An Address

ON

•RAND MINERS' PHTHISIS.

Delivered to the North of England Branch of the British Medical Association at Blyth.

By THOMAS OLIVER, M.A., M.D., LL.D., F.R.C.P.,

Physician, Royal Infirmary, Newcastle-upon-Tyne.

WHEN the invitation to deliver an address to the members of this Branch was conveyed to me by your Honorary Secretary, my first impulse was to refuse, for I felt I had nothing new to communicate to you; but when Dr. Anderson was good enough to suggest that a paper on miners' phthisis, as met with in men returned from the Transvaal, would be acceptable to the Branch, I acceded to the request of the Council, not that I could throw any fresh light upon the important problems connected with the malady, but that, living as we do in a large mining centre, it seemed to me to be a subject that had interest for all of us, and one to which in discussion you could contribute more than I could give.

ETIOLOGY.

The circumstance that brought gold-miners' phthisis into prominence in this country were more or less accidental. Three to four years ago I happened to be consulted by men who had returned from the Transvaal, and who were suffering from a type of phthisis something different to that which is ordinarily met with in tuberculous subjects, and which struck me as being probably connected with the dusty occupation which they had followed when mining in South Africa. Till then I had no idea of the high death-rate of miners on the Rand, nor had the medical profession and the public in this country. The publication of my paper in the *Lancet* of June 14th, 1902, drew the attention both of the Home Government and that of the Colonies to the high rate of mortality in both the white and native populations at the South African mines. A commission of local mining engineers and medical men was appointed by the South African Government to inquire into the subject and report upon the same.

The report of the Miners' Phthisis Commission was published in Pretoria, May, 1903, and it is for all persons who are interested in the subject a store of useful information. It forced the hand of the Government to introduce certain reforms in methods of mining, and to apply some of the remedies that had been previously recommended.

The rock of the Transvaal mines is extremely hard; it is of a quartz like nature compared with the coal of this neighbourhood, which although hard, yet comparatively speaking, gives off little dust. As a measure of the activity and the importance of the coal mining of this district, and for a few miles around Blyth, mention need only be made of the fact that 25,000 men are employed underground, and that the output of coal, according to Professor Merivale, is something like 9,000,000 tons a year. Rotary hand drills are used both in rock and stone, and coal cutters driven by compressed air and electricity are coming into use. When we compare the methods in use in this district with those on the Rand for getting the ore we find in South Africa a harder stone, greater depth of mines, higher temperatures, longer hours, and in addition the use of machine drills to an extent unparalleled by anything in this country.

From the North of England, especially Northumberland, there had been a steady migration for years past of young healthy miners to the Transvaal, attracted thither by the high wages which mining in South Africa offered, and the rapidity with which fortunes could be made. But there was another side to this race for wealth. Many of the men after working a few years died in South Africa, while others returned home shattered in health, although enriched in pocket. These circumstances pointed to mining in the Transvaal as an unhealthy occupation, and as calling for some change in the method of conducting underground operations. It was known that the ventilation of the mines was bad, that rock drills were almost in universal use, that they were worked on the dry system, and that the higher explosives were used with a lavishness which far outstripped anything of the kind at home.

We shall never know the number of white miners who found a grave in South Africa, nor shall we ever know the number of Kaffir boys whose life was brought to an early close by working underground on the Rand. Many of the

boys when ill crept away to their kraals where they died without the fact ever coming under the knowledge of the inspector. How far the work there is responsible for creating a taste for alcohol and its attendant evils it is impossible to say. In the returns presented to the House of Commons in August, 1903, it is stated that lung diseases formed 42.8 per cent. of the deaths of the natives on the Rand and that pneumonia formed the greater part of the cause of this high mortality. Taking the mortality returns of natives employed at the mines for the six months ending December 31st, 1903, the number of deaths from pneumonia was 45 per 1,000 living and 3.8 from phthisis; for the same period in proclaimed labour districts the deaths of natives from pneumonia were 27 per 1,000, and from phthisis 3. This is a high mortality from pneumonia towards which the dust given off by the rockdrills when in the mine, exposure to rapid changes of temperature on leaving the mine, overcrowding in the compounds and the absence of sunlight from the dwellings all contribute.

