few minutes the general anaesthetic was discontinued, and the patient passed into a hypnotic state, during which voluntary movements of the previously paralysed limb were normally executed in response to verbal commands, reinforced by occasional painful stimuli, such as twisting the ear, pressing the supraorbital notch, pricking the previously anaesthetic limb, etc. During this stage analgesia of the opposite limb was temporarily suggested, and pins could be passed through the skin without pain. Lastly, it was suggested that all his sensory and motor disabilities should disappear, and, as the effects of the ether passed off, this was found to be actually the case.

Ever since his séance with ether and nitrous oxide, the patient has remained able to move the limb normally at all joints (see Fig. 2), whilst all varieties of cutaneous and other stimuli are promptly and normally recognized.

The Milroy Lectures

ON

THE HYGIENIC ASPECT OF THE COAL-MINING INDUSTRY IN THE UNITED KINGDOM.

DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS OF LONDON.

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LECTURE II.

CAUSES OF EXPLOSIONS.

UP to a comparatively short time ago colliery explosions were attributed to the inflammability of fire-damp; but in a modern well-ventilated mine, while the explosion of fire-damp may be the initial agent, it plays practically no part in the actual explosion in the workings. An explosion can be produced readily by firing a mixture of coal dust and air, and the proportions necessary to form an inflammable mixture are, roughly speaking, 1 lb. of coal dust to 160 cubic feet of air.

COAL DUST WATERING.

The finer the coal dust the more explosive. While fire-damp explosions begin at the working face, coal dust explosions usually take place in the main haulage roads. The coal dust may be ignited either by a blown-out shot (a shot that had been put into the hole in such a manner as to be blown backwards without blasting the rock or coal), or by the exposed flame of a broken safety lamp, by a fused electric cable, or by sparks emitted from coal-cutting machines. In other cases, however, there has been an initial explosion of fire-damp at the working face, carried through the workings by the ignition of coal dust, and a large number of explosions have been caused through the ignition of fire-damp by naked lights in pits where safety lamps are not employed.

Fire-damp explosions can be and are prevented by improved methods of ventilation and by the early detection of the fire-damp in small quantities by means of the cap over the flame of the safety lamp. In considering the prevention of coal dust explosions, the first problem is how to prevent the accumulation of coal dust. The presence of coal dust is inevitable in a mine. The removal of dust by periodical sweeping of the roadways, sides, and roof has been advocated, but a more effective method is by watering the roadways, a method practised for some years in Germany and Belgium, and successfully adopted in many mines in this country. It is necessary to water the sides and roof as well as the roadways. It is, however, the general opinion that watering can never, for various reasons, be universally adopted, and spraying might under certain conditions have an injurious effect upon the miners' health. Again, falls of ground are more numerous in wet mines than in dry. Dust removal and spraying may be of some use, but they do not entirely remove the danger, though it may be hoped that

as a result of the Government experiments at Eskmeals a possible remedy is near at hand.

POISONOUS GASES.

The poisonous gases found naturally in mines are black-damp, fire-damp, carbonic acid, and, in small quantities, sulphuretted hydrogen and sulphurous acid; as a result of explosives we may also find oxides of nitrogen. Carbon monoxide is invariably generated as the result of an explosion, whether of fire-damp or coal dust.

Black-damp.

This is the residual gas after oxidation of materials present in the coal, oxygen of the air being taken up with the formation of carbonic acid. It is found more or less in all mines, and always in the return air of the upcast ventilating shaft.

The composition of black-damp varies under different conditions, but, speaking generally, it is a mixture containing about 87 per cent. of nitrogen and 13 per cent. of carbon dioxide. It is probably formed in the process of oxidation of iron pyrites which is present in the coal. This sulphide is oxidized to sulphuric acid and sulphate of iron, and as calcium carbonate in the form of calcite is also present in the coal, calcium sulphate is formed with the liberation of carbonic acid, and, according to Haldane, the process may be represented by the following equation:

Black-damp as a rule has a greater specific gravity than air, and consequently is found on the floor in low-lying workings, but there are cases in which black-damp is lighter than air, cases in which the black-damp contains less than 5 per cent. of carbonic acid (Cadman), or when it is mixed with other gases, such as fire-damp. When there is an accumulation of black-damp lighter than air it is most important that it should not be examined except with a safety-lamp, on account of the possibility of the presence of fire-damp. With a falling barometer the percentage of black-damp may be very greatly increased, and to such an extent in some workings that it is necessary for the miners to suspend their operations.

