Coal miners’ nystagmus was one of the first occupational illnesses ever recognized as being due to a hazardous working environment. It aroused great concern and much controversy in Great Britain in the first half of the 20th century but was not seen in the United States. Miners’ nystagmus became a significant financial problem for the British workmen’s compensation program, and the British medical literature became a forum for speculation as to the nature of the condition. Although new cases of miners’ nystagmus were rare after World War II, the condition continued to be discussed in textbooks through the 1970s, after which it abruptly disappeared without any authoritative summing-up, and thereby hangs a tale.

MINERS’ NYSTAGMUS IN NEURO-OPHTHALMIC TEXTBOOKS

The authoritative chapter on nystagmus, written by Dell’Osso and Daroff in Glaser’s text Neuro-ophthalmology in 1999, lists 46 types of nystagmus in 3 columns occupying an entire page.1 Halfway down the center column there is a listing called “miners’” with a subset called “occupational.” A dagger leads the reader to a footnote that consists only of the curiously attenuated and enigmatic phrase “may not exist,” from which the reader may justifiably infer “may never have existed.” The footnote is obscure and provocative at the same time. The authors later give miners’ nystagmus a few sentences in the section on acquired pendular nystagmus, but nothing else. Miller’s 1985 edition, Miller and Newman’s 1998 5th edition, and the 2005 6th edition of Walsh & Hoyt’s Clinical Neuro-Ophthalmology do not mention miners’ nystagmus at all.2-4 and neither does the excellent book by Leigh and Zee.5 So miners’ nystagmus has almost disappeared from modern textbooks.

This contrasts with its treatment in Cogan’s classic Neurology of the Ocular Muscles,6 a text that taught many of us our neuro-ophthalmology and may still be read with profit. There the following description of miners’ nystagmus appears, in Cogan’s typical style—concise, clear, confident:

Miners’ nystagmus is . . . a pendular nystagmus, an exceptionally fine and rapid one, occurring in persons who work in poorly lighted mines for long periods of time. It is much less frequent now that mines are better illuminated. The nystagmus is accompanied by an impairment of vision that varies according to the degree of nystagmus and occasionally by an illusory movement of the environment. . . .

The condition has been likened to that occurring in animals reared in the dark. The prognosis is favorable when the patient is removed to quarters having adequate illumination.

The amount of light at the coal face necessary to prevent nystagmus must be in the order of 0.1 Candle per square foot. . . . Where power lines are not available this light is adequately supplied by cap lamps, and where these are used, as in the United States, miners’ nystagmus is practically nonexistent.6(p192)

Walsh and Hoyt7 in 1969 devoted 4 columns to miners’ nystagmus; the treatment is essentially a duplication of Walsh’s first 2 editions in 1947 and 1957:

The cause of miners’ nystagmus remains disputed. . . .

The affection is usually considered as “functional” but it is not proven that a pathologic background does not exist. . . .
Since the occurrence of nystagmus without symptoms is high among British miners it would be difficult to explain the condition simply as a manifestation of a neurosis. General symptomatology is that of neurasthenia. There is complaint of dizziness, headache, and weakness . . . ; photophobia . . . ; tremors [of] . . . eyelids . . . , head . . . , hands. . . .

Now we hear a more complicated story in a more uncertain voice: “remains disputed,” “not proven,” “difficult to explain.”

Even more ambivalent was the work of Duke-Elder and Wybar in the multivolume System of Ophthalmology series, in its day considered the encyclopedia of clinical ophthalmology. The authors were British, and in 1973 they devoted 6 pages to miners’ nystagmus:

The aetiology of the disease is disputed . . .

. . . one important cause is lack of illumination at the coal face . . .

A second factor . . . is the crouched and strained attitude of a miner at the coal face with his constant upward gaze at work which may disturb the vestibular apparatus and certainly brings about physical and ocular fatigue.

A third factor may be the inhalation of noxious gases over long periods. . . . [But] possibly the most important factor of all is the mental make-up of the workman himself, for many are unable to withstand the stresses of years of hard work in an ungenial environment wherein constant discomfort and occasional danger are too often evident. . . .