The South African Government Commission had considerable difficulty in obtaining information, statistical and other, regarding miners' phthisis in the Transvaal, notwithstanding the fact that the medical men who were members of the Commission had made the malady the subject of previous study. Still, the labours of the Commission brought many interesting facts to light, which, but for the ravages of the war, would have been more numerous. Out of 4,403 miners, who were working underground in the Witwatersrand district, 1,210 were medically examined on behalf of the Commission, and of this number 187, or 15.4 per cent., were certified by the doctors to be suffering from phthisis, while a further 88 were suspected cases. These numbers may not be absolutely reliable, but the facts confirmed the general impression regarding the prevalence of the disease and of the urgent need there was of reform in methods of mining. While pulmonary phthisis affects all classes of miners, it is the rock-drillers who suffer most. Rock-drillers formed 91.9 per cent. of the cases; the average age of the men at death was 35.5. Some of the miners had only worked at the drills for five years, others from seven to nine. It is estimated that in the Witwatersrand district, out of 1,377 rock-drillers, 225, or 16.34 per cent., had died during the two and a-half years immediately preceding the Boer war.

Inhalation of fine dust is the cause of Rand miners' phthisis; and while most of this dust is created during machine drilling by the dry methods, we must also incriminate the dust that rises during the dislodgement and breaking up of stone by the use of explosives, and the shovelling aside of the debris of fallen stone. There is danger in all mining operations where there is much dust; but since the white miner and Kaffir boys are longer in contact with drills, working often in confined spaces, or at the head of a level where ventilation is imperfect, the danger from such is correspondingly greater. What has happened to the white miners and the Kaffirs will undoubtedly happen to the imported Chinese if pains are not taken to keep down the dust. Perhaps, after all, dust is not the sole cause of the malady. The men—after a hard and fatiguing day's work in a hot mine, when perspiring, are suddenly transported in a cage to the surface, where the temperature is much lower. At many of the mines there are now "change houses," where the men can have a warm bath, put on warm, dry clothing, leaving their wet working clothes behind, and which they find there next day dry and warm. In addition to dust and rapid changes of temperature, the miners are far too hasty in returning to a working after explosives have been used, and when the atmosphere of the working is thick with dust, and laden with the gases given off by explosives. Some idea of the vitiation of the atmosphere of the Rand mines may be formed from the fact that in the Witwatersrand mines alone there were used in the six months January to June, 1902:

	lb.
Blasting gelatine	1,412,600
Gellignite	383,200
Dynamite No. 1	3,250
A total of	1,799,050

All miners are agreed that in underground work the operations known as "developing," "raising," and "driving" are much more dangerous than working in "stopes." In the Phthisis Report mention is made of two brothers who worked rock-drills for four years, always "raising." At the end of the four years both died from lung disease at the ages of 28 and 30. In "raising" and "driving" it is extremely difficult to secure adequate ventilation. During the boring of the holes a

very fine dust is given off, which quickly renders the atmosphere thick and irrespirable. It is in such an atmosphere when rock-drilling is carried on by dry methods that the miners have to work; the work, too, is fatiguing, and obliges the men to take deep inhalations. At the Geldenhuis Deep Mine 21 men who had worked rock-drills for 5.5 years died from lung disease at the average age of 35.5 years; on the Geldenhuis Estate 33 men died at the average age of 34.4 after 6.9 years spent in rock-drilling; on the Jumper Deep Mine 39 men died at the age of 37 after 6.8 years of rock-drilling. On the Crown Reef Mine 32 men died at the average age of 32, after having spent 8.8 years in rock-drilling. The dangers of rock-drilling are not the same in all mines, a circumstance to be explained either by the character of the dust—some dust being harder than others—the manner in which the drills are used, wet and dry methods, and the ventilation of the mines. The shortest time of rock-drilling followed by death from phthisis in a Rand miner was 3 years.

