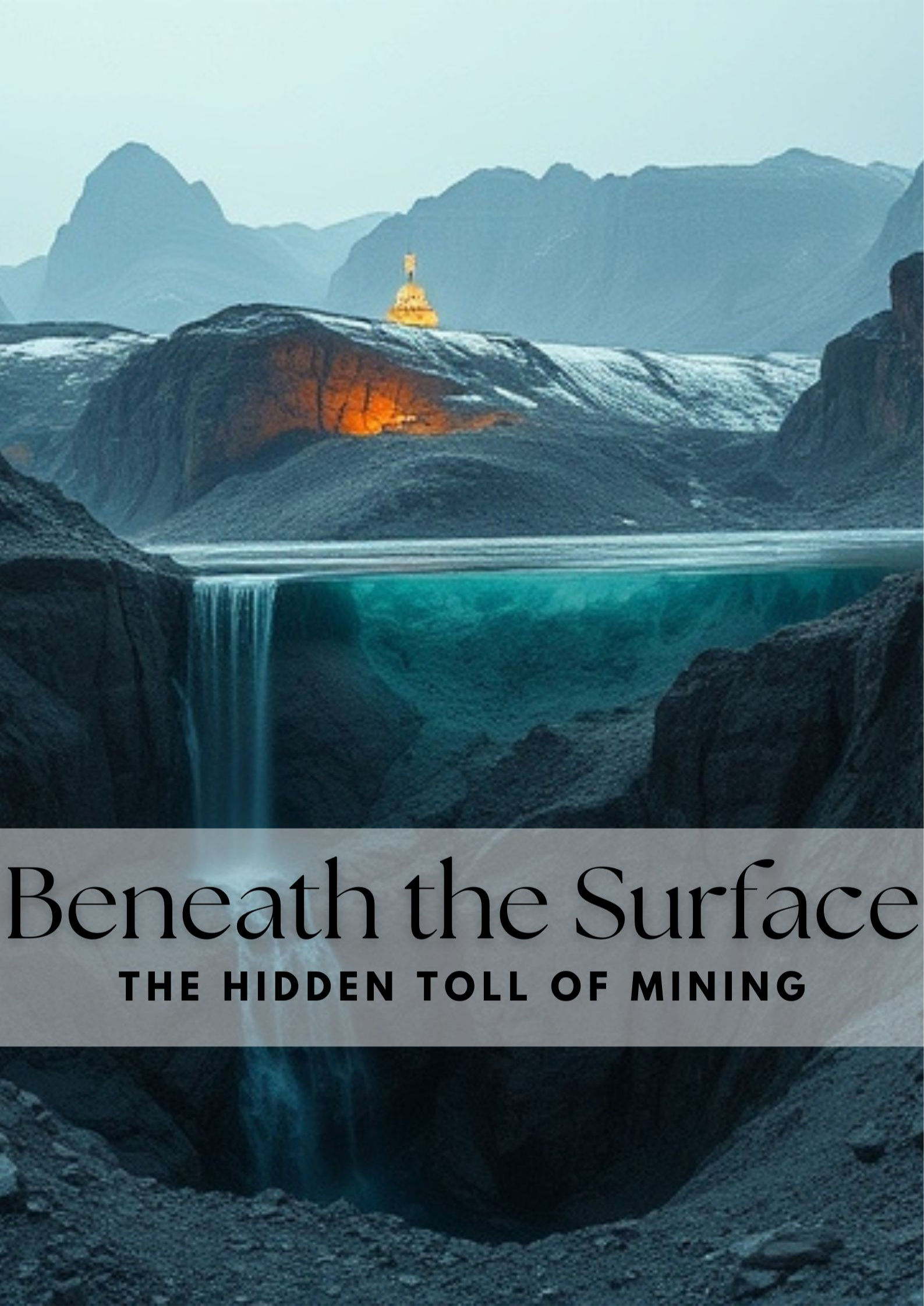

Beneath the Surface

THE HIDDEN TOLL OF MINING

Among the many diseases incident to the coal-miner, none come oftener under medical treatment, than affections of the respiratory and circulating organs. While the collier is subject—during his short but laborious life—to the other diseases which afflict the labouring classes in this country, such as inflammations, fevers, acute rheumatism, and the various eruptive diseases, he, at last, unavoidably, falls a victim to lesions within the cavity of the chest, arising from the nature of his employment. In the present communication, it is proposed to lay before the profession a series of remarks, which I have been enabled to put together, with a view to elucidate the cause and progress of that very peculiar pulmonary disease, incident to coal-miners, which I shall denominate BLACK PHTHISIS, or Ulceration induced by Carbonaceous Accumulation in the Lungs. The rise and progress of the malady may be thus sketched: A robust young man, engaged as a miner, after being for a short time so occupied, becomes affected with cough, inky expectoration, rapidly decreasing pulse, and general exhaustion. In the course of a few years, he sinks under the disease; and, on examination of the chest after death, the lungs are found excavated, and several of the cavities filled with a solid or fluid carbonaceous matter. During the last ten years, my attention has been much directed, in the course of my professional labours in the neighbourhood of the coal-mining district of Haddingtonshire, to the above phenomena in the pathology of the lungs, which have not hitherto been brought so fully before the profession, as their importance demands. The subject presents a very interesting field of investigation to the physiologist and pathologist. When we consider the difficulties which the medical man has to encounter, in prosecuting his researches in morbid anatomy in a mining district, it is sufficiently explained why the peculiarly diseased structures in the body of the coal-miner should have been left so long uninvestigated. Not many years ago, the obstacles in the way of post mortem examinations among colliers were insurmountable, and consequently, till lately, few medical men could obtain permission to examine, after death, the morbid appearances within the chest of a collier. With the rapid advance in the general improvement which has been going on, the collier's position in society has become greatly elevated; and his deeply-rooted superstitious feelings have been, to a great extent, dissipated. Let us hope that the school-master will find his way into every collier's dwelling, enlightening his too long uncultivated mind; and that the foolish prejudices shall cease, which have been hitherto the barriers to postmortem examinations in his community. The only medical writers, as far as I am aware, who have brought this subject before the notice of the profession, are, in the report of a case of peculiar black infiltration of the whole lungs, resembling "Melanosis," in an article on "Spurious Melanosis," in a paper in The Lancet for entitled "Cases of Spurious Melanosis of the Lungs;" now Professor of Medicine in the University of Glasgow, in two able essays, wherein he gives a number of very interesting cases, collected from various coal districts of Scotland, illustrating different forms of the disease; in the Philosophical Trans. for, on the "Inhalation of Carbon into the Pulmonary Air Cells;" and in a paper, by. of the Edinburgh Medical and Surgical Journal. Recently, professional and other writers have directed attention to the influence of various occupations in the production of diseases of the chest. The pernicious employment of the needle-pointers, razor and knife-grinders of Sheffield, and other manufacturing towns in England, have not only engaged the attention of the public at large, but science has been at work to ascertain, with as much accuracy as possible, the relative effects of the different avocations, on the constitutions of those occupied in these destructive employments. Researches of this nature tend much to the well-being of society, as they make us acquainted with the maladies and sufferings peculiar to certain classes of our fellow-men; and point out, also, the causes of their early decay, and premature death. The coal-miners—those in whose behalf I would now solicit the intervention of science—are most valuable in their place, and their exhausting labours promote, in no small degree, our domestic comforts. Some of the diseases of colliers have in past time been very much overlooked by the medical inquirer. There has been, within the last few years, a very searching investigation as to the employment of women and children in coal-mines; and by the laudable exertions of Lord Ashley—a nobleman whose name shall ever be honoured among miners, and by all who have the true interests of that community at heart—an Act of the Legislature has been passed, declaring it unlawful for any owner of any mine or colliery whatever, to allow any female to work therein; and also enacting, that no boy under the age of ten years can be employed in mines. It is to be regretted, however, that his Lordship did not embody in his measure, provisions enforcing the free ventilation of mines under government inspection; for nothing would tend more to improve the health of those employed in them.