Now the reader gets 4 “factors” and is further confused, usually a sign that the writers are confused also. That was in 1973. After that, for 26 years there is silence. British and American ophthalmology journals had been silent since the 1950s. Then in 1999 we get “may not exist.”

Textbooks encapsulate the wisdom of the day and are always subject to revision, but rarely is an entity given such respect at one time only to be given such short shrift and so ignominiously cast aside 2 or 3 decades later, without explanation. It’s as if an embarrassed fog had descended, as if there were a consensus that it would be best to forget the whole thing and move on.

What happened? What was going on here?

**THE TECHNIQUE OF COAL MINING**

Coal had been used in ancient Rome, but it was the advent of the steam engine that greatly increased demand for the fuel and made feasible the deep-shaft mining of the last part of the 19th century and the first part of the 20th, when most cases of miners’ nystagmus were noted.

Access to the veins of coal usually required a long approach through a vertical or horizontal shaft and from there through a warren of rooms and walls to the active coal face. When a new area of the coal vein was to be exploited, an approach tunnel was dug, shored up with timbers, and the coal face undermined by creating a cleft as low as possible near the floor. The “holer” or “undercutter” was a man with some skill with a pickax and proud of it, since it often required wielding the ax while crouching or even while prone or lying on the side, striking the bottom of the coal seam with a horizontal swing. If wedges pounded in high up on the coal face could not displace the coal downwards, holes for explosives were then drilled by hand in the upper layer. The blast then brought the coal face down on the undercut. With the undercut, larger and more valuable pieces of coal were yielded when the upper area was dropped. Some owners paid only for pieces larger than a certain size, and this was important because miners at this stage usually worked as independent contractors and were paid only by the bulk or weight of acceptable coal that they produced.
tagmus usually took 2 or 3 decades of working underground to develop, new cases were uncommon by the 1940s.

WORKING CONDITIONS IN THE COAL MINE

The coal mine was arguably the worst working environment to come out of the Industrial Revolution, worse even than the dark satanic mills of the textile industry. The work was dirty, dark, damp, back-breaking, dangerous, and deadly. A long workday without being able to stand erect made it an advantage to be short. Many mines were infested with rats. Human waste disposal techniques were primitive, so the stench was pervasive. Explosions were a constant danger where the tunnels were not adequately ventilated and pockets of methane could be ignited by the bare flame of candles or oil lamps. Pockets of carbon monoxide or oxygen-deficient air could be encountered unexpectedly and could suffocate an unsuspecting miner in seconds. Collapse of tunnel roofs, fires, and flooding could kill whole groups of miners in a single stroke. Mine accidents involving rockfalls, machinery, explosions, and being crushed by coal cars took the lives of 1000 coal miners a year in Britain a century ago. The whole environment was even more dangerous in the United States, where safety standards were poorly enforced: a 1907 survey by the US Geological Survey revealed a death rate of 3.39 per 1000, more than 3 times that of the United Kingdom, France, or Belgium.12 Even if an accident was not fatal, it often left the miner maimed for life. By the time he had put in many years in the mines, it would have been the rare miner who had not observed, if not been an actual part of, some mine catastrophe. (Incidentally, the rate of fatal occupational injury in mining [23.5 per 100,000 employed] was still the highest of all industries in the United States as late as 2002.13)

Well into the 20th century, the industry was a sinkhole of child labor. “Breaker boys” as young as 8 years old were thought too small to handle a pickax but not too young to sit for hours in the dust and noise of the “breaker” rooms, picking away the slate and other rock mixed with the coal that went past beneath them on conveyor belts. Many of them chewed tobacco to keep from swallowing the coal dust. Extant photographs of breaker rooms attest to their similarity in the Pennsylvania coal mines and the UK collieries (Figure 1). Similar parallels existed in mine construction and operation.