This gas is recognized by the safety lamp from the fact that when present in small quantities the flame will only burn dimly, and when in larger quantities the flame may be extinguished altogether. This is due to the lack of oxygen, and not to the presence of carbonic acid.

The effects of black-damp on the human subject are due to the presence of carbonic acid and the deficiency of oxygen. The initial symptoms are shortness of breath, quickened pulse, and increased respiration-rate, followed by headache and giddiness. If the victim is unable to get away he may be overcome with drowsiness, and if the black-damp be of sufficiently high percentage he may become insensible and eventually die. Before death there may be marked cyanosis, and the heart may continue to beat for some little time after the breathing has stopped. Death is always due to suffocation or to injuries produced as the result of a fall when the miner is overcome by the gas.

Treatment.—It is most important to get the victim into pure air as soon as possible, and if breathing has stopped, artificial respiration should be resorted to without delay. If the heart has not stopped and oxygen be administered at the same time there is every chance of recovery. If oxygen be available in the pit the rescuer should administer the gas to the sufferer if he be unconscious without removing him, and artificial respiration should be carried out by a colleague.

The *post-mortem* appearances due to black-damp poisoning are similar to those of asphyxia.

Fire-damp.

The constitution of fire-damp is at the present time a matter of controversy. Dr. Haldane holds that it is pure methane, and he has found that the fire-damp met with in lead mines, shale mines, and the Cleveland ironstone mines has also reacted as pure methane. On the other hand, Le Chatelier finds that fire-damp in French coal mines apparently consists of two constituents, one of which is combustible and the other non-combustible, the former constituting in some cases about 95 per cent. of the

whole. Chamberlin, in the United States, has found that, in addition to methane, paraffines and olefines are also present in small percentages, and in Germany, associated with certain kinds of coal, ethane is also said to be found as a constituent of fire-damp. Methane (CH_4), a completely colourless and odourless gas, exists in the coal seams at a high pressure, which sometimes may be as great as 400 lb. to the square inch. The air in abandoned workings often contains a considerable percentage of methane, derived not only from the coal, but from the decomposition of old timber props.

The specific gravity is 0.559, air being 1, and thus the gas is always found in the highest places of the mine. It burns with a bluish flame, and when mixed with air forms an explosive mixture, the explosive character of which varies with the proportions of the two gases, the most explosive mixture being reached when methane forms about 10 per cent. of the mixture with air. The lower limit of inflammability is 5.5 per cent. of fire-damp in a mixture of methane and air, and this limit seems to be pretty well established; the upper limit of inflammability does not extend beyond 15 per cent., and the combustion in many instances may not be complete when the proportion is greater than 13 per cent. of methane. No explosion can take place in a mixture of methane and air if the temperature of the flame be lower than 740°C . The limit of inflammability will depend to some extent upon the atmospheric pressure, and by increasing the pressure a mixture containing less than 5.5 per cent. of methane may become explosive, and conversely if the pressure be diminished a mixture containing a greater percentage of methane than 5.5 may not explode.

When methane is present the flame of the safety lamp flickers and a pale, non-luminous, slightly blue cap is seen above the ordinary flame. The observations and experiments of Professor Cadman have made it possible to estimate roughly the percentage of methane in mine air by measuring the height of the cap as compared with a test flame of a standardized and measured height. His observations when recorded in an atmosphere containing 3.7 per cent. of fire-damp show as follows:

Height of Testing Flame in Inches.	Height of Cap in Inches.
0.1	0.85
0.2	1.1
0.3	1.4
0.4	1.75
0.5 cap not seen; testing flame too luminous.	

While a mixture is not inflammable unless 5.5 per cent. of methane is present, methane can be detected by means of the luminous cap when it is present to the extent of only 1 per cent.; but it is impossible to see the tip of the cap unless at least 2 per cent. of methane is present in the mine air.