In the course of the inquiry, which formed the prelude and basis of Lord Ashley's Act, much valuable information regarding the diseases of colliers was elicited; and no one can peruse the voluminous parliamentary report pertaining to these investigations, without being struck with the very general prevalence of affections of the chest among miners. It is to be hoped, that the interesting facts in regard to disease, which this recent most necessary investigation has laid open, will be the means of directing the attention of scientific men to the subject, with a view to obviate, as far as human efforts can, the evils which have been exposed. It may at first appear difficult, to point out the means of removing effectually the causes of the pulmonary carbonaceous disease of miners, but, be the difficulties what they may, humanity encourages us to make the attempt. In the first place, let us endeavour to ascertain the cause, and secondly, to suggest means for the mitigation or prevention of this scourge. My present remarks do not refer to coal-miners in general, but to a district in Scotland, in the Lothians, east of the river Forth, where the labour is hard, and where its severity is in many cases increased by a want of proper attention to the economy of mining operations. These operations, as at present carried on, are extremely unwholesome, and productive of diseases which have a manifest tendency to shorten life. I draw the materials of my description from what I saw in a part of that district referred to, where the various cases, hereafter to be adduced, came under my medical treatment, and where I had the privilege of examining the morbid appearances after death. The locality in which my observations were made, is that part of the Lothians, extending from south to north, stretching from the foot of the Lammermoors towards the sea-coast, including the coal-works of Preston-Hall, Huntlaw, Pencaitland, Tranent, and Blindwells. In this range of the coal-formation, the seam of coal is variable, but generally exceedingly thin, varying in thickness from eighteen inches, to three or four feet. It is with difficulty that mining operations can be prosecuted, from the extremely limited space in which the men have to move, and from the deficient ventilation. It appears, after thorough investigation, that in the majority of the coal mines above mentioned, ventilation is very much neglected, and that this neglect is partly caused, by the immunity of these mines from carburetted hydrogen gas, which exempts them from the danger of explosion. But though there be no explosive gas, there is generated, to a certain extent, in the more remote recesses of the pit, carbonic acid and other gases, producing the most injurious effects—impairing the constitution by slow degrees, and along with the more direct cause (the smoke from the lamp, candle, and the product of the combustion of gunpowder,) making progressive inroads on the health of the unfortunate miner. And how, I ask, can it be otherwise, in such circumstances? So long as it is possible for him to go on—so long as there is air enough to support the combustion of the lamp or candle, the labourer must proceed with his toil. I say, from there being no fire-damp, less attention is paid to ventilation, and it is a common occurrence with colliers in these localities, to be obliged to leave their work, from there not being a sufficiency of oxygen to keep their lights burning, and support respiration; and this temporary cessation of labour under such circumstances is regarded as a hardship by some proprietors, while the bodily sufferings of the miner, shut up and necessitated to labour in this situation, are little considered. After labouring beyond a given time in those confined situations, there is a much freer action of the respiratory apparatus, the oxygen is considerably exhausted, and to make up for this deficiency, the volume of air inspired, (impure though it be,) is much greater. Every now and then, there is a disposition to draw a deep breath, followed by a peculiar and gradual decrease of strength. Therefore, in these forcible expansions of the chest, it is to be expected that a considerable quantity of the floating carbon will be conveyed to the cellular tissue. The atmosphere of the coal mine at length becomes so vitiated, by the removal of the oxygen in breathing, and the substitution of carbonic acid, that the respiration becomes gradually more difficult, and the exhausted labourer has ultimately to retire from the pit, as there is no other mode by which the noxious air can be removed—owing to the underground apartments being so small—than by gradually allowing purer air to accumulate. The miner is thus enabled to return to his employment. It is about thirty years since miners in this district adopted the use of coarse linseed oil, instead of whale oil, to burn in their lamps; and it is very generally known, that the smoke from the former is immensely greater than that from the latter, and many old miners date the greater prevalence of black spit to the introduction of the linseed oil. This change took place entirely on the score of economy.