Many experienced coal miners from England, Wales, and Scotland emigrated to the Pennsylvania coal fields in the last half of the 19th century. Thus, at least part of the workforce in Britain and the United States was to some extent genetically similar.14

Although the working environment and the genetic constitution of the miners were similar, the prevalence of miners’ nystagmus was not. A survey of US miners showed that 1% to 4% had nystagmus, but almost all were asymptomatic. In the United Kingdom, Llewellyn15 found that 25% of underground workers had oscillations, and although only 0.5% to 2% were symptomatic, the coal industry in Britain was so large and employed so many miners (more than a million) that when British claims for disability due to miners’ nystagmus became increasingly common after 1913, it became a heavy load on the entire workers’ compensation system.

WORKMEN’S COMPENSATION IN THE UNITED KINGDOM

The workmen’s compensation system after the turn of the century in the United Kingdom was a distinct improvement over previous means of compensating workers for injuries incurred on the job. This usually required workers to file suit against the employer and prove his negligence; the employer could defend himself by asserting contributory negligence by the worker or his fellows or that the worker had known of dangers inherent in the work and had therefore assumed responsibility for any injury by accepting employment. The process was subject to all the vicissitudes of the court system to establish employer liability before compensation was paid, much like what happens currently with medical malpractice. Starting in the latter part of the 19th century, safety codes were enacted specifying the responsibility of the employer to provide safe working conditions. Employers began to carry liability insurance and to become more interested in mine safety. A no-fault system of liability was established that proved advantageous to both mine owner and miner. Government commissions then set regulations and payment scales not only for injuries but also for disease. By listing, prescribing,
or scheduling a disease as being caused by unavoidable exposure to the work environment, coverage was extended to diseases incurred in the line of work.\textsuperscript{16-19} The court system could still be used if an employer denied that a certain case was covered by the regulations.

In the words of the parliamentary commission on workmen's compensation, the criteria were as follows:

\textquote{Those symptoms which were due to a cause which operated at a definite moment of time were regarded as the result of "accidents"; others were the result of "diseases" or injuries not being injuries caused by "accident."} Two other tests applied to any disease or injury considered were (i) did it incapacitate for more than one week? and (ii) was it so specific to an employment that the cause could be established in individual instances?\textsuperscript{20}

The requirement that actual nystagmus need not be present was passed by a parliamentary commission in 1913 in what sounds like a contentious and acrimonious session:

It was suggested that miners suffering from clonic spasm of the eyelids had been refused certificates because they did not exhibit nystagmus, i.e. oscillation of the eyeballs. There was a considerable divergence of opinion and experience. . . . The term "nystagmus in the process of mining" should be replaced by "the disease known as miner's nystagmus, whether occurring in miners or others, and whether the symptom of oscillation of the eyeballs be present or not."\textsuperscript{20}

Thus, coverage was extended to "miners' nystagmus" in 1906, originally referring only to symptomatic ocular oscillations. However, in 1913 the definition was changed to "the disease known as miners' nystagmus," and this change in effect extended the scheduled disease to include other manifestations. At that point, the incidence of new cases each year began to climb rapidly, and by 1938 it is said that 1.4% of all underground miners in the United Kingdom were affected.\textsuperscript{21} One individual who experienced miners' nystagmus was said to have been Aneurin Bevan, who, as minister of health in the Labor Party government voted into power in 1945, was instrumental in establishing the cradle-to-grave national health service of the postwar years.

\section*{THE PHYSICIAN'S DILEMMA}

Physicians in Britain were right in the middle of the problem because they had to certify the presence of miners' nystagmus for the worker to claim disability. In this they were acting as mediators between the state, the law courts, and the individual, an uncongenial role for many physicians and a factor that may help explain some of the acrimony that developed around the diagnosis.

The basic problem with miners' nystagmus in Britain was the conflation of an objectively seen eye defect—nystagmus—and a group of second-order manifestations into one "disease" called "miners' nystagmus."

