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*** START OF THE PROJECT GUTENBERG EBOOK AN INVESTIGATION INTO THE NATURE OF BLACK PHTHISIS ***

**AN INVESTIGATION
INTO THE NATURE OF
BLACK PHTHISIS;
OR
ULCERATION INDUCED BY CARBONACEOUS ACCUMULATION
IN
THE LUNGS OF COAL MINERS,
AND OTHER OPERATIVES.**

BY

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PREFACE.

An abstract of the investigations into the nature of carbonaceous infiltration into the pulmonary tissues of coal miners, was read by Dr Makellar at a meeting of the Medico-Chirurgical Society of

Edinburgh, Wednesday, 8th July, 1845, Dr Gairdner, President, in the Chair.

Reference was made, in particular, to the East Lothian coal-miners. The carbonaceous disease described, was