suffering from "enteric" (?) was recently tested. In 15 there was no agglutination; 20 gave evidence of a pure typhoid infection, but 5 gave evidence of a pure paratyphoid B infection. Further, in two other cases of acute pleural effusion in civilians, paratyphoid B bacillus was isolated from the exudate.¹

2. *Bacillary Dysentery*.—This was formerly thought to be confined to asylums, yet Flexner Y bacillus was isolated from a boy with acute diarrhoea, and from two out of 504 healthy recruits in a training camp; Shiga's bacillus was isolated from the spleen of a woman who had always lived in Liverpool, and who died of puerperal sepsis, but was found *post mortem* to have chronic ulcerative colitis.²

3. *Amoebic Dysentery*.—Fifty-nine patients in an English asylum suffering from acute dysentery were examined for protozoa, "in 3 cases vegetative *Entamoeba histolytica* were found in the stools."³

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MINER'S NYSTAGMUS: SUGGESTIONS FOR ITS PREVENTION.

BY

D. LECHMERE ANDERSON, L.R.C.P. AND S. EDIN.,
D.P.H.,

MEDICAL OFFICER OF HEALTH, DONCASTER.

SOME suggestions I made to Mr. T. H. Mottram, C.B.E., Divisional Inspector of Mines for the York and Midland Division, with the object of reducing the amount of miner's nystagmus in our coalfields, were embodied by him in his annual report for 1919. Further inquiry has strengthened my opinion that the only way to eliminate the "grave," or what might be termed "compensation," cases of miner's nystagmus is by some such method as therein outlined, and, as the outcome of an informal conversation with Dr. J. S. Haldane, I have endeavoured to state the case somewhat more fully in the following article.

The importance of removing the personal factor in the causation of the disease has been somewhat overshadowed by concentration of thought and effort on removal of the external exciting factors. Inquirers have centred their researches on questions of posture and illumination; that is, attempts have been made to eliminate nystagmus by improving the conditions in the mine instead of preventing the man who is predisposed to the disease from entering the mine.

No man the refractive condition of whose eye is normal will develop miner's nystagmus to such an extent as to incapacitate him from following his employment as a miner. Of this I am persuaded from investigations among men suffering from miner's nystagmus in the Doncaster area.

Astigmatism is by far the most frequent predisposing cause of miner's nystagmus, and the greater the degree or the more marked the abnormality, the more susceptible will the subject be when exposed to the exciting factors of this disease. A subject with mixed astigmatism in oblique meridians will almost certainly develop the disease when exposed to the conditions of a collier's life. Simple refractive errors, myopia and hypermetropia, also act as predisposing causes, though to a much less degree.

Most observers are agreed that ametropia is the rule in cases of miner's nystagmus. Various authors have published figures ranging from 90 per cent. downwards, but my experience has led me to believe that unless nystagmus is associated with ametropia it will not be so grave in type as to incapacitate a miner from following his occupation. Severe nystagmus may, of course, be due to the other known causes of the condition, such as affections of the cerebrum or cerebellum, diseases of the labyrinth, sclerosis cerebri, etc.

Age as a Factor in the Production of Miner's Nystagmus.

In my series of cases the highest age incidence was 40 to 44, as shown in Table I; the explanation is that physio-

logical changes are then occurring in the lens resulting in presbyopia. This imposes an additional strain upon the neuro-muscular mechanism concerned in accommodation and convergence. Given, then, that there exists an error of refraction as mentioned above, the disease will be particularly prone to manifest itself at the age of presbyopia. That this should be so lends support to the theory that an error of refraction is an essential factor in the production of the disease.

TABLE I.—Age Incidence of Miner's Nystagmus; showing Number affected in Five-yearly Age Groups.

Age 20-24	...	...	...	...	...	3
25-29	...	...	...	...	...	3
30-34	...	...	...	...	...	10
35-39	...	...	...	...	...	16
40-44	...	...	...	...	...	24
45-49	...	...	...	...	...	19
50-54	...	...	...	...	...	16
55-59	...	...	...	...	...	8
60-64	...	...	...	...	...	2

Length of Colliery Life as a Factor.

Length of life as a collier bears no direct relation to the incidence of miner's nystagmus. It is not a matter of surprise that miners who have a long record of life underground should have a high incidence of nystagmus, as shown in Table II. As presbyopia increases so does its influence as a factor in the production of nystagmus when the eye is ametropic; and the greater the abnormality of refraction the greater the influence.