Any one can conceive how hurtful to the delicate tissues of the respiratory organs, must be an atmosphere thickened by such a sooty exhalation. It is now known, that this disease originates in two principal causes, viz., First, The inhalation of lamp smoke with the carbonic acid gas generated in the pit, and that expired from the lungs; Second, Carbon, and the carburetted gases which float in the heated air after the ever-recurring explosions of gunpowder, which the occurrence of trap dykes renders necessary. To those acquainted with mining operations, an explanation of the coal and stone hewing process is unnecessary; but, for the sake of the uninitiated, I may be allowed to state, in explanation, that, previous to any coal hewing, it is needful to remove various strata of stone, to open up road-ways, and break down obstructing dykes, by the aid of gunpowder. All coal-miners are engaged exclusively with one or other kind of labour; that is either in removing stone or coal: and the peculiar disease to which each class is liable, varies considerably, according to the employment. For instance, the disease is more severe and more rapid in those who work in the stone, than in those engaged in what is strictly coal-mining, while, at the same time, both ultimately perish in consequence of it. The fact of the disease being more acute in stone-miners, I am disposed to attribute to the carbon and other products of the combustion of gunpowder, being more irritating and more destructive to the lungs. A very striking instance of this occurred, a few years ago, at the colliery of the Messrs Cadell of Tranent. A very extensive coal level was carried through their coal field, where a great number of young, vigorous men were employed at stone-mining, or blasting, as it is called, every one of whom died before reaching the age of thirty-five years. They used gunpowder in considerable quantity:—and all expectorated carbon. It was long a very general belief with medical writers, that the various forms of discoloration in the pulmonary tissue was induced by some peculiar change taking place in the economy or function of secretion, independently of any direct influence from without. They were, therefore, usually supposed to belong to the class of melanotic formations, from presenting, as their distinguishing feature, a greater or less degree of blackness. But, by recent investigations, it has been proved, that the infiltrated carbon found in the bodies of coal miners is not the result of any original disease, or change taking place within the system, but is carbon, which has been conveyed into the minute pulmonary ramifications, in various forms, during respiration; and which, while lodged in these tissues, produces irritation, terminating in chronic ulcerative action of the parenchymatous substance. The very minute bronchial ramifications first become impacted with carbon, and consequently impervious to air; by gradual accumulation, this impacted mass assumes a rather consistent form, mechanically compressing and obliterating the air-cells, irritating the surrounding substance, and promoting the progressive extension of the morbid action, till the whole lobe is infiltrated with carbonaceous matter, which, sooner or later, ends in ulceration and general disorganisation of the part. It is evident, in tracing the disease through its various stages, up to that of disorganisation, that wherever there is an impacted mass in any part of the pulmonary structure, this is followed, sooner or later, by softening, from its irritating effects upon the tissues by which it is surrounded; and as this softening process advances, the innumerable sets of vessels composing the dense network of capillaries are broken down, extending the cyst, so that, as the cysts enlarge, they gradually approximate to each other, till all at last become merged in one great cavity. The majority of colliers, soon after they engage in their mining operations, become afflicted with bronchial disease to a greater or less extent. Those who are hereditarily predisposed to pulmonary irritation, are, it is my decided belief, more liable to "black phthisis" than others; but I cannot suppose it possible, that any constitution, however robust and sound, could resist the morbid effects resulting from carbon deposited in the lungs. Tubercular phthisis is not at all prevalent in any collier community with which I am acquainted, only occasional cases occurring, and that amongst females. It is my impression, that a phthisical person, engaged in the operations of a coal-pit, similar to those in Haddingtonshire, would come under the influence of the carbonaceous disease, instead of the true phthisis; for, in all the post-mortem examinations which I have conducted, connected with this pulmonary affection, I have never found tubercular deposit:—while other members of the same family, having a like predisposition, and who never entered a coal-pit, have died of phthisis. Can carbon inhaled destroy a tubercular formation? I never knew or heard of a case of black spit in a female collier, and this is accounted for by the circumstance, that the women, when permitted to labour, previous to the late prohibitory enactment, were only occupied as carriers; and from their movements towards the pit shaft, in transporting the coals, were enabled to inhale at intervals a purer atmosphere.