Fire-damp has no direct deleterious effect on man. It simply dilutes the oxygen of the air so that its action may be regarded as the same as that of nitrogen, or, to put it in other words, it is due to deficiency of oxygen. Life is not endangered until the percentage of fire-damp reaches somewhere about 70, although when the percentage is between 40 and 50 the respiration-rate and the pulse-rate will be increased, and there will be palpitation of the heart, cyanosis of the face, and pronounced muscular weakness. Fatal accidents sometimes result from miners walking into an accumulation of pure fire-damp.

When the mine air contains fire-damp to the extent of 5.5 per cent., or the lower limit of inflammability, even if there is no explosion, the flame of the safety lamp is extinguished; this fact is an indication of the presence of fire-damp, and should be of great use to exploring parties.

Treatment.—The treatment of poisoning by fire-damp consists in restoring the patient to pure air, and the application of artificial respiration in severe cases. Oxygen should be applied wherever available in all serious cases.

The *post-mortem* appearances after poisoning by fire-damp are not unlike those found in cases of black-damp poisoning; they are those of asphyxia.

After-damp.

This term is applied to the gases after an explosion. Haldane has described it as a variable mixture of nitrogen,

carbonic acid, and carbon monoxide, together with air; in dust explosions there may also be present a little sulphurous acid or sulphuretted hydrogen and various products of the dry distillation of coal. While sulphurous acid and sulphuretted hydrogen are highly poisonous bodies, still the deleterious properties of after-damp are undoubtedly due in nearly every case to carbon monoxide. After-damp may be found under several different conditions as a result of incomplete combustion, as from a gob-fire, or as a product of combustion of a blasting explosive.

When fire-damp ignites in the presence of an excess of air, carbonic acid and water are formed, but when the proportion of air is not sufficient for complete oxidation, carbon monoxide is produced as well as carbonic acid. We may infer from *post-mortem* observations that death in the vast majority of cases is due to carbon monoxide poisoning, and that, speaking generally, there is never sufficient air to bring about complete oxidation. When sulphurous acid or sulphuretted hydrogen are present the after-damp acquires a characteristic and unpleasant smell, but otherwise it is odourless. Carbon monoxide has an affinity for haemoglobin which at the ordinary body temperature is more than 300 times greater than that of oxygen, producing the stable body carboxyhaemoglobin. The effect of the gas is cumulative; 0.4 per cent. in the air will produce a fatal result if the air be breathed for a sufficiently long time, but after an explosion from 2 to 5 per cent. of carbon monoxide is generally found, and as a consequence death rapidly ensues. Leonard Hill regards 0.05 per cent. as the highest allowable limit of after-damp in the atmosphere of a mine. Pure carbon monoxide burns in air with a bluish flame, but when diluted to the extent found in after-damp a naked candle and a safety lamp will continue to burn in it. After-damp is best detected by means of a mouse or a small bird, such as a canary, either of which will show symptoms of poisoning very much sooner than the human owing to the rate of metabolism in these small animals being very many times greater than that of man.

Symptoms.—The symptoms of carbon monoxide poisoning depend upon the amount of gas inhaled and the amount of carboxyhaemoglobin formed in the blood. If the air contain only a small percentage of the gas the symptoms are headache, nausea and palpitation, and shortness of breath and giddiness on exertion; with a larger amount of gas headache may be accompanied by singing or buzzing in the ears and throbbing of the temples, but the most striking symptom is always muscular weakness. If the gas be present in the air to the extent of 0.05 per cent. the limit which Dr. Hill has laid down, slight giddiness results after inhaling it for half an hour; if carbon monoxide be present to the extent of 0.1 per cent. there is inability to walk after half an hour; if 0.2 per cent. be present there is loss of consciousness after half an hour, and with 1 per cent. loss of consciousness results after a few minutes and death rapidly ensues. Drowsiness, and even unconsciousness, occur in a large number of non-fatal cases, and in fatal cases death may be ushered in by convulsions and coma. Exposure to this gas in cases which recover may produce a deep-red blotchy appearance of the face, which has been noticed for as long as fourteen days after the explosion, and in some cases the characteristic rosy flush which is associated with carbon monoxide poisoning has been observed. Chauffard has found an extreme exaggeration of the olecranon reflex, while the knee-jerks were not exaggerated to the same extent, and he noticed that Babinski's sign was positive on both sides. Sometimes we find incontinence of the bowels and retention of the urine, and transient glycosuria may be observed for a few days. The pupils may be fully dilated and insensible to light, and Ruata records as a symptom acute delirium, which in one case lasted for five days.

