believe
with Swell that the miners' hystagmu
is similar to writers' cramp, that
is to say, that miners' hystagmu
is a myopathic disease."
In order to understand this, it is
necessary to know the particular work
a miner has to do, and the position
he has to assume in order to follow
his occupation.
All the men engaged underground
are not colliers proper, or men that
hew coal. They are engaged in various
kinds of work, and their work will
be seen to differ materially, but they
all work with the same kind of lamp
or two varieties of equal illuminating
power.
1) Trappers, or door boys.
These are boys when they first go into the pit from 13 to 15 years of age now, but some years ago from 8 to 11 years of age.
The accompanying photograph is interesting as showing the age of the children working in coal mines some 15 years ago.
Their duty is to open and close doors, and in candle lighted pits to see that the men are supplied with candles.

(2) Ostlers.
Men that look after the horses, but have nothing to do with coal getting, but are ostlers pure and simple, and do not as a rule leave the stable.
(b) Trammers and Hauliers

Trammers are men that push the loaded tram to the bottom of the pit and take the empty ones back to the stalls.

A Trammer.

Hauliers are drivers of the horses which draw the loaded tram to the bottom of the pit and take the empty ones back to the stalls.

A photograph of a haulier may be seen in the enlarged photograph marked I.

(c) Engineers.
These men as a rule do not move from their engines which are stationary and are used for winding purposes. The photo on the last page is of a colliery engine room.

(3) Deputies or Firemen.

These men are the ones who examine the pit for gas, see that the roof is secure, and are responsible for the proper working and safety of the seams under their control.

Mr. Snell mentions two cases of instamnum as occurring in Firemen. This is accounted for by the position the Fireman has to adopt in examining the roof or for gas. The following is an illustration of a Fireman examining for gas in some old workings, and it will be seen that his eyes look obliquely upwards.
In a seam lower than his own height, his head would naturally be flexed on the low shoulder and his eyes would be looking obliquely upwards. Furthermore, they have been holers all their lives, and have been promoted Firemen on account of their intelligence.

(6) Labourers, Repairers, and Timbermen.

General labourers do all sorts of odd jobs, keep the roads clear, help the Repairers do all the repairs necessary. Timbermen prepare the props by cutting them into various sizes and props up any part requiring propping. The following is a photograph of a Timberman preparing his "arms" and "collars" above ground.

A timberman pure and simple, never knew coal.
(y) Colliery proper, or the men that are engaged in coal getting.

The two chief methods of working coal are by the pillar and stall and the longwall.

The pillar and stall method consists in driving in the solid coal, one set of excavations called boards, and another set at right angles to these called walls or headways.

These excavations form blocks or pillars of coal, which are more or less rectangular in shape, and these are subsequently extracted in shafts, that is by narrow strips being worked off them.

In the longwall method of getting coal, the whole of the seam is extracted in a more or less straight face in one operation, the roof being allowed to sink as the workings advance.

In the actual cutting of the coal, there are three operations of work.

1. Hobing, shoveling or undercutting
2. Getting or breaking down and
3. Filling or loading into tubs.

In some pits the three operations
The work at the face and are paid a certain wage. The holes are followed by the second man who break down the face, and are paid a certain rate per yard. The third man is paid a certain rate per yard. The coal is generally loaded off a is usually loaded on the move or from one man to another. It is generally cut off from the face.
to the surface, and in this price is included his remuneration for undercutting and breaking down. Another arrangement is for three or more men to share the work and the money resulting from their labour. They agree to work a certain length of coal face amongst them, doing all the work connected with bolting, getting spilling, and in some cases in packing, timbering and making the place generally safe. Sometimes an agreement is made with one man to be responsible for the working, timbering and packing of a certain length of face, and to find and pay all the labour required to do the work.

When a miner starts bolting he has to assume a very awkward position. He sits down with one leg crooked under him, and the other extended till he undermines the coal for a little distance. He then lies on his side, sometimes the right, sometimes the left, and strikes the coal with a horizontal swing of the pick.
His head is thrown back and floored more or less on the shoulder beneath and the eyes will look more or less obliquely upwards.