The British physician tended to diagnose "miners' nystagmus" when confronted by a symptom complex that included giddiness, insomnia, depression, tremors of hands or head, lid tics (specified as "clonic spasms" in the regulations), headache, night blindness, photophobia, anxiety, and palpitations in a coal miner—even in the absence of nystagmus. When it came down to it, the nystagmus was not crucial. The whole symptom complex in a coal miner was due to the malign nature of the work in a susceptible individual.

Voices unsympathetic to miners objected that money spent on disabled miners raised the price of coal and made British coal less competitive against foreign sources. But all were caught in a logical bind due to the contemporary definition of occupational disease: if the disability was due to a scheduled disease or to illness even indirectly subsequent to it, the worker was eligible for compensation just as much as if the disability were due to an accident.

Physicians searched for purely organic pathophysiologic rationales for the clinical findings, and the darkness model became the most popular for explaining the ocular oscillations. Some were taken with the prolonged contortions, with the head held back at an angle,\textsuperscript{22} required of the miner at the coal face digging the undercut, especially when the vein of coal pitched upward (Figure 2 and Figure 3). It was hard then to resist the temptation to feel that disturbed vestibular reflexes or oculomotor fatigue were involved.

Others recognized that there were psychogenic elements but generally were adamant in denying that these men were malingering (although there undoubtedly were such cases). Certainly if one looks at the paltry sums the miners were paid for disability, the money does not seem to be much of a motive. Also, a claim for disability held a good deal of risk for the miner. Usually these men had been many years in the pits before symptoms disabled them, and they usually improved in 3 to 6 months if they could spend days and nights above ground. However, benefits were paid for only a limited time. If
a recovered miner wished to resume work, and the only work his employer was willing to assign him was a return to the coal face, mine owners often resorted to various legalisms to avoid continuing to employ such a miner at all.23 Still, what the diagnosis of miners' nystagmus gave these miners, consciously or unconsciously, was a socially acceptable excuse to get out of the mine, at least for awhile.

There was a certain logic to all this, but it led to controversy and confusion. British journals were full of the discussion.24-64 A spirited exchange of letters occurred in The Lancet in March and April 1940, just before blitzkrieg hit the British and French armies.55-67 After Dunkirk, miners' nystagmus disappeared from the pages of The Lancet until 195162 and then disappeared for good.

But miners' nystagmus persisted in the textbooks. What could have been done would have been to split the condition in two: (1) a nystagmus in coal miners with subsequent blurred vision of a sort, illusory motion of the environment, and perhaps also head tremor (which is common in acquired pendular nystagmus due to brainstem or cerebellar disease), and which in and of itself was infrequently symptomatic, and (2) another syndrome of various psychogenic dysfunctions with or without nystagmus and with a problematic relation to it.

In effect, this is what Cogan did in his textbook; he discussed the first and ignored the second. But the British physician could not do that. Only "miners' nystagmus" was scheduled as a compensable disease—not anxiety reaction or hysteria or neurasthenia or any other psychiatric term. "Miners' nystagmus" it had to be.

**WHY DID THE UNITED STATES ESCAPE THE EPIDEMIC OF MINERS' NYSTAGMUS SEEN IN THE UNITED KINGDOM?**

"Is there any point to which you would wish to draw my attention?"

"To the curious incident of the dog in the night-time."

"The dog did nothing in the night-time."

"That was the curious incident," remarked Sherlock Holmes.59

This crucial question evidently was never raised in print, although it was surely equivalent to the Holmesian hound that did not bark in the night. First, the US compensation system for disability was just starting to recognize industrial disease.68 But there was also something else. The epidemiology of miners' nystagmus in the United Kingdom resembled that of a contagious disease. There were "infected mines" just as there were "infected regiments" with shell shock in World War I. Suggestibility is common in those susceptible to hysteria, and there was surely a pool of such miners in both countries. Luckily the United States was far enough away from the United Kingdom—and without television—so as to escape spread of the contagion to suggestible US miners.

Showalter's70 views on hysteria, sometimes controversial, are particularly germane here:

Hysteria is a mimetic disorder: it mimics culturally the permissible expressions of distress....[H]ysterical epidemics require at least three ingredients: physician enthusiasts and theorists; unhappy, vulnerable patients; and appropriate cultural environments.... During the 1880's, English physicians began to describe numerous cases of "traumatic hysteria": men suffering from physical symptoms and emotional distress after railway accidents [which had exposed them to] fear, shock, and terror....