Examination of the Blood.—If blood be saturated with carbon monoxide it has a bright scarlet or cherry colour, but the blood from the body of a man directly killed by carbon monoxide has a dark purplish-red colour, the dark colour being due to an admixture of carboxyhaemoglobin with reduced haemoglobin. On spectroscopic examination blood which contains carbon monoxide shows two definite observation bands between D and E. If the blood be saturated with carbon monoxide, the addition of ammonium sulphide produces no effect, thus differing in this respect from healthy blood. Haldane has devised a colorimetric test which is both simpler and much more

delicate than the spectroscope. A drop of blood from a patient who is supposed to be suffering from carbon monoxide poisoning is diluted with about a hundred times its volume of water, and compared with a solution of the same depth of colour from normal blood obtained from the lobe of the ear or a prick of the finger. Part of the solution of normal blood is saturated with coal gas and changes from yellow to pink. We thus have three solutions: (1) The solution of blood from the supposed case of carbon monoxide poisoning, (2) a solution of normal blood diluted to the same extent as No. 1, and (3) the normal blood through which coal gas has passed. These three solutions are then poured into narrow test tubes of equal diameter, and a comparison is made. If the depth of colour of the first solution appears to be greater than that of the other two solutions water must be added until the tints are exactly the same, but if the depth of colour is less than the two solutions then a few more drops of blood are added for the same purpose. We are now able to compare the tints of the three solutions, and a rough estimate can be made of the degree of saturation by noting the amount of water or blood, as the case may be, which it has been necessary to add to the first solution to ensure the same depth of colour. Normal blood, when diluted with water, is yellow in colour, while blood containing carboxyhaemoglobin is pink, and it is upon this observation that the colorimetric test is made.

Notes on After-damp Poisoning at Senghenydd.

I paid a visit to Senghenydd two days after the terrible explosion which occurred there in October, 1913, and had the opportunity of examining many men who were rescued from the pit on the day following the explosion. The principal clinical features of these cases were that in those who had been badly gassed the pulse-rate was most irregular, not only as regards frequency, but as regards volume and character, and examination of the pulse gave no indication of the physical condition of the patient. At one time the pulse might be slow, feeble, and irregular, apparently the pulse of a patient slowly sinking; but, without apparent cause, ten minutes afterwards the pulse would be of normal rate and would have materially improved in quality. Dr. Philip James of Senghenydd, the principal medical officer to the colliery, told me that this was a special feature of these cases, and it made it impossible to give a correct prognosis to the friends of the patient.

The large majority of these cases showed large erythematous patches of a bright cherry colour with clearly defined margins, but of irregular shape; they varied in size from areas of 6 in. long by 4 or 5 in. broad down to areas $1\frac{1}{2}$ in. long by $\frac{1}{2}$ in. broad. They were tender and tense, with a considerable amount of induration around the patches. The patches were principally located upon the buttocks, sometimes only on one side. When both sides of the buttocks were affected the patches were not symmetrical. I am not aware that this condition had been described before, and in some cases they were reported to me as superficial burns. I am sure they were not burns, not only because of the location of the rash, but also because there was no blister over any of these areas; further, some patches developed for days after the explosion. The induration was very slow in clearing up. Six weeks after the explosion the patches were smaller and the induration had subsided to a large extent, but not completely. The skin over the patches was discoloured, and there was desquamation, while the follicles were prominent. The oedema around the patches had disappeared, and there was hyperaesthesia over the patch of skin which remained, and anaesthesia over the area of skin which had been originally affected.

The third striking clinical point was the development of peroneal palsy, or ankle-drop, in many of the cases who were rescued. Previous writers have recorded paralysis of different kinds as being a symptom of carbon monoxide poisoning, but I have never found any special reference to peripheral neuritis affecting the peroneal nerve and causing ankle-drop. This symptom developed from two to four days after the explosion. The early symptoms were pains in the legs, there was tenderness along the peroneal nerve, and talipes equino-varus. The peroneal paralysis passed on from the acute to the chronic stage, and in some cases I fear that the paralysis will be permanent. Six

weeks after the explosion the symptoms were loss of power of dorsiflexion of the foot. In one or two instances there was complete paralysis in this respect, and in some diminished power of plantar flexion. The cutaneous reflexes were absent over the area of skin supplied by the peroneal nerve and in some cases irregular areas of skin, apart from the distribution of this nerve, were similarly affected.