The clear the coal to a height of 18 inches or 2 ft and from 2 or 3 ft to 7 or 8 ft horizontally, and as he undermines it, he draws his body in after him. As he gets further in, under the coal, he lies down straight out with the elbow on the floor, his head floored on the low shoulder and turned slightly upwards and the eyes looking obliquely upwards.

As he undermines the coal, he places pieces of timber called sprags, between the bottom of the coal and the bottom of the seam, to keep the coal from falling on top of him.

When he has loosened the coal sufficiently, the sprags are knocked off and the coal falls. If not they employ wedges or explosives are used when safe.

This is bottom holing. He may have to do stop holing between the top of the coal and the
roof of the seam, or he may have to do middle-holing, where soft, grusly, coal sometimes exists.
In any case the work is the same, as regards the position of the head & eyes.
There are other men who are colliers proper or working on the coal.
They are the men who drive the headings and open out the pit, but they do not assume the same position, as the stall men, in following their occupation.
They work on their feet or their knees, according to the thickness of the seam, and swinging their picks vertically like the ordinary method above ground, with the head straight, and the eyes generally looking straight ahead and downwards.
I have never found any of these men suffering from hystagmus.
All the men suffering from hystagmus with the exception of one or other, two fillers and four timbersmen, which will be mentioned later on, were occupied in hewing coal, and only those occupied in the first operation
of getting coal, that is holing.

The proportion of men engaged in holing is rather difficult to arrive at, as the number depend upon the nature of the coal, and the amount of holing required to get the coal. The amount of holing required varies in different seams, and even in different parts of the same seam. In some pits every yard of coal obtained is holing, in others very little. Again in some pits men who are skilled as holers do nothing else but holing, and they are the only ones who do hole, whereas in other pits three or four men join together and take a piece of work, and each one of them will do holing as well as breaking down and filling the tram. About 30 per cent of the work at the coal face is holing, and the proportion of colliers to other men engaged underground is about 30 per cent, hauliers form another 20 per cent, while the general labourers, and the rest of the men engaged underground form the remaining 40 per cent.
In order to understand this more thoroughly, I decided to try and take some photographs of the method of working a coal pit and the position of the men at work.

Accompanied by a friend, we proceeded to a candle lighted pit, the only pit in the district where it was considered fairly safe, to use a magnesium light.

We took a number of photographs, but owing to the difficulties, and trouble with the light, when we came to develop them, several of them were failures, and before we were able to replace these, the pit caved in and was abandoned.

In the accompanying photograph three men are seen at work.
They are engaged in loading a tram after getting the coal down. Not one of them is in the position assumed when holing.

I have mentioned as exceptions two fillers as suffering from dyspepsia. It was very difficult to account for this, as filling is such different work to holing, but after long and careful inquiries I found that these men were not only fillers but for several hours a day were occupied in holing, but being the youngest of the party did most of the filling.

I have not found dyspepsia occurring amongst fillers pure and simple. In the next photograph two colliers are seen at work, the one on the left...
is sprawling, while the one on the right is partly underneath the coal. He is not at the moment using his pick, but is examining the under part of the coal, which they have undermined to a considerable distance. His head is not placed sufficiently low on the low shoulder, as it would naturally be if he was clearing the under part of the coal, but the direction of his eyes can be seen to be more or less obliquely upwards.

In the next photo two colliers may be seen holing. The one on the left has got his legs doubled up under him, the head placed on the low shoulder, but is looking downwards and not upwards. He is examining the bottom of the seam. The collier on the right,
is in the typical position of a miner when holing. The lie is fully extended on the right side, with his head flexed on the low shoulder and slightly rotated. He is swinging his pick in a horizontal direction, and the direction of the gage will be obliquely to the left and upwards.

It is impossible to show the direction of the gage in this photograph, but that will be seen in one of the enlarged photos and mentioned later on.