TABLE II.—Showing duration of Work in Collieries in Five-yearly Groups and Number of Men with Nystagmus.

1 to 5 years	...	...	...	...	...	2
6 to 10	...	...	...	...	...	4
11 to 15	...	...	...	...	...	9
16 to 20	...	...	...	...	...	12
21 to 25	...	...	...	...	...	12
26 to 30	...	...	...	...	...	19
31 to 35	...	...	...	...	...	16
36 to 40	...	...	...	...	...	11
41 to 45	...	...	...	...	...	5
46 to 50	...	...	...	...	...	2
51 to 55	...	...	...	...	...	1

Heredity as a Factor.

Other observers have found a hereditary history of nystagmus in as many as 20 per cent. of their cases. In my opinion it is not nystagmus that is hereditary, but the refractive error. Similar errors of refraction are commonly found in parents and children. What more natural, then, than that with the transmission of an error of refraction there should be associated a tendency to miner's nystagmus? The latter disease is thus not in itself hereditary, but the refractive errors—the personal predisposing causes of miner's nystagmus—are markedly so.

Classification of Causes.

The chief factors which result in the production of miner's nystagmus are thus:

Predisposing.

1. *Errors of Refraction*.—These, when associated with the conditions of a collier's work, may result in miner's nystagmus at any age period. When this occurs in early life the astigmatism present is usually severe in type or abnormal in character.

Exciting.

(a) *Presbyopia*.—This has a marked influence upon ametropic eyes in the production of nystagmus when associated with the conditions peculiar to coal miners' work.

(b) *Defective Illumination, etc., in Coal-mining Work*.—This in itself cannot create "grave" miner's nystagmus in an emmetropic eye.

If we accept the theory that refractive errors are the main predisposing causes of the affection we should exclude men who have certain types of ametropia from following the occupation of a miner. In the great majority of employments the eyesight of young persons has to be tested before commencing work. This ensures correction of errors of refraction, whereas the eyesight of the collier is seldom if ever examined or corrected until the onset of disease renders it imperative. It is easy to understand how, in a man affected with uncorrected ametropia, the defective lighting of a coal mine and the posture at work would impose an additional strain upon the ocular muscles.

Improvement in the illumination will unquestionably reduce the strain and at the same time the incidence of nystagmus, but will never stamp out the disease from our mines whilst refractive errors exist amongst the colliers.

Types of Nystagmus found in Miners.

Two chief types occur—the minor, latent or transitory, mild in character and degree, and the major, incapacitating, grave type. The minor type, which does not incapacitate a man from his work, exists in a very considerable proportion of men employed at the coal faces, whereas the major type occurs in less than 1 per cent. of men similarly engaged. In each there are two principal personal factors in production: (a) Refractive errors, structural and other defects of the eye; (b) abnormalities of the neuro-muscular mechanism of the eyeball. When these conditions are slight the minor type as a rule results, when marked the major type. In no other employment do we get the same combination of exciting factors; defective illumination I have no doubt is the most important, and great improvement has been made in this respect; but there has been no advance in the removal of the personal predisposing cause of the disease, and without this we can hardly hope for success. It seems essential to establish a refraction standard for miners, and thus prevent men from taking up a form of employment totally unsuited to their physical powers. By this means we can eliminate the major cases of disease from the mines, and although the minor types may occur they will be reduced in severity and in frequency.

A Fixed Refraction Standard for Coal Miners.

The benefits derived from a fixed refraction standard would be:

1. *To the Individual.*—(a) A man would be prevented at the beginning from following an employment for which he was unsuited, and which sooner or later would prove detrimental to his health and his life prospects. (b) He would at an early age, if ametropic, come under the observation of a skilled oculist, and would thus learn the importance of correctly adjusted glasses and save his eyes from further injury. (c) The standard would eliminate these distressing examples of miner's nystagmus, who tend to become a burden to themselves, being unable to work as miners and unable or unwilling to follow other occupations. (d) It would tend to prevent injury to other workmen. The man with marked refractive errors is a source of danger to his fellow workers.

2. *To the Owner.*—(a) There would be a saving in the money expended on compensation, as the major types of the disease would be kept out of the mines. (b) The standard would tend to prevent accidents. (c) It would enable better coal to be got, "the men being able to see whether they are filling coal or dirt," as Sir Arthur Markham put it.

3. *To the Nation.*—(a) It would exclude men from unsuitable employment. (b) It would protect the eyesight of the nation, giving useful instead of handicapped men in other employments. (c) It would tend to reduce poverty, disease, alcoholism. (d) It would give a higher average output of coal per man.