After many explosions it has been frequently observed that pneumonia of a particularly dangerous type was a frequent sequela, and the Senghenydd explosion was no exception. Several of the patients developed pneumonia almost immediately they had been rescued. The temperature was very little raised, the pulse was variable in frequency and quality, the respirations were quick, and the expectoration from the onset contained blood of a dark blue colour. Examination showed irregular patches of dullness on both sides of the lung.

Retention of urine was a striking symptom in every case, and in two cases there was paralysis of the sphincter ani.

I do not propose to give details of the cases which I examined at Senghenydd, as they are being carefully observed by Dr. Ivor Davies, of Cardiff, who will shortly publish an account of the clinical aspect of after-damp poisoning.

After-effects of Carbon Monoxide Poisoning.

The after-effects of carbon monoxide poisoning are often serious, and may be so varied as to suggest the possibility that the patient is suffering from some other disease. Headache may persist for weeks, and I have known severe headache to persist for six months. Symptoms of indigestion may also persist for an equally long time. In cases which recover within a few weeks we may find that muscular weakness, pains in the legs, and aching of the knees and ankles are complained of as after-effects for some days, and there are recorded cases in which these symptoms were present for a week or two after the explosion. Other noticeable symptoms are coldness, heaviness, and numbness of the legs and feet, and, occasionally, shooting pains. These symptoms are, in my opinion, due to neuritis.

The after-effects of carbon monoxide poisoning upon the human subject are entirely confined to the central nervous system. Mental symptoms, disturbance of memory, changes in the voice and speech, hemiplegia, and monoplegia all denote some toxic effect on the brain; sclerosis of the spinal cord, poliomyelitis indicate pathological changes in the spinal cord, and we have seen that peripheral neuritis is one of the most frequent sequelae of this poison, and these toxic effects produced by carbon monoxide are so similar to the toxic effects produced by other poisons that it almost seems as if toxæmia, no matter how produced, has the same effects upon the central nervous system.

A large number of miners are pale, and it is a matter of speculation whether the paleness is due to the daily inhalation of very small quantities of carbon monoxide. This peculiarity cannot be the result of working underground for forty-eight hours each week without some further cause, and it may be a subject for further observation, and even research, whether this condition might not result from breathing some deleterious gas, such as carbon monoxide, in very small quantities. I have taken blood counts of many miners, and have examined the blood for carbon monoxide, but with only negative results. Sir Thomas Oliver has questioned whether miner's nystagmus may not be due to the toxic effect upon the central nervous system of small quantities of carbon monoxide continuously inhaled while the miner is at work in the pit.

Treatment.

It is important to remove the man into fresh air with as little delay as possible and without undue exertion, and it is equally important that he should be kept warm so as to diminish the risk of after-complications. In some cases artificial respiration must be resorted to, and it is generally admitted that Schäfer's method is the best. In apparently hopeless cases patients have been revived after artificial respiration has been practised for three or four hours. The artificial respiration must be carried out in fresh air on the surface and not in the vitiated atmosphere of the mine.

Oxygen is of the greatest assistance in restoring patients suffering from after-damp, but it should be warmed by passing from the cylinder into an india-rubber bag placed in a bucket of hot water; the gas may thus be brought to the atmospheric temperature or a little higher.

Wilcox and Collingwood have recommended the inhalation of alcoholic vapour along with oxygen, and they claim that this mixture has a most beneficial action on the heart. Stimulants are of the greatest use in assisting the action of the heart, and of these sal-volatile by the mouth or hypodermic injections of strychnine have been found useful; adrenalin and pituitrin have also been recommended to increase the blood pressure. Venesection and transfusion of defibrinated blood have been tried in individual cases, and Mr. William Sheen of Cardiff has recommended in severe cases, where there is unconsciousness, that the patient be transfused with defibrinated blood on one side and that venesection be carried out on the other side.