The next photograph shows three men at work. The one on the extreme right is loading, while the other two are engaged in middle holing. The man in the middle has not progressed very far, but his head is seen to be flexed on the low shoulder, the one on the left has advanced.
Further, and the flexed position of the head is very well shown. From the foregoing illustrations it will be seen that the position of the head is the same in both bottom and middle holing. In the enlarged photograph marked 2 the two men on the left are examining the hole, and are not in the proper position for holing. But the photograph is interesting on account of the man on the right. He is one of the exceptions mentioned. He came to me complaining of the lights dancing, pain in the head, giddiness, and all the symptoms of dyslagmus. He described himself as a timberman. When I found that all the men I had treated for dyslagmus were holers with the few exceptions mentioned, I found it very difficult at first to account for its presence in these men, whose work was apparently so very different to that of the holers. However, on closer inquiry and a more intimate knowledge of the work in the pit, I found this man
was not a teamster pure and simple, but that he and the other two men seen in the photograph had taken a goal, and did all the three operations of work at the coal face, viz (1) hoisting, (2) getting and (3) felling and also timbering, but that they had arranged amongst themselves for some reason or another, that this man should do most of the timbering, hence his description of himself as a teamster, which was quite erroneous as he did hoisting for a considerable part of each day. Even in timbering in some positions the direction of the look is obliquely upwards. This is shown in this photo to a certain extent, as it will be seen that this man's head is gilded slightly on his right shoulder, and the direction of his eyes is obliquely upwards to the left. In the nearest enlarged photograph marked three, three men will be seen working, but the one that interests us is the one on the left. He came to me complaining of dyslagmus.
He is also one of the cases mentioned as exceptions, as he described himself some as a Tickerman, but after some difficulty and a good deal of questioning, I found he was a holer, but having taken a facing with two other men, he sometime after found he could not continue holing for any length of time each day, but having found relief in timbering, loading etc., he did most part of the timbering, and by changing his work at the facing several times a day, he was able to continue at his occupation, but with a great deal of discomfort. This had been going on for some months, but he had not consulted any medical man, as he had not been compelled to leave his work. He had recently had an attack of Influenza, and when he resumed work, he found he was quite unable to do any holing, so he had done the timbering instead, hence his description of himself as a Tickerman. For the last few days, he had had the utmost difficulty in following his
occupation, and had to cease working the day he consulted me. He was 34 years of age, and had worked in a coal pit since he was 12 years of age. He was a stout, glabrous, individual, somewhat anaemic, and was very much run down after an attack of influenza.
On examining his eyes, the movements were very evident.
On asking him what kind of timbering he was unable to do, he told me that it was high timbering, and he had been compelled to stop the job he was at that day, as he could not see to go on with it. I asked him to continue at his occupation the following day, and I would come down, and see the place. I went down and asked him what he was doing when he had to stop working.
He instantly placed himself in the position seen in the photograph, and we immediately took a photograph of him in that position.
which is an excellent representation of the position of the head and eyes which causes dysgagnus.
The head will be seen to be flexed on the low shoulder, and the direction of the eyes to be obliquely upwards, in this case to the right.
This man felt no discomfort Whatever in timbering when he looked below the horizontal line.
Hobers have a great dislike to timbering when it necessitates their looking above the horizontal line, especially when the direction is obliquely upwards, as it causes them a great deal of discomfort.
The other two timbermen mentioned as exceptions, were not really timbermen, but a good part of the day was occupied in holing, and timbering was only a part of the day's work. I was unable to get a photograph of these two men at their work, as they worked in a very fiery mine.
The next case mentioned, as an exception was an onsetter, whose.
photograph is seen in enlarged photo marked it.

An onsetter is the man in charge of
the shaft signals at the bottom of the
shaft, and who changes the tubs
when the cages arrive at the bottom.

When this man came to consult
me first of all for Nystagmus, I
had not come to a conclusion as
regards the definite cause.

On questioning him, I found he was
suffering from objects dancing in
front of his eyes, giddiness, headache,
and all the symptoms of Nystagmus.

The movements of the eyes were quite
evident.

When he informed me that he was
an onsetter and did not work with
the lamp, I was considerably astonished
and quite at a loss to account for
it in this man.

The shaft bottom was lighted with
paraffin flares, and the electric light
was put in later.

It was certainly very surprising to
find a man, suffering from Nystagmus,
who was working by the light of a
paraffin flares, and it seemed to show that there was something wrong with the lamp theory, but on further inquiry I learnt that this man had been working as a holer for some years, but owing to an injury to the back, some months previous to the time he consulted me, he had been unable to continue his old occupation, and he had been given the job of an onecatcher. He had noticed the dancing of the objects when engaged as a holer, but the symptoms had not been severe enough to cause him to leave work, up to the time of the accident, and the symptoms only got severe enough to cause him to leave work at this time after an attack of influenza which had left him in a very debilitated condition.