The boys also, who were employed as carriers to the pit shaft, continued to labour with like impunity, from their occasional change of situation; but the miner, lying on his side in a confined, smoky recess, under ground, gasping for breath, proceeding with his exhausting labour, cannot fail, in his deep inspirations, to draw in the deleterious vapour, to the most minute ramifications of the pulmonary structure, and, as he daily repeats his employment, so does he daily add to the accumulation of that foreign matter which shall ultimately disorganize the respiratory apparatus. In the first stage of the affection, there is an incessant dry cough, particularly at night, and all the prominent symptoms of bronchitis are present. Indeed, from the time a man becomes a coal-digger, and inhales this noxious air, there is ever after a manifest irritation in the lining membrane of the respiratory passages, which is apparent before carbon in any quantity can be supposed to be lodged in the lungs. The mucous membrane of the air passages, by its continually pouring out a viscid fluid, has the power of removing any foreign matter that may be lodged in them. Now, should this membrane, owing to previous irritation, lose to a certain degree this secretory power, then the foreign body adheres to it, and is retained, and this, I think, constitutes the preparatory stage of black deposit. In tracing the progress of the disease, it is my belief, that immediately after the carbon is established in the air-cells, the absorbents become actively engaged, and the glandular structure soon partakes of the foreign substance. One of the peculiar features, as we shall find, when we come to describe cases, is, that the secretory function is ever after so changed in its character, that the gland which formerly secreted mucus, to lubricate the passages, now performs the same service with muco-carbon, and continues to do so during the remainder of the patient's life—even, as I have often seen, long after he has desisted from the occupation of a coal-miner. In fact, it constitutes a striking peculiarity of this disease, that when the carbon is once conveyed into the cellular tissue of the lung, that organ commences the formation of carbon, thus increasing the amount originally deposited, as was strikingly exemplified in the case of Duncan and others, to be afterwards detailed. Duncan had not for fifteen years been engaged in mining operations, nor was there any possibility of his having inhaled more carbon: yet in him it was found to have increased to the greatest possible extent, leaving but a small portion of useful lung. I have been long impressed with the belief, that the carbon is contained in considerable quantity in the blood, particularly in the blood of those far advanced in the disease. This impression arises, not only from its dark and inky appearance, but from its sluggish flow, and non-stimulating effects on the heart and general system; and when we examine the morbid condition of the pulmonary structure,—ascertain the presence of carbon in the glandular system and minute lymphatic vessels of the lungs, and consider the relation existing between them and the circulating fluid, we cannot suppose it possible, that such a mass of foreign matter should be lodged in their parenchymatous substance without imparting a portion to the blood. I was never more struck with this, than in the case of Duncan, where the blood was more like thick brownish ink than vital fluid. No one who has witnessed the economy of these pits, can doubt the inhalation, to a great degree, of lamp and gunpowder smoke into the pulmonary tissue. What may be its chemical action there, is a question for us to attend to as we proceed. If it be considered an established fact, that carbon is inhaled, possessing all the chemical qualities of that substance found floating in the air of the coalmine, and either expectorated from the lungs during life, or retained in those organs till after death, we cannot but conclude, that the black matter is the result of an external cause, and that that cause is the sooty matter. Another question arises here, in connection with this phenomenon, viz.—Does the carbon increase in the pulmonary tissues after the collier has relinquished the occupation of a miner, and when there can be no further inhalation, and if so, whence comes this increase? It must be admitted, judging from several of the cases which follow, that it does considerably augment. From this remarkable fact, does it not appear probable, that when carbon is once lodged in the pulmonary structure by inhalation, there is created by it a disposing affinity for the carbon in the blood, by which there is caused an increase in the deposit of carbon, without any more being inhaled. Appearances on Dissection. In classifying the morbid appearances observed in the pulmonary structure, I arrange them according to divisions corresponding to three stages of the disease. First, Where there exists extensive irritation of the mucous lining of the air passages; and the carbon being inhaled, is absorbed into the interlobular cellular substance, and minute glandular system, thereby impeding the necessary change upon the blood.

Secondly, Where the irritative process, the result of this foreign matter in the lungs, has proceeded so far, as to produce a variety of small cysts, containing fluid and semi-fluid carbonaceous matter, following the course of the bronchial ramifications. Thirdly, Where the ulcerative process has advanced to such an extent, as to destroy the cellular texture, and produce extensive excavation of one or more lobes. Stethoscopic Signs.—In the early stages, the sounds indicate a swollen state of the air-passages, and vary in character according to the part examined. The whistling and chirping sounds are loud and distinct in the large and small bronchial ramifications, and both from the absence of expectoration and the presence of the pulmonary bruit, the highly irritated state of the mucous linings is apparent. The affection ultimately assumes a chronic form, and continues present in the respirable portions of the organ during life. As the carbonaceous impaction advances, the sounds become exceedingly dull over the whole thoracic region, and in many of the cases no sound whatever can be distinguished. Where the lungs are cavernous, it is very easy to discover pectoriloquy, from the contrast to the general dulness, and when pleuritic and pericardial effusion advance much, it is difficult to ascertain the cardiac action. Such is a short account of the Cause, Progress, and Morbid Appearances of this deadly malady, as they came under my notice. From a variety of cases to which my attention was directed, I I have selected ten, with the post-mortem appearances in nine of them. These cases extend over a period of eleven years, all of them exhibiting, with some slight variation, the same character of disease, and proceeding from the same cause—inhalation of carbonaceous matter. Some of the cases occurred as far back as the years while the last case came under my notice within these twelve months. Of the ten patients, six were engaged at one period with stone-mining, and four were entirely coal-miners; eight expectorated carbonaceous matter, and two did not show any indication of black infiltration from the sputum; six exhibited, on examination, most extensive excavations of the pulmonary structure; and three only general impaction of these tissues, with numerous small cysts containing black fluid; the body of the tenth, I regret to say, was not examined, owing to neglect in communicating in time the death of the patient, which took place a few weeks ago. These morbid appearances exhibit three stages of the disease in regular progression. The first is that where the carbon is confined to the interlobular cellular tissue, and minute air-cells, producing cough, dyspnœa, slight palpitation of the heart, and acceleration of pulse, while, at the same time, the patient continues able to