Many of the mining engineers in Johannesburg are of the opinion that miners' phthisis is not caused by dust but by the deleterious gases given off during the use of explosives. The explosives used in the Transvaal mines belong to the nitro-glycerine group, and are mostly blasting gelatine, which is composed of nitro-glycerine with 7 to 8 per cent. of colloid cotton. When nitro-glycerine explodes under proper conditions the gases produced are carbonic acid, nitrogen, water, and a small surplus of oxygen, the oxygen being sufficient to burn up all the combustible elements in the nitro-glycerine. It is only when a "missfire" takes place that gases are produced which are dangerous—namely, oxides of nitrogen with carbon dioxide and carbon monoxide. The nitric-acid fumes are extremely irritating to the lungs and have caused death in twenty-four hours by inducing a peculiar form of inflammation of the lungs. As medical men we are not disposed to under-rate the harmful effects of nitrogen-oxide fumes; but they are only capable of setting up, as already mentioned, an acute congestion of the lungs like what occurs in the first stage of pneumonia or in the less acute cases, and after frequent exposure they bring about a diminution of the vital resistance of the individual. It is impossible to see how the gases given off by imperfectly-exploded cartridges, apart from dust, can produce in the lungs the hard unyielding fibrosis which is characteristic of gold miners' phthisis.

In corroboration of the statement that dust, especially that given off by machine rock-drills, is the cause of miners' phthisis, let us consider briefly the fate of the tin miner in Cornwall. The tin miners of Cornwall have had for many years an unenviable notoriety for a high mortality from lung diseases. Until 1892 this was specially true of men above 40 years of age, but since that date, and especially within more recent years, there has been an enormous increase in the death-rate from phthisis of the younger men between the ages of 25 and 40. The cause of the high death-rate of Cornwall miners is to be found in the occupation. Tin miners in drilling a hole upwards have often to breathe an atmosphere containing as much as 14 mg. of dust per cubic foot of air. Machine drills always give off more dust than those worked by hand. The average age at death of Cornwall miners who did not work the machine drills was 53 years, while that of the men who had worked drills was 37.2. Comparing the death-rate of these men with that of men engaged in other mining operations, it was found by Haldane that the death-rate among machine men from disease of the respiratory apparatus was about thirty times, and the total death-rate about ten times, as great as that among colliers and ironstone miners of the same age. Of 142 rock-drill men who died in Cornwall, 120 were certified as having died from miners' phthisis and 13 from other forms of respiratory diseases, whereas among the other miners not engaged in rock-drilling, of 178 deaths 68 were ascribed to phthisis and 48 to bronchitis.

To Cornwall just as to Northumberland several miners have returned from the Transvaal, many of them only to die. The average number of years worked by rock-drillers in Cornwall was 8.4. Those who had returned from the Transvaal and worked in the Rand mines alone had only spent 4.7 years in rock-drilling, while the length of time spent in the same occupation by men who had worked both in Cornwall and the Transvaal was 11.6 years. The fact that in the Transvaal the average length of time a rock-driller followed his occupation was 4.7 years as compared with the 8.4 of the Cornwall miner is proof of the disastrous condition of things that until lately prevailed in the Rand mines. Compare these death-rates with those of coal miners of this country. It is the boast of

Northern coal-mining districts that they can show many old men whose health above 60 and 70 years of age remains good. The British coal mines are extremely well ventilated, the shifts are short, and the coal dust, although it often contains particles of stone, is yet soft when compared with the quartzite of the South African mines. I quite agree with Dr. Trotter, of Bedlington, when he says in his very interesting paper that it is not coal as coal that causes miners' phthisis, but the stone particles to which the carbon is adherent, and that probably the main causes of phthisis as affecting mining populations are to be found not in the occupation followed by the men but in the homes. Between the ages of 25 and 35 3.9 per cent. of the deaths of tin miners are due to lung disease, while in coal miners it is 2.1 per cent.; between the ages of 35 and 45 the percentages are for the Cornwall miner 9.5, and for the coal miner 3.5. In certain districts the percentages are still even more favourable for the coal miner.

No doubt on the part of the Transvaal gold miner there has been a recklessness and a disregard for laws of health that have been quite inexcusable. In his haste to make larger wages he has worked hard—10 to 11 hours a day—and he has returned to the working far too soon after explosives have been used—before, in fact, the atmosphere has had time to clear. The miners in South Africa who are paid by piecework can make from £50 to £60 a month; hence the temptation to work hard. Several Northumberland miners have come home after three to four years' residence in the Transvaal with £700 to £900 saved, but the conditions under which this money has been made have been unusually hard and exacting. There is no home life for the men out there, and no social comforts. If the wages are high food is expensive. Away from such a town as Johannesburg the men at the mines sleep in corrugated iron huts, and get their food at boarding houses.

SYMPTOMATOLOGY.