The fact that this man was suffering from hysteragmus while working with the aid of paraffin flares, although he had noticed the symptoms while working with the lamp, together with other reasons mentioned before,
led me to look for some other cause than the lamp, and when I had come to the conclusion that it was caused by some particular kind of work, I found it very difficult to account for it in this man, whose position at work was so very different to that of a hoist.

I went down the pit on several occasions and watched him at his work, and found it was only at a particular part of his work, that he complained of discomfort.

An overseer changes the wagons in the cages, and when he has put a loaded train in, he signals to haul it up.

As the cage ascends, he stands on the edge of the shaft, and flexes his head on one shoulder, and rotates it slightly to one side, and looks obliquely upwards. This he does also when the empty train is descending.

It was when in this position, and in this position only, that he complained of discomfort. It will be seen that the cases mentioned
as exceptions, were really not exceptions, in that, that they all at one time had worked as miners, and that even the work they were doing at the mine they consulted me, necessitated their looking upwards in an oblique direction.

So many men suffering from the same disease, and following several apparently totally different occupations, caused me the greatest difficulty in arriving at a definite conclusion as to its real cause, till I had a very intimate knowledge of pit work. Having described the position of a miner at work, and the muscles involved, it will be seen that a miner working on his left side, will be using in the left eye, the superior rectus, the inferior oblique and internal rectus, and in the right eye, the superior rectus, the inferior oblique and external rectus.

If he works on his right side, he will be using in his right eye, the superior rectus, inferior oblique and internal rectus; while in the left eye, the
superior rectus, inferior oblique and external rectus.
The two and fro movements of hystagnus are thus accounted for by the
weakness of the external and internal
recti, the rotatory by the inferior
oblique, and the superior rectus
aids in causing the vertical movements.
Of the many hundreds of men suffering
from hystagnus whom I examined,
I did not find a single instance,
whose occupation did not necessitate
his looking obliquely upwards.
Shortly after the portable electric
lamps were brought out, I purchased
two, and after they had been duly
examined, and passed, I obtained
permission to experiment with them.
I asked two men whom I had
attended for hystagnus, to resume
their occupation of holers and to use these lamps. They did so but
were only able to continue working
for a short period before the symptoms returned. I tried this with a great
many more, but not one of them,
was able to continue this occupation,
for any length of time, before the symptoms returned.
The fact that the symptoms recurred in these men when they resumed their old occupation, which necessitated their looking obliquely upwards, when they were using a very superior light to the lamp, and that there had been no recurrence of the symptoms on change of occupation although using the same lamp, and its occurrence amongst men who had never worked with a lamp, I consider effectively disposes of the lamp theory.
From the foregoing it will be seen that Hystagmus is caused by fatigue of the Superior Rectus, External and Internal Recti and Superior Oblique induced by any work which necessitates the collier looking obliquely upwards for lengthened and continuous periods.
It has been stated that Hystagmus is on the increase, but I do not agree with this.
The reason for the apparent increase is, that the disease is better known amongst Colliery Surgeons & Colliers,
and more attention is paid to it, and to the fact that there are now three times the number of men engaged underground to what there were in 1870.

Prognosis
Very good, as the symptoms quickly and completely disappear with rest and tonics, and do not recur on change of occupation.

Treatment.
Complete rest, tonics such as iron, strychnia, and good nourishing food. When symptoms have disappeared, change of occupation.

As a preventive of dyschagnus, it has been suggested that all coal should be undermined by machinery, as when coal is undercut by machinery, it...
does not necessitate the collier looking obliquely upwards.
This will be seen in the illustration on the last page, which is that of a collier undercutting coal by machinery. It will be seen that the head is quite straight, and the direction of the eyes directly forwards.
In America where the seams are exceedingly thick, machinery is used to a large extent for cutting coal, but in this country, for various reasons, they have not been very extensively used, although their employment has greatly increased during the last few years.
According to the statistics for 1903, which are the latest out, the total number of machines in use in Great Britain were 483 which mined 4,161,202 tons of coal out of a total output of 230,334,469 tons of coal.