And hysteria was a significant burden on both sides of the Atlantic:

By the end of [World War I] 80,000 [British] men with shell shock or war neurosis had sought medical help....In 1932, 36% of British veterans receiving disability payments...were psychiatric casualties. In the USA, 58% of the patients in VA hospitals were neuropsychiatric casualties of the Great War.70

**WAS THERE A UNIQUE FORM OF NYSTAGMUS DOWN IN THE MINE?**

Was there actually a core condition of nystagmus induced by prolonged years of working at the coal face in dim light? Leigh et al71 write of miners' nystagmus in their discussion of acquired pendular nystagmus:

Miners' nystagmus is a rarity, limited presumably to mine workers in the UK. It is described as a small-amplitude, horizontal and vertical nystagmus that is often more pronounced in upward gaze. The pathogenesis of this putative dysfunction is uncertain but functional contamination with voluntary "nystag-
This supposes that voluntary nystagmus, usually considered a kind of parlor trick by a few unusual individuals, was much more common down in the pits than usually thought true of the general population (although one opinion, based on an informal study of a single sample, feels that some 5% of the general population may have the knack). It also implies that most of the miners’ nystagmus cases were malingered.

Yet what was Llewellyn seeing when he recognized nystagmus in up to a quarter of all veteran miners? Whatever it was, I doubt it could really have been all a voluntary nystagmus, no matter how mischievous his subjects were.

Duke-Elder and Wybar cite observations of unilateral nystagmus, in which the movements were frequently vertical, and dissociated nystagmus, in which one eye had vertical oscillations and the other eye had rotary movements, a bit too bizarre for volitional action. They reprint an electronystagmogram of one patient with conjugate pendular movements but do not indicate whether nystagmus was sustained. That would have been a crucial way of distinguishing it from voluntary nystagmus, which is rarely sustainable for more than a minute.

It is useful here to read the earliest reports of miners’ nystagmus, before the entity became common knowledge and controversial, and when the miners themselves could be assumed to be more unsophisticated about its implications. The clinical findings as described in the early reports of the condition in the 1870s and 1880s do not impress the reader as a conspiracy to confuse the examiners.

Also, a recent article from Pakistan, in a context where workers’ compensation was not a likely factor, found nystagmus in almost 3% of miners, even supposedly with modern forms of illumination underground.

I think there probably was a unique phenomenon down there in the darkness, and although now we will never know for certain, I would trust the astuteness of these early observers.

THE MORAL OF THE STORY

Of what earthly use is there in discussing the passing of an obscure and (yes!) minor eye condition that was rarely seen in the United States? For one thing, miners’ nystagmus lives on in the many books and Web sites devoted to the history of the coal mining industry and the subject of occupational disease generally. A search of the Web via the Google browser in August 2006 revealed 948 Web sites discussing miners’ nystagmus, including the esteemed Dorland’s Illustrated Medical Dictionary, which repeats material from the textbooks of 30 to 40 years ago. The International Classification of Diseases, Ninth Revision, lists miners’ nystagmus (300.89) under nystagmus (379.30) (and just after numbness (302.89)).

British books from the interwar period refer to miners’ nystagmus when they attend to the hardships experienced by coal miners and their families. Orwell’s classic book of the 1930s on the British underprivileged, The Road to Wigan Pier, evokes sympathy for the scourge of miners’ nystagmus. A contrary view by Cronin in his famous novel The Citadel berates miners for faking symptoms. Miners were certainly exploited, but to present them as either fakers or as subject to some devastating disease of the central nervous system does not make the best case for them.

The story is also an example of how the social milieu influences the appearance and management of disease. Without workers’ compensation and the ensuing litigation it occasioned, there may have been just as many distressed miners, but they would have come rarely to the attention of anyone but a few physicians, and those physicians would have had a harder time getting better lighting and other reforms applied to the mines.