In nearly all the Transvaal miners who have consulted me there has been a marked bronzing of the skin, which gives the patient a deceptive appearance of health. As the disease progresses this bronzing of the skin is often followed by desquamation in the form of light branny scales. One of the peculiarities of Rand miners' phthisis is the silence with which it invades the lung without producing symptoms, also when it has gained a footing, the rapidity with which in some cases it advances. One of the distinctions between gold miners' phthisis, or silicosis, and ordinary tuberculous phthisis is that in miners' phthisis a man does not feel he is really ill until he is practically speaking past all work, whereas in the tuberculous form the patient is often ill long before there is extensive disease in the lung, owing to the fact that toxins are secreted by the tubercle bacilli, while there is no soluble poison in miners' phthisis.

An early indication that a miner is becoming "lunged" is shortness of breath. When this symptom has become fully developed it is a permanent and distressing feature all through the remainder of his illness, for it tends to get worse rather than better. It is aggravated by the slightest exertion, and is often far in excess of the physical signs of disease in the chest. In the early stages of the malady there may be little cough and no expectoration. Some miners, on the other hand, are the subjects of recurrent cold on the chest, of the nature of bronchial attacks, which they never throw off thoroughly, but as the men feel fit for work they continue to follow their employment, although there is a loss of flesh, which is slowly progressive.

Once the disease is fully developed the miners themselves are of the opinion that if they remain in South Africa their chances of life are better than if they come to Britain. Sea air and a sea voyage, which are usually helpful in other diseases, seem to aggravate the symptoms of Rand miners' phthisis.

If the shortness of breath is not severe a miner may continue to follow his employment, when all at once he feels obliged to give up work on account of debility and increasing dyspnoea. The dyspnoea is a pronounced symptom. It is accompanied by rigidity of the walls of the chest. In some instances the breathing is suggestive of advanced asthma, but there is an absence of the loud wheezing and musical râles which are heard in bronchitis and asthma. Physical examination of the chest in the early stages of the disease often reveals but very little; there may be inequality or jerkiness with coarseness of the respiratory murmur without any râle. In other patients there may be weakness of the respiratory murmur, particularly so of the expiratory murmur, which at some parts of the chest may be quite inaudible and yet accom-

panied by exaggeration of the vocal resonance. The chest may on the whole be wonderfully resonant on percussion, but at times there is flattening of the percussion note amounting to distinct dullness over one of the apices or bases. In some patients the breathing is coarse and tubular, and instead of having the expiratory murmur inaudible it is prolonged over the site of the dullness. Notwithstanding this alteration of the respiratory murmur in the direction of coarseness and tubularity, no râle or moist sound may be heard. Occasionally pain in the chest is complained of, and over the painful area friction can be heard. The dullness on percussion may be located at the apex or base. Before the disease has advanced to any great extent there is observed a marked diminution in the ratio observed in the measurement of the chest in inspiration and expiration to the extent of 1 in. or $1\frac{1}{2}$ in. There is no rise of temperature in uncomplicated cases and no sweating. As the disease advances and dyspnoea increases, cough, if more frequent, is accompanied by very little, often by no expectoration at all, but moist râles may be heard, crepitant and subcrepitant, with tubular or cavernous breathing. It is difficult to obtain sputa for examination owing to the comparative absence of expectoration, but in most of my cases when examined no tubercle bacilli have been found. When tubercle bacilli are present the patients have exhibited to a greater degree catarrhal signs in the chest, and have usually had a rise of temperature. Haemoptysis is an unusual event. In nearly all cases the pulse is rapid and the breathing is quickened. When, therefore, a miner who has had signs of slowly-developing disease of the lungs, accompanied by marked dyspnoea but unattended by rise of temperature and sweating, rapidly changes for the worse and becomes hectic, these symptoms are extremely suggestive of some tuberculous infection having become grafted on to the original malady.

In the report presented by the Transvaal Medical Society to the South African Commission on Miners' Phthisis it is stated that, out of a series of over 30 sputa from cases of disease of the lungs of miners examined by a member of the Committee, only 2 or 3 were found to contain tubercle bacilli, which led the Committee to conclude that while in some cases a true tuberculous phthisis may co-exist or may be superadded, the conjunction is only seen in a minority of cases. The disease, as already stated, develops insidiously. In the case of some of the miners who had returned to Northumberland, the men had been at home for several months—a year or two—before the symptoms attracted attention.