The burns very often are of a serious nature and require special care. The skin affections, especially those which are angioneurotic, are best treated with powders rather than ointments, although if there be great pain it may be necessary to apply an opium lotion.

As the treatment of pneumonia is very largely a matter of nursing it is essential that patients should be attended by trained nurses from the very onset of the pneumonic symptoms. While Red Cross nurses may be very willing to do what they are told and may have very good intentions, unless they have been properly trained as nurses their efforts in cases such as these may be in many cases of little avail. I wish to emphasize this point because I feel that it is useless to rescue men from a mine after an explosion at great personal risk to the members of the rescue parties unless everything possible is done to save the lives of those who are rescued. There should be some proper arrangement for the immediate treatment of men who are rescued from explosions. I suggest that a few beds should be kept in the office to meet the immediate needs of men who are gassed, that in each colliery district there should be a cottage hospital with a few beds so that ordinary accidents may be treated in an efficient way and without delay, and then in the big centre we should have the large general hospital where serious injuries may be dealt with if no risk is incurred to the patient in removing him from the mine or from the cottage hospital.

The experience at Senghenydd clearly points to the fact that cases of peripheral neuritis will not cure themselves, and it is most important for patients to have the advantage of massage and electric treatment carried out under medical supervision and in a systematic way at the earliest possible moment. In the Senghenydd cases the amount of damage done to the nerves by the carbon monoxide was extensive, judging from the rapidity with which atrophy of the muscles set in, and it is not sufficient in such cases for the patients to be treated at home, and probably by themselves, with simply liniments and medicines. As systematic massage and electric treatment can only be carried out in hospitals or institutions, it is most desirable that the patient be admitted for this treatment at the earliest possible moment, and before atrophy of the muscles supervenes.

The *post-mortem* appearances due to after-damp poisoning are for the most part characteristic of poisoning by carbon monoxide, but they may be associated with other conditions—the bodies may be severely burned as a result of exposure to flames, or there may be extensive wounds due to falls of ground produced by the explosion. Pneumonia in some instances may be the cause of death.

Sulphuretted Hydrogen.

Sulphuretted hydrogen may be found in mines under varying circumstances. It may be found mixed with fire-damp, or it may be found associated with gases which are given off from coal which has undergone spontaneous combustion, known as white-damp, choke-damp, or in some districts gob-stinks. It may also be a product of the chemical action of the ignition of some of the explosives. It is an extremely poisonous gas; it causes irritation of the eyes and the respiratory tract, with conjunctivitis, nasal catarrh, and pharyngitis; in severe cases there may be bronchitis, bronchopneumonia or lobar pneumonia, sometimes of a septic type.

Smoke.

In the case of an underground fire, smoke may be emitted in such large quantities as to be of danger to the workers, not only in the immediate vicinity of the fire but in any part of the workings where the smoke may be carried by the ventilating current. Carbon monoxide is the dangerous constituent of the smoke, although traces of sulphuretted hydrogen and sulphurous acid and nitrous fumes may also be present.

Sulphurous Acid.

Sulphurous acid is sometimes produced in small quantities along with after-damp. It causes irritation of the eyes and of the respiratory passages; with 0.003 per cent. the symptoms of irritation are most marked, and as little as 0.001 per cent. may produce some irritation of the conjunctiva and the air passages. Apart from conjunctivitis, the most common symptom noticed after inhaling an atmosphere containing sulphurous acid is bronchitis; the expectoration may contain blood mixed with the mucus, and as a result of the violent paroxysms of coughing in severe cases haemoptysis may be noticed. In some cases we find symptoms which affect the digestive organs, and dyspepsia of a more or less severe type may be set up.

Nitrous Fumes.

Nitrous fumes are very dangerous to life. The nitrous oxide (NO_2), which is the principal irritating constituent of nitrous fumes, when inhaled and absorbed into the system, unites with the haemoglobin of the blood and displaces the oxygen. While the patient is exposed to the fumes there may be momentary symptoms of irritation, such as smarting of the eyes, cough, expectoration, feeling of suffocation, and sickness; but these symptoms may pass away for some hours; then, sometimes quite suddenly, more serious symptoms may arise—shortness of breath, cough, feeling of suffocation, cyanosis, and difficulty of breathing. Septic bronchitis and bronchopneumonia are frequent sequelae, and the patient may die within a few days. In non-fatal cases the illness may extend over several weeks, and if the exposure to the gas has taken place in the early or mid winter there may be chronic bronchitis until the warm weather appears again. If a strip of white blotting paper be moistened with a solution of starch and a little potassium iodide and slightly acidified and exposed to nitrous fumes, even when present to a very low percentage, it becomes blue owing to the liberation of free iodine.