More generally, there is the continuing problem in medicine of how to deal with patient symptoms for which no anatomical or biochemical abnormality can be demonstrated. Chronic fatigue syndrome, fibromyalgia, irritable bowel syndrome, Gulf War illness, and premenstrual dysphoria, for example, are still puzzling conditions with no clear pathogenesis. Even defining these entities is problematic. The distinction between a hysterical conversion syndrome and malingered continues to be vexing especially in military medicine. Chronic posttraumatic stress disorder, a term criticized by some as medicalizing normal human emotions, seems to be so widely accepted today that psychological counseling is advised for its prevention in victims not only of war but also of crime and natural disasters.

A recent appearance of miners’ nystagmus in the literature—in an editorial actually labeled “Miners’ Nystagmus”—appeared in of all places the Journal of Hand Surgery, where the author uses miners’ nystagmus as an object lesson for modern physicians trying to deal with hand pain in computer operators and other repetitive stress or strain injuries” that rely on patient symptoms alone and do not have demonstrable abnormalities.

Last, there is the behavior of the medical literature, both then and now. Miners’ nystagmus was acknowledged on both sides of the Atlantic Ocean to be a serious problem. The US Department of the Interior in 1916 commissioned a monograph that dealt with miners’ nystagmus at some length (with 8 references from Germany, 11 from France and Belgium, 56 from the United Kingdom, and none from the United States), as if the Bureau of Mines was preparing itself for the other shoe to fall. Meanwhile, like a camel with its nose under the tent flap and soon to occupy center stage, pneumoconiosis was making a tentative and long-delayed appearance in the literature.

The British ophthalmic literature on miners’ nystagmus extended more than 70 years. There were panel discussions, letters to the editor crossing back and forth, articles on dark adaptation, color vision, binocular vision in miners, even the deliberate induction of nystagmus in immature kittens and in a 7-month-old chimpanzee kept in the dark for prolonged periods, and...
cited to defend the miner with “nystagmus” from being automatically deemed neurotic. The writing was sober, earnest, and considered. Much of it consisted of unvarnished clinical impressions, with writers promoting their favorite theories and, until relatively late, often failing to distinguish ocular oscillations from the other manifestations. Only occasionally did the literature get to the core of the problem.60 (See particularly the eminently sensible discussion by an anonymous psychologist in 1940. 93) Physicians of the time were not obtuse but were unwilling to accept purely psychological explanations, partly for the social stigma involved, although Britain after 1914 became very much aware of the shell shock or war neuroses induced by the unprecedented viciousness of trench warfare.94 One cannot avoid the impression that the social implications of the problem—trade unions vs mine managers, class vs class, lawyers and press chiming in—induced much of the acrimony and made the calm and dispassionate scientific voice harder to hear.

This then presented a grand opportunity for the authors of textbooks, and that opportunity was lost. In the writing of a textbook, each author strives a balance between the urge to be all-inclusive when abstracting the literature and the obligation to qualify it with the author’s personal opinion, so as to give the reader some guidance. Walsh and Duke-Elder were bastions of learning in their time, but they failed to fulfill this obligation to the reader when it came to miners’ nystagmus. Walsh, although stating that he had seen only 1 possible case in all his vast experience, was curiously loath to face up to the disparate status of miners’ nystagmus in the United Kingdom and the United States, tiptoeing around the subject in such a way as to make one suspect that all this was by then a particularly sore point in Anglo-American neuro-opthalmic relations.

So in neuro-opthalmology textbooks, as we have seen, the subject was eventually dropped without, in the overused modern parlance, obtaining “closure.” But “may not exist”? Well, nystagmus in coal miners did exist at one time. Was it real? Yes, it was real, as real as all the other hardships that assailed these men when they went underground.

It’s dark as a dungeon and damp as the dew,
Where the danger is double and pleasures are few,
Where the rain never falls and the sun never shines,
It’s dark as a dungeon way down in the mine.

[From the song “Dark as a Dungeon” by Merle Travis]

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