PATHOLOGY.

The essential pathological feature of gold miners' phthisis is the formation and retraction of fibrous tissue of a low type. The disease once developed is seldom interrupted; it tends to become progressive. If the malady becomes arrested it is only by its being detected early, and by the miner renouncing underground work and taking to some out-of-door employment. On attempting to remove the lungs from the chest of a person who has died from Rand miners' phthisis, these organs are found to be extremely adherent at places. The lungs are brownish-black in colour, and on section there can be squeezed out of them a dirty, ink-like fluid. The lungs are smaller but weigh more than normal organs, owing to the large amount of foreign matter they contain. A distinct gritty sensation is felt on cutting them with a knife. The substance of the lung is observed to have been replaced by hard, unyielding tissue, hence its inability to functionate during life and the explanation of the extreme dyspnoea that was such a prominent symptom. The walls of the bronchi and blood vessels are thickened; dense strands of white fibrous tissue are observed radiating through the lung and ending on the surface in thickened pleura. Here and there can be felt small nodules which are harder than the surrounding tissue. Cavities are often absent; if present they are necrotic in origin. The bronchial glands are enlarged and on section are as black as ink.

On incineration of the diseased lungs of two Transvaal miners, the total ash found by J. R. Williams was 4.9 and 2.28 grams respectively. The bulk of the ash was made up of silica and iron; but aluminous, calcareous, and manganese particles were also present. When the insoluble ash is submitted to microscopical examination, it is observed to be composed of fine angular gritty particles exactly resembling the fine rock dust itself.

Microscopical examination of sections of the lung confirms naked-eye appearances. The alveolar structure of the lung is found to have disappeared here and there, and to have been replaced by fibro-connective tissue. Small fibrotic nodules

are observed in which the fibrillae are arranged in a concentric or ring-like manner. Myriads of black pigment particles lie freely distributed between the fibrillae, or they are heaped together in places to form small black masses. Occasionally in the centre of a small nodule there is seen a clear circular mass somewhat defined from its surroundings. It looks at first like a giant cell of tubercle, but more careful examination shows it to be a thrombosed artery. In advanced forms of the disease, nearly all the lung is taken up by the deeply-pigmented connective tissue, but here and there groups of still fairly healthy alveoli are detected or the alveolar walls are thickened, and the epithelium which lines them is proliferating. Lying free within the alveoli or imbedded in their walls can be seen several large cells filled with black granules, often so crowded together and diffused through the substance of the cells as to obscure their structure and to conceal their nucleus. When the pigment particles are fewer, the cells are observed to be well developed, and to contain a large nucleus.

Running through the section can be seen lines of dark pigment, which are the trail of lymphatic vessels blocked by pigment particles. In addition to these large cells lying inside the alveoli, there are evidences of catarrhal inflammation. Similar conditions are observed within the small bronchi. In some instances tubercle bacilli are detected, in others not at all. Since during life no tubercle bacilli are found in the expectoration, and after death none are found in the lungs, it is apparent that in Rand miners' phthisis we have an illustration of a true pneumokoniosis—that is, of a lung that has been irritated by dust, and in which, while the changes become progressive and ultimately lead to death, the malady from first to last can be non-tuberculous. During the course of his illness, if it is of lengthened duration, the miner may become the subject of recurrent colds on the chest, and may become accidentally infected by the tubercle bacillus. When this occurs the illness, which up till that time was unaccompanied by fever and was of slow progress, now advances rapidly, cough becomes more frequent, expectoration more profuse, the temperature rises, sweating occurs, and emaciation is quickly progressive. The advent of hectic fever marks the grafting of a tuberculous lesion on to structural conditions of lung that until then had not been tuberculous, so that when tubercle does invade the lung it finds these organs already fibrotic. To the production of the fibrosis, which is the essential feature of gold miners' phthisis, tubercle, therefore, in no way contributes. What I have said of gold miners' phthisis and its non-tuberculous origin applies with greater force to anthracosis or coal miners' phthisis. Some physicians maintain that coal dust exercises a protective influence upon the lung so far as tubercle is concerned.