Rambousek says that in the treatment of patients who have been exposed to nitrous fumes the inhalation of oxygen is perhaps the most important remedy, and should always be tried. He also states that chloroform may be used, not because it produces any actual curative effect, but because some of the symptoms may be abated by its inhalation, and narcosis in this way induced.

Cases due to Explosives.

When miners are using the cartridges which contain the explosives, the men who are working at that place seek safety at some distance before the shot is fired. Gunpowder, gelignite, bobbinite, and samsonite are the four explosives most commonly used in the coal mines of this country. Gunpowder is a mechanical mixture of sulphur, potassium chlorate, and charcoal, and when it explodes gives off carbonic acid and nitrogen in large quantities along with a small quantity of sulphuretted hydrogen and carbon monoxide. Gelignite is a mixture of nitro-glycerine and sodium nitrate, and contains 65 per cent. of the former body. On detonation it gives off carbon monoxide. There are two kinds of bobbinite, both of which contain about 65 per cent. of potassium nitrate, from 18 to 20 per cent. of charcoal, and $2\frac{1}{2}$ per cent. of sulphur; but in one preparation there is added a mixture of the sulphates of ammonium and copper, while in the other we find a mixture of rice or maize starch with paraffin wax. With this explosive nitrous fumes and sulphuretted hydrogen in addition to carbon monoxide may be given off.

We are thus faced with the same problems in connexion with the gassing as a result of explosives as we have been in gassing after explosions. Haldane points out that the most serious accidents in mines from gases from explosives

are due to the accidental burning of the explosives and not due to detonation. When these explosives burn quietly it is found that a large proportion of nitrous fumes are produced.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

THE ELECTRICAL TREATMENT OF INTESTINAL STASIS.

I HAVE read with much interest the papers and subsequent discussion on auto-intoxication. That stasis in the bowels is responsible for much misery cannot be doubted, nor is it confined to the "idle rich," as Dr. Arthur Brock would have us believe. On the contrary, the trouble is very common in women who have to earn their own living by occupations which do not permit them to obtain sufficient fresh air and exercise. Some of these unfortunates suffer so long in silence that they are beyond any form of purely medical aid, even when first seen. For such, short-circuiting, or even colectomy, offers the only hope of relief.

In many, if not the majority, of cases, however, operation is unnecessary. It is, I think, commonly agreed that lack of tone in the system generally, and in the intestinal and abdominal musculature in particular, is the initial cause of the trouble. Abdominal belts and paraffin are merely props; massage and exercises will cure cases in their early stages; but for bad cases, which are yet not the worst, electricity is essential. Many forms may be used, but the rhythmically interrupted sinusoidal and static-induced currents appear to give the best results, and these results are fairly rapidly produced.

Improvement in the constipation sets in within a fortnight, and *pari passu* with this there is a gain in appetite, energy, and weight. The tongue cleans, and headaches disappear. There is no class of case in which electrical treatment may be prescribed with greater confidence; and it may be laid down that any case in which the diagnosis of stasis is established by a bismuth meal, and which is not at all improved by six weeks' electrical stimulation, properly carried out daily, can be cured only by operation. If colitis is present as well, with tenderness, a preliminary course of x rays and high-frequency may be necessary.

The cures, when made, are genuine cures, in that the previously lacking nervous and muscular tone has been restored; but relapse may occur after some months if the original depressing conditions are not removed.

The mere fact that ordinary medical measures, even combined with massage, have failed to cure a patient, does not, in my opinion, justify a recommendation to operate. Skilful electrical treatment, carried out by a qualified medical man in person, will cure quite 50 per cent. of such obstinate cases, and nearly all the milder ones. It will do so without pain, without risk, and—what is to many a most important matter—without interfering with the earning of daily bread.