prosecute his daily employment. The respiratory sounds, in this state of the chest, are loud and distinct. Such a condition of the pulmonary structure is often found on examination in the Carron iron-moulder, who has been killed by accident, or has died from some other disease, having been subjected in the course of his employment to the inhalation of carbonaceous particles. The second is that stage where the softening has commenced in the several impacted pulmonary lobular-formed small cysts throughout the substance of one or more lobes, the contents of which may either be expectorated or remain encysted, giving rise to most harassing cough, laborious breathing, and palpitations, dull resonance of chest, and obscure respiratory murmur. The third and last stage, is that in which the several cysts in one or more lobes have approximated each other, forming extensive excavations, the prominent symptoms of the disease becoming considerably aggravated, and the powers of the system sinking to the lowest degree of exhaustion. George Davidson, collier from his youth. When I first saw him professionally, in May he was aged thirty-two. From his earliest years he was employed about the coal-works in Pencaitland parish, and when very young, he went down the pit to assist in conveying coals to the shaft, and ultimately became a coal-miner. For a considerable length of time, he enjoyed good health, having neither cough, nor any other affection. He was well-formed, and robust in constitution. A few months previous to my seeing him, he had taken to the employment of stone-mining in the pit at Huntlaw, where he was accustomed to labour, and soon after being so engaged, he began to complain of uneasiness in the chest, and troublesome short cough, quick pulse, especially at night and in the morning, for which he sought medical advice, and was treated for bronchial affection. He continued to prosecute the employment of stone-mining in this coal-pit so long as his strength would permit, which was a little more than two years, when he was entirely disabled, from general exhaustion. By this time his cough had much increased, and there was considerable dyspnœa, accompanied with sharp pain in the thoracic region, both in walking quickly, and when lying down. He expectorated bloody tough mucus without any tinge of black matter. All remedial means were adopted with a view to the removal of the irritation of the chest, without producing any very decided effect. The thoracic pain was occasionally subdued, but the cough became incessant; loss of appetite, rapid emaciation, and cold nocturnal sweats, with slow weak pulse, supervened.

After a severe fit of coughing, during one of his bad nights, the black expectoration made its appearance, in considerable quantity, by which his sufferings were for a few days alleviated, when the cough returned in the same degree of severity, and was again mitigated by the black sputa, which was expectorated without difficulty, and from this time there was no interruption to a free carbonaceous expectoration. In the early part of this man's illness, the stomach, the alimentary canal, biliary and urinary secretions, continued unimpaired; but as the cough advanced, gastric irritation, which was followed by vomiting during the paroxysms, annoyed him; and for the last eight months of his life, he suffered occasionally from severe attacks of gastrodynia, which, when present, had the effect of considerably modifying the thoracic irritation, and allaying the cough. There was nothing very remarkable in the character of the urine; the quantity voided was small, and very high coloured, with occasionally a lithic deposit. The fæces were natural, and smeared with dark blue mucus. On examining the chest with the stethoscope, the crepitant ronchus was heard in the upper part of each lung. There was general dulness throughout the lower part of both, with the exception of a small space at the inferior angle of the left scapula, where pectoriloquy was distinctly heard, from which was concluded the cavernous state of a portion of that lung. The heart's action was languid, and often intermitting, producing vertigo and occasional syncope. The pulse was gradually becoming slower; and at this time, (Nov. 1836,) it was forty-three in the minute. I was informed by this man, that his chest affection first became manifest, after being engaged with a difficult job in a newly formed coal-pit at Huntlaw, where he had very little room to conduct his mining operations, which were carried on with the help of gunpowder, and where he experienced a sensation of suffocation from the confined nature of the pit, which did not permit of the exit of the evolved carbon, and ever after, his cough and difficulty of breathing had been increasing rapidly. During the greater part of the period he was under my charge, he continued to expectorate black matter, of the consistency of treacle, mixed with mucus in considerable quantity, and I would suppose, taking the average of each week, that he expectorated from ten to twelve ounces daily of thick treacle-like matter. I had the curiosity, during my attendance on this patient, to separate the mucus from the carbon, by the simple process of diluting the sputa with water, and thereafter separating and drying the precipitated carbon. I was enabled by this means to procure about one and a-half drachms of a beautiful black powder daily, and in the course of a week, I had collected near to two ounces of the substance. This process I continued for some weeks, till such time as I had procured a sufficient stock of this remarkable product of the pulmonary structure, and I am certain that the same quantity, if not more, could have been obtained till his death, in. It is undoubtedly a striking phenomenon, connected with the pathology of the chest, that the human lung can be converted into a manufactory of lamp black! Towards the close of this poor man's existence, the countenance and surface of the body assumed a leaden hue, from the very general venous congestion, and as his system became more exhausted, and he was about to sink in death, the gastric irritation and nocturnal cold sweats which had been long present with him considerably increased, along with a cough so severe as actually to produce vomiting of the black sputa. His tongue and fauces became so coated with the expectoration, that a stranger viewing the patient would have said that he was vomiting black paint. This case resembled in many of its features, one of tubercular phthisis, more than is generally found in the disease before us, there being cough and expectoration, dyspnœa, sharp pain in the thoracic region, colliquative sweats, and great emaciation, while at the same time, the pulse was slow and weak, not exceeding thirty-six in the minute for a week before death. No hectic heat of skin, but an extraordinary depression of the arterial action, arising evidently from the redundancy of carbon deposited in the pulmonary tissue, preventing the proper oxygenation of the blood circulating in the organs, and thereby producing a morbid effect on the whole system, which sufficiently explains the cachectic condition of the body. Post-mortem examination, twenty-four hours after death.—In removing the anterior part of the thorax, the lungs appeared full and dilated, and of a very dark colour. Both lungs were strongly attached to the pleura costalis, and a very considerable effusion of straw-coloured fluid was found in both cavities of the chest. A few irregularly situated dark glandular bodies were observed on the surface of the costal pleura at each side of the sternum, and on the mediastinum. The lungs were removed with difficulty on account of the strongly adhesive bands attaching them to the ribs, and in handling them they conveyed the impression of partial solidity:—several projecting, irregular firm bodies, were felt immediately beneath the surface of the pleura, and there was also present emphysematous inflation of the margins of the upper lobes.