The large dust cells in the alveoli are phagocytes, and they play an important part in the development of the disease. They are endowed with powers of locomotion, and can engulf the particles of pigment and transport them by way of the lymphatics to the bronchial glands, where the cells rid themselves of their burden, or they disintegrate and deposit the particles of dust in the gland substance. These phagocytic cells or scavengers remove not only particles of dust but micro-organisms as well from the lungs, for in cases where there is no tuberculous disease of the lung tuberculous bacilli have been found in the bronchial glands, and most of these bacilli could only have reached these glands by means of the lymphatic vessels through the phagocytes of the respiratory passages.

TREATMENT: PREVENTIVE AND CURATIVE.

Since gold miners' phthisis is so clearly the result of the inhalation of dust, the best efforts of mining engineers should be put forward to render dust as innocuous as possible by means of water-spraying at the time the rock is being drilled. The contemporaneous use of the water-spray and the drill not only cools the rock, and keeps down the temperature, but allays the dust, so that the men can work in a clearer atmosphere, and thus run fewer risks to health than when no water is employed. Good ventilation and water-spraying are therefore the first essentials. Miners ought not to return too soon to a working after detonation of explosives. Respirators have been recommended, but it is difficult for men to do the laborious work of rock drilling wearing a respirator. Two years ago the Rand Chamber of Mines offered a prize for the best practical suggestion and devices for obviating the occurrence of miners' phthisis. The competition was open to the world; 229 competitive suggestions were received. In July of this year the prize was awarded to

Mr. T. J. Britten, one of the oldest mining engineers in South Africa, for his water drill and atomizer to allay the dust and gases during blasting and shovelling. Britten's atomizer was found to allay 75 per cent. of the dust and was also successful in allaying the nitrous fumes after blasting. There is not the least doubt that by using water-spray drills and the atomizer and by better ventilation a considerable reduction in the death-rate from miners' phthisis will occur in South Africa.

There is no medicine or combination of medicines that I know of that will check the onward course of the disease once it is fully established. Cod-liver oil, nux vomica and pot. iodi, liq. strychniae, calcium glycerophosphates or the hypophosphites will help to maintain the general health, but the best treatment of all is for men not to work too long at rock drilling, to work fewer hours per day than they have been doing, and on the first indications of failing health and strength to give up the work and seek for a life in the open.

PULMONARY ATELECTASIS IN ADULTS.

By WILLIAM R. HUGGARD, M.A., M.D.(R.U.I.),
F.R.C.P.LOND.

ATELECTASIS, or imperfect expansion of the air cells, in so far as it affects a small portion of lung in adolescent or adult life, receives very scanty notice in most textbooks of medicine. It seems to be considered a rare condition except at the base, and as a result of hypostasis. As a matter of fact, however, it is an extremely common condition at the apex, but is overlooked owing to the ordinary method of examining the chest. Only within the last few years have I become myself acquainted with the frequency of its occurrence.

Nearly every practitioner has, as a student, been well drilled into method in the examination of the chest; and to see a man deviate from the orthodox order of inspection, palpation, percussion, and auscultation causes a feeling akin to what we should have if we saw a man trying to fix the crupper on the head of a horse and the bridle on the tail. We inevitably think that he does not know much about what he is doing.

A change from the orthodox order, however, is not merely justified but is indispensable for the ascertainment of the facts. The hitherto usual method requires a little modification. The deep breathing that we call for during inspection frequently clears away or diminishes the evidence of atelectasis. If percussion is employed both before and after the patient breathes deeply, dullness—slight, medium, or pronounced—will often be observed over the apex of the lung at the first percussion, while a clear note will be elicited after deep breathing. In very early apical tuberculosis this is common—I had at first written "almost invariable." In slight bronchial catarrh of growing young people, also, it is extremely frequent.

The usual physical signs in the form of atelectasis now described are dullness on percussion with feeble breath sounds, the dullness diminishing or passing off after a few deep breaths, the breath sounds at the same time becoming more distinct. A few sticky or viscid râles can often be heard towards the end of the first two or three deep breaths, but they get gradually fainter, and then disappear.

The signs of atelectasis may reappear with extraordinary rapidity. In a case where the patient was systematically doing deep breathing exercises every hour, and where the physical signs usually disappeared completely with the deep breathing, I have on more than one occasion observed dullness within an hour after a deep breathing exercise was said to have been performed.