Darlington.

FRANCIS HERNAMAN-JOHNSON, M.D.

HYDATID OF THE OMENTUM.

R. B., a Brahmin woman, aged 30, came into hospital in June, 1913, with a history of the abdomen having enlarged gradually for two or three years. She had considerable pain in the abdomen, which was greatly enlarged, and on palpation about twenty movable rounded swellings could be felt. They were tense, and felt cystic; some were very hard. They reached from the costal margin to the groins, and varied in size from a hazel nut to a large orange. The enlarged spleen was also felt. On vaginal examination the uterus appeared normal; one cystic movable swelling, about the size of an orange, could be found in the right fornix.

I showed the case to two doctors of large experience, and neither had seen a similar case before.

The patient clamoured for operation owing to the discomfort of the enormous abdomen, but I could not operate for three weeks, as the abdomen was covered with psoriasis. Meanwhile it continued to enlarge.

When the skin condition had improved I operated, assisted by Dr. Holland. On opening the abdomen we found it filled with cystic swellings of all sizes up to a fetal head; they were attached to the omentum—some very loosely, others wrapped up in it. They proved to be hydatid cysts, not daughter cysts enclosed in a capsule, but numerous cysts, all separate in the omentum, and many contained daughter cysts, while some only held fluid. Some were easily shelled out of their omental covering, others had to be very carefully separated, and necessitated many ligatures as the omentum was very vascular. After we had removed forty-two cysts we thought it best to leave the remaining dozen or so behind, as they were deeply embedded in omentum and would have taken some time to remove, and the patient, whose pulse had been poor from the start, did not appear to be able to stand any more. As it was, her condition was very critical for two or three hours after she was taken off the table, and for the next three days the pulse was about 160. She gradually improved. Three weeks after the operation she was again anaesthetized, for a swelling the size of an orange had formed in the epigastrium; this was opened and some 4 oz. of pus evacuated; this was evidently one of the cysts that had been left behind. Soon after another cyst near it also enlarged, and I tapped it and drew off clear hydatid fluid. The patient left the hospital fairly well, but returned two months or so later. There was a sinus and some of the cysts had again increased in size. She left before the sinus healed.

Shortly after this case another Brahmin came in with irregular masses in the abdomen and in great pain. She was very exhausted, but as she could not live on as she was I operated, and found, as I expected, that it was another case of hydatids of the omentum. This case was much more advanced than the first; many cysts had broken down, many contained pus, and the whole made up an adherent matted mass impossible to remove. The patient lived twenty-four hours—then collapsed suddenly.

By a rather curious coincidence I this year excised the eye in two Pathans; both cases proved to be hydatid of the orbit, the first I had seen.

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DEATH DURING ETHER ANAESTHESIA: STATUS LYMPHATICUS.

M. B., female, aged 34, was admitted to the Montreal General Hospital on November 12th, 1913, for bilateral talipes valgus. She had been a premature infant (eighth month), and had been artificially fed. At the age of 18 months she had had acute anterior poliomyelitis. In September, 1913, she underwent the operation of tonsillectomy under general anaesthesia.

At the time of her admission she appeared a well-nourished child, and presented no signs of rickets. Examination of the heart and lungs was negative. The anterior and posterior cervical glands were palpable. There was no apparent enlargement of the spleen. The urine was normal. On November 15th, 1913, she was given ether by the open method for a tendon-grafting operation. The course of the anaesthesia was uneventful until about an hour after its commencement, when the operation was nearly completed. Breathing then became somewhat gasping in character, and within a minute ceased. Artificial respiration was immediately commenced. Oxygen, camphor, and strychnine were administered, but without success. Respiration was never re-established.

At the autopsy the following conditions were found: The thyroid gland was normal. The thymus gland was greatly enlarged, especially on the left side. There was slight enlargement of the heart. The bronchial lymph glands were hypertrophied and showed areas of caseation. A caseous gland was present in the posterior mediastinum in close contact with the branch of the left pulmonary vein from the lower lobe. The spleen was enlarged. Peyer's patches and the solitary follicles in the large intestine were enlarged and very prominent. There was hypertrophy of the mesenteric glands. The pancreas, liver, kidneys, adrenals, and brain were normal.

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