In transecting the upper lobe of the left lung, it was found considerably hollowed out, (to the degree of holding a large orange,) and containing a small quantity of semi-fluid carbon, resembling thick blacking, with the superior divisions of the left bronchus opening abruptly into it. Many large blood-vessels crossed from one side of the cavity to the other, to which shreds of parenchymatous substance were attached. The inferior lobe was fully saturated with the thick black fluid, and it felt solid under the knife, and several small cysts containing the carbon in a more fluid state were dispersed throughout its substance, in which minute bronchial branches terminated, and by which this fluid was conveyed to the upper lobe, and thence to the trachea. In examining the right lung, the upper, and part of the middle lobe were pervious to air, and carried on, though defectively, the function of respiration, while the interlobular cellular tissue contained the infiltrated carbon. The inferior portion of the middle and almost the whole of the under lobe were densely impacted, so that on a small portion being detached, it sank in water. Both lungs represented, in fact, a mass of moist soot, and how almost any blood could be brought under the influence of the oxygen, and the vital principle be so long maintained in a state of such disorganization, is a question of difficult solution. In tracing the various divisions of the bronchi, particularly in the inferior lobes, some of the considerable branches were found completely plugged up with solid carbon; and in prosecuting the investigation still farther, with the aid of a powerful magnifier, the smaller twigs, with the more minute structure of cells, were ascertained to contain the same substance, forming the most perfect racemes, some of them extending to the surface of the lung, and to be felt through the pleura. The lining membrane of the permeable bronchial ramifications, when washed and freed from the black matter, exposed an irritated and softened mucous surface, which was easily torn from the cartilaginous laminæ. The interior of the trachea and its divisions gave evidence of chronic inflammatory action of long standing which extended from about midway between the thyroid cartilage and bifurcation to the root of the lungs. A considerable number of lymphatic glands, filled with—to all appearance—the carbon, were situated along the sides, and particularly at the back part of the trachea; which, from their size, must have interfered by pressure both with respiration and expectoration. The mucous membrane of the left bronchus in particular was much swollen and partially ulcerated towards the root of the lung. In examining the heart after its removal from the body, it was found peculiarly large and flabby, its cavities considerably distended, especially the right auricle and ventricle, while the valvular structure seemed natural. The pericardium contained about ounces of straw-coloured fluid. After examining the organ particularly, I could discover nothing abnormal, but the enlarged and softened state alluded to. The liver was large and highly congested with dark thick blood, but otherwise it was healthy. The gall-bladder was empty, and the spleen large and congested. The stomach was smallish and empty. The mucous membrane was smeared with a blackish, tenacious fluid, which, upon removal, appeared to be a portion of the expectoration. The structure, as far as could be ascertained, was healthy. The small and great intestines contained fluid carbon (evidently swallowed), while no disease was manifest. The mesenteric glands were small and rather firm, but they contained no black matter; the mesentery was much congested with dark venous blood. The kidneys were apparently healthy, though soft. The bladder was small and contracted. The head was not examined, as I expected nothing but general congestion of the vessels. This case comes under the third division of the disease, where the lungs were cavernous, and where there was free expectoration of carbon. The following case is one of unsuspected carbonaceous accumulation in the lungs, the history of which proves the fact, that the disease, when once established in the pulmonary structure, continues to advance till it effects the destruction of the organs, although the patient has not been engaged in any mining operations for many years previous to his death. Robert Reid, aged forty-six at his death, had been a collier since his boyhood. He was a short, stout-made man, of very healthy constitution, and never knew what it was to have a cough. He spent the early part of his life at a coal-mine, near Glasgow (Airdrie), where he all along enjoyed good health. In he removed from Airdrie to the coal-work at Preston-Hall, Mid-Lothian, where he engaged in mining operations; and, from the time he made this change, he dated the affection of which he died, at the end of. Two months after he removed to Preston-Hall colliery, he was seized with bronchial affection, giving rise to a tickling cough in the morning and when going to bed, accompanied by dyspnœa, with a quick pulse, and palpitation of the heart. In the first stage of the affection, he had no expectoration of consequence; but soon after, a little tough mucus was coughed up, and when it was difficult to expectorate, the sputum was occasionally tinged with blood.