In some cases the dullness does not disappear so quickly. Sometimes it may remain for months, or may even become permanent; and I have seen retraction of an apex—distinct falling-in—occur from this cause in the course of a few days. Such cases are apt to be ascribed to infiltration with tubercle or with the products of inflammation, all the more so as a patch of tubercle or a patch of inflammation may be present as a nucleus. Indeed the presence of apical atelectasis justifies a suspicion of tuberculosis, and may be an aid to diagnosing the disease in an early stage.

The most frequent seats of pulmonary atelectasis in the adult, according to my observation, are, first, from the apex to the second interspace in front; next, the suprascapular, and then the interscapular region.

It is obvious that, in order to find out whether atelectasis

is present or not, we must percuss in front and behind before the patient begins to breathe deeply, and again at the end of the examination, when he has ventilated his lungs to the utmost.

The limited form of atelectasis here described does not give rise to any symptoms apart from those due to the primary disease.

As to treatment. The primary ailment must be attended to. For the condition itself systematic deep breathing must be employed; for example, deep respirations for a couple of minutes every hour. If there are no contraindications, exercises to develop the chest muscles are advisable. The patient must be careful to avoid anything, whether clothing or a cramped position, that might interfere with the free expansion of the chest.

TRACHEOTOMY UNDER LOCAL ANAESTHESIA.

By STOLAIR THOMSON, M.D., F.R.C.P.LOND.,
F.R.C.S.ENG.

Physician for Diseases of the Throat, King's College Hospital; formerly
Physician to the Throat Hospital and Surgeon to the Royal
Ear Hospital.

THE last nine cases of tracheotomy I have had to perform have been carried out quite easily under the local anaesthetic action of cocaine (Schleich method).

It is always well to avoid the usual drawbacks and risks of a general anaesthetic when an operation can be done as satisfactorily without one. But this avoidance is still more desirable in the condition for which tracheotomy is generally required—namely, considerable obstruction to the air-way. This may be so marked that the patient cannot assume the horizontal position without choking. Breathing in such cases is sometimes only maintained by the use of the accessory muscles of respiration. If their action is arrested by the administration of a general anaesthetic, the patient's narrow margin of breathing capacity may be lost. Many a death has occurred "on the table," not always because the operation has been deferred too long, but often because the anaesthetic has induced complete asphyxia before the trachea was opened. In any case the increased stridor and congestion add greatly to the anxiety and difficulty of the operation. As pointed out by Sir Frederick Treves, "the hurry and excitement of the operation, and the fear that the child is ceasing to breathe, are in the main answerable for the accidents which so often occur during tracheotomy."

The patient may be only semi-conscious, and his restlessness, the rapid movements of the trachea with every struggling breath, the increased vascularity, and the imminent fear of some false move or of complete cessation of breathing, only too often lead to a scene which the elder dramatists would have described as one of "wild excursions and alarms."

Besides, tracheotomy is an operation which any practitioner may be called upon to carry out, not infrequently at short notice, and without the help of a skilled assistant to administer a general anaesthetic.

With local anaesthesia these drawbacks are avoided. Respiratory difficulty is not increased, congestion is lessened, the patient is always able to assume a comfortable position and remain quite passive; his retention of consciousness may be of use for the purpose of coughing, or so that he may hold his breath in order to leave the trachea quiet for a few seconds at any stage of the operation. The surgeon is relieved from the special anxieties attending a general anaesthesia in respiratory stenosis, the operation is practically bloodless, and it can, therefore, be carried through more deliberately, rapidly, and satisfactorily.

The following is the method I have adopted. The first and most important point is to limit the amount of cocaine employed. I have never exceeded 1 cg. ($\frac{1}{2}$ gr.), and have never seen the slightest toxæmia from this dose. In many cases half the quantity has sufficed. A tabloid containing cocaine hydrochloride $\frac{1}{2}$ gr., morphine hydrochloride $\frac{1}{10}$ gr., and chloride of sodium $\frac{1}{2}$ gr., is dissolved in 56 minims of sterilized water. To this adrenalin chloride of full strength (that is, 1 in 1,000) is added in the proportion of 1 drop to every 15 of the solution, so that 4 minims of adrenalin would be contained in 60 of the prepared liquid.

The skin over the trachea having been purified, a drop of pure carbolic acid is deposited on it at the two extremities of the proposed incision—that is, for high tracheotomy, over the centre of the thyroid cartilage and over the situation of the