Standard Suggested.

The standard which I would suggest for admission to pit life is the ability to read Snellen $\frac{20}{40}$ at twenty feet with each eye separately or Snellen $\frac{20}{30}$ (at least three letters) with both eyes at twenty feet. In the event of failure to pass the above tests the man would be referred to the certifying factory surgeon, who should have a knowledge of eye work. With a considerable amount of hypermetropia or myopia (which might be arbitrarily fixed at 1 D) the man's attention would be directed to the abnormality, and such abnormality noted on the register. Although he might not be excluded from work as a miner, he would be advised to seek other employment, and to wear suitable glasses. If the error of refraction exceeded 1 D hypermetropia or myopia, or if astigmatism was present, the man would be excluded from work as a coal miner.

These suggestions as to standard are only intended as provisional, and could be modified in the light of experience.

COAL MINER'S NYSTAGMUS AND ITS PREDISPOSING CAUSES.

BY

A. J. MARTIN, M.D. LOND.,
BLOXWICH, WALSALL, STAFFS.

COAL MINER'S nystagmus is a disease which, owing to its most obvious sign being oscillation of the eyeballs, has been most discussed by the ophthalmological sections of our medical societies and only rarely considered, as I believe it should be considered, as a functional disease of the nervous system. Nystagmus is only one of its signs and that one not necessarily always the most prominent.

The disease is essentially one of exhaustion. First the visual centres and then the higher centres become worn out by constant effort. Any one who is doing much work on pensions boards and at the same time is engaged in colliery practice, cannot fail to be struck by the similarity between cases of nystagmus of the coal miners and anxiety neurosis of the war-strained. Each is a replica of the other, the only difference being the accentuation of the signs in the latter. Each has the same nervous, depressed and often haunted aspect; the same loss of self-confidence; the same fine general tremor; the same alteration of reflexes. (In bad cases of miner's nystagmus the accommodation reflex is sluggish.) The same headaches, giddiness, and at times fear of the dark. In each the blood pressure is often abnormally high. Cases of miner's nystagmus may remain latent for years, so long as the disease of the eyeballs is the only sign of the disease. It becomes manifest so soon as tremor of the head or general tremor begins—for example:

Case 12.—Stallman, aged 56; examined March 24th, 1909. Nystagmus, but no tremor. Is still working regularly.

Case 20.—Nystagmus, but no tremor, for seventeen years. Tremor first noticed April 17th, 1913. Refused to give up work until June 17th, 1918. A hard worker and a hard drinker. Is now working in a candle pit.

Case 24.—Stallman, aged 56; examined January 9th, 1911. Nystagmus, but no tremor. No complaint except that the right eye was weaker than the left. Worked regularly until he "retired" two years ago. Re-examined October 20th, 1920: no nystagmus.

The subjective distress is not proportional to the extent of the nystagmus, its rapidity, or amplitude, but is to the accompanying nervous symptoms. Some of my cases, in which time has shown the prognosis to have been bad, have had nystagmus of such small amplitude that it has been difficult to detect it without the ophthalmoscope. But the nervous symptoms, particularly tremor, have been very obvious. This tremor is so very fine that it is impossible of simulation by voluntary effort, and is easily distinguished from the coarse head-wagging of the "income neurotic." These men complain just as much of "dancing lights," or of the "lamps going round in a circle," as do those with nystagmus of coarse amplitude.

That the exciting cause of the disease is deficiency of light is now generally admitted,¹ and ² but what are its predisposing causes? And can anything be done to diminish or remove at least some of them?

Bad ventilation in the mines, or the breathing of gases given off by the coal, or the result of shot-firing can be ruled out.¹ Ventilation is more efficient than ever it was, yet the cases do not become fewer. The balance of informed opinion appears to be that errors of refraction do not influence its incidence.³ I believe the main predisposing causes are as follows:

1. *Nature of the Work done.*—Stallmen (that is, the actual coal-getters) suffer in the highest proportion; they constitute 88 per cent. of my cases. The greatest strain falls on them. They, as a rule, work harder than the drivers, loaders, or dateliers, and their vision is more strained; in addition they are responsible for the safety of those working in the stall with them.

2. *Excess of Alcohol and Tobacco.*—As regards the latter, the excess is especially of the cheaper brands of cigarettes. As for the former, nystagmus is often worse on Mondays, and many latent cases become manifest after bank holidays.

3. *Illness.*—Several cases followed attacks of influenza during the recent epidemic.