At this period, the appetite continued to be good, and the strength little impaired. During the day, he felt in his usual health; and, therefore, he continued in full employment. At the end of the four months , his cough had increased much, his palpitation of heart, dyspnœa, and bronchial irritation had become very oppressive, and general exhaustion had manifested itself. Recourse was had at this period of the affection to bleeding, blisters, and expectorants, which relieved him only temporarily, and while under this treatment, he—having a large family dependent on his exertions for their support—continued to struggle on at his daily vocation so long as he was able to handle the pick-axe. At the close of which completed three years of labour in this coal-mine, he was obliged to discontinue all work, and take refuge in medical treatment, with a severe cough, palpitation, annoying dyspnœa, small intermitting pulse, and sleepless nights. On inquiring as to his general habits and mode of life, I found that he had been all along a sober, regular-living man, that he never complained of ill health till he engaged in this coal-mine at PrestonHall, where the work was difficult and the pit confined, he having only twentyfour inches of coal seam which obliged him to labour lying on his side or back. He was also at this time occasionally engaged as a stone-miner, and was consequently subjected not only to the inhalation of the smoke of linseed oil, but to that of gunpowder. For his chest complaint at this stage, he underwent a variety of medical treatment, which produced mere palliation in his symptoms, and though breathing a pure atmosphere in a country situation, he experienced a most painful sensation of want of air, or, as he himself expressed it, "a feeling as if he did not get enough down." By this time the countenance had become livid, the lips and eyelids dark and congested. After undergoing medical treatment in the country, without much relief, he was removed to the Edinburgh Infirmary, in July in the hope of deriving benefit; but after being a patient in that hospital for some weeks, he returned home much worse. In addition to the aggravation of his other symptoms, there were present œdematous swelling of the extremities, which were generally cold and benumbed, gnawing pain in the right hypochondriac region, and almost total loss of appetite. On examining the right hypochondrium, which he described as swollen, there was evident indication of an enlarged liver, and he complained much of shooting pain in that region during a paroxysm of cough. Hitherto the functions of the stomach and bowels had remained unimpaired; but at this period, the former became irritated, and the latter obstructed. Tonics and gentle purgatives were administered, and continued for a considerable time. The urinary secretion was all along scanty and high coloured; but, as the disease advanced, the quantity became exceedingly small, (almost none was voided for days together,) for which he was taking diuretics; and on examining it with the application of heat, I repeatedly found it coagulable. General anasarca was now rapidly increasing; and as the cellular effusion advanced, the breathing became more laborious. I understand, that at the commencement of this person's affection, the pulse was frequent, with some heat of skin at night, but from the time he became my patient, there was a tendency to languor in the circulation, and the beat at the wrist, for some months previous to his death, was almost imperceptible. With a view to remove the enlargement of the liver, a slight mercurial course was proposed; but owing to debility, indicated at its commencement, it was discontinued, and no effect produced on the organ. All medical treatment having been given up, except mere palliatives, such as blisters and expectorants, this poor man lingered out a most miserable existence from his pectoral symptoms, and particularly from palpitation of heart. Expectoration continued the same, of tough, ropy mucus, small in quantity, and got up with difficulty from the airpassages. In repeated examinations with the stethoscope, there was considerable dulness over the whole thoracic region, no bruit whatever could be discovered in the left side of the chest, no cavernous indication, although that side of the thorax was fully developed. The mucous râle was heard very strong in the upper lobe of the right lung, and some little crepitation at the inferior angle of the scapula on the same side. The action of the heart under the stethoscope gave rather an uncertain indication as to the state of that organ, for though the sound was evidently communicated to the ear, as being transmitted through a fluid, and not the heart striking the ribs, still, from the very general dulness in the left side of the chest, it was exceedingly difficult to decide whether this obscurity arose from effusion into the pericardium, or from effusion into the cavity of the chest. There was one remarkable symptom manifested in this case,—that though the heart's action was to the observer feeble, the patient's sensations were as if the pulsation was very strong, and painfully difficult to bear, and this peculiar feeling to a great extent prevented him from sleeping.

I cannot record this case without the painful recollection of this poor man's sufferings. For six months previous to his death, the dyspnœa and palpitation attendant upon his disease were of such a severe character, as to prevent him at any time lying down; and his sensations would not even permit his maintaining the sitting position, for he found it necessary to get upon his hands and knees, as the only posture affording any alleviation to his uneasiness. This peculiarity in the cardiac action was such, that, as he expressed it, "he lived in continual dread of death," and this being ever present to his mind, he was for weeks known almost never to close his eyes. He died exhausted, in; and there being doubts entertained regarding some of the symptoms of his disease, he requested that his body should be examined, which was done twenty-six hours after his death. Post-mortem Examination.—The general anasarca gave the body a bulky appearance. On raising the sternum, the ribs seemed very firm and unyielding. The lungs were of a dark blue colour, and seemed at first appearance to fill completely both sides of the chest. Towards the sternal end of the ribs, on the left side, three or four of the substernal or mammary glands were found enlarged and filled with black fluid. The pleura pulmonalis had (where there wore no adhesions) interspersed over it patches of false exudation, of a dark brown colour. The lungs adhered extensively to the pleura costalis, and from the character of the adhesions, they were evidently of some years' standing. In both sides of the chest there was effusion to a considerable extent of a dark-coloured fluid, resembling porter in appearance. On removing the left lung, which was difficult, from the strong adhesive bands, it seemed, from its weight and softness, to contain a fluid; and on making a longitudinal section of both lobes, a large quantity of thick, black matter, similar to black paint, gushed from the opening, exposing an almost excavated interior of both lobes. The carbonaceous matter contained was in quantity about an English pint, and the lung, when emptied, became quite flaccid, and very light. The air-cells of this lung were entirely destroyed, or nearly so, and one of the divisions of the left bronchus opened abruptly into the cavity at the upper part. Both lobes were so completely adherent to each other, from inflammatory action, as to form a continuous sac, containing the above fluid. On examining the internal structure of the cavity, the parenchymatous substance which formed its walls presented a rugged and irregular appearance, resembling a sponge hollowed out, and infiltrated with black paint. At different points, the large pulmonary blood-vessels crossed the cavity in the form of cords, with portions of structure attached, and though these fragments had a black appearance, they exhibited, to a considerable extent, their original cellular structure when washed in water. The process of carbonaceous ulceration had proceeded so far in this lung, that at some points the pleura pulmonalis, which was much thickened, was left the sole medium between the contents of the sac and the cavity of the chest; while in other parts it was thick and spongy. On examining more minutely with the magnifier, open-mouthed bronchial twigs, and very small blood-vessels, were seen plugged up with solid and fluid carbon, and, from the appearance of the morbid structure, it was manifest, that the ulcerative process had effected a complete disorganization of the bronchial tubes of every calibre, while the smaller arterial vessels had alone suffered, leaving the larger ones entire. Along the margin of the inferior lobe, indurated accumulations were felt through the pleura, and, on being laid open, they were ascertained to be impacted lobules, which resisted the knife. Previous to the division, both lungs weighed about six pounds. On examining the right lung, which seemed much similar in weight to the left, and on making a section throughout its three lobes, the morbid appearances varied in each. The upper lobe was infiltrated with carbon into the interlobular cellular tissue, leaving the bronchial ramifications respirable, and lubricated with frothy mucus. The middle lobe presented a solid appearance, and contained a mass of indurated black matter, of the size of a largish apple, and consistency of consolidated blacking. The surrounding parenchymatous substance was disorganized, and undergoing the process of softening. In dividing the indurated substance, its internal structure exhibited a variety of greyish lines, forming parallel and transverse ramifications, which resembled small check in appearance, and which, when more accurately examined, was ascertained to be the disorganised walls of the minute air-cells and cellular tissue. The inferior lobe presented a state of complete infiltration, with the air-cells generally entire, and on putting a piece of it into water, it showed its density by sinking. When we examine the morbid appearances in this case, and compare them with the symptoms—when we consider that nearly all the respiration carried on in this man's chest, was performed in the upper lobe of the right lung, we are not surprised at his sufferings, nor is there much difficulty in explaining the very painful dyspnœa, on his attempting the recumbent position; and as death was instantaneous, it was evident that the immediate cause was the bursting of the left pulmonary cyst into the corresponding bronchus; the fluid carbon thus finding its way to the trachea, produced suffocation.

The liver was exceedingly large, projecting outwards and downwards from under the ribs, and pushing up the diaphragm. Its substance was soft, engorged with dark blood, and easily torn. There was no carbonaceous deposit throughout its structure, and its weight was upwards of twelve pounds. There was a considerable quantity of very dark bile in the gall-bladder. The heart was large, soft, and pale. There was considerable attenuation of the walls of both auricles and ventricles. The coronary veins were much distended with dark blood. The columnæ carneæ of the right ventricle were exceedingly slender and bloodless; the tricuspid valve was much thickened, and studded on both sides with small cartilaginous granules; the other cavities of this organ were apparently healthy, though thin in substance. The pericardium, which was rough, and much distended, exhibited a variety of false membrane on its internal surface, of a dark brown colour, and contained about eight ounces of dark fluid, similar to that found in the cavity of the pleura. In tracing the bronchi from the lungs to the bifurcation, the mucous membrane, which was smeared with fluid carbon, appeared much irritated, and considerably thickened, diminishing the diameter of these passages; and there were found externally at the root of the lungs, and around the bronchi, several large glands, containing a fluid to all appearance carbonaceous. The trachea showed a similar irritated condition with that of the bronchi. A little above the bifurcation, and at the back part of the trachea, a cluster of lymphatic glands were found, some of them the size of a horse bean, filled with carbon. The spleen was very large, and much darker than usual, highly congested with venous blood, easily torn with the fingers, and weighed about three pounds. Kidneys small, pale, and soft; bladder small, and corrugated; large accumulation of light brown fluid into the cavity of the abdomen, to the extent of two Scotch pints. The viscera were much compressed from effusion. There was a rough brown exudation upon the surface of the peritoneum and intestines. The stomach was contracted to a small size. The mucous membrane was soft, pultaceous, and easily removed, tinged with dark green bile. The lymphatic glands along both curvatures were small and flaccid, and contained no black matter. The intestines appeared empty and contracted. The duodenum showed the same softened state of its mucous membrane as was exhibited by the stomach. The mesenteric glands were free from any disease. The head, on removing skull-cap, dura mater found natural; serous effusion to small extent under the arachnoid; very general congestion of the pia mater, giving both hemispheres of the brain a blackish appearance. The superior longitudinal sinus was filled with dark, inky-looking blood. In removing the pia mater, the convolutions of the brain were firm, and appeared natural. There was a light brown effusion into both lateral ventricles to the extent of about an ounce. Reid, when he first came to Preston-Hall, had inhaled the evolved smoke of the coal-mine, thereby laying a foundation of this infiltrated mass. It must be manifest to every one who follows out the history of this case, and attends to the morbid appearances found within the chest, that there was a progressive accumulation of carbonaceous matter going on in the substance of the lungs from the time the patient engaged in working this difficult seam of coal till his death. was aged years at his death, in. He had been engaged as a coal-miner so soon as he was able to undertake work. He was a tall, muscular man, and for a long time enjoyed excellent health. He first began mining operations at one of the Pencaitland collieries, and continued to labour there for many years. About six years before his death, he was induced by an increase of wages, to undertake stone-mining in the same pit; and soon after engaging in this employment, he began to be troubled with a slight cough, accompanied by dyspnœa, palpitation, and oppressive headach, which symptoms rapidly increased in severity. He declared that his cough and general ailments first showed themselves after labouring for a considerable time at stone-work, with the aid of gunpowder, in a situation where the air became so impure, both from defective ventilation and carbonaceous particles floating in it, as materially to affect the breathing. Although he repeatedly changed his place of labour from one coal-work to another more healthy in the same parish, he experienced no mitigation of his annoying cough. When I first saw this man for medical advice in July, he had then been about two years engaged as a stone-miner, the bronchial irritation was very general throughout the chest, he had severe cough, hurried breathing, little or no expectoration, and on applying the ear to the thorax, the sibilant and sonorous bronchi were distinctly heard, which indicated a swollen and irritated condition of the mucous linings of the air-passages, and this irritation was also manifest in the mucous membrane of the nostrils, which was much swollen, acutely tender, and impeding considerably the passage of the air. The pulse was rather frequent, about in the minute. There was present much heat of skin during the night, which subsided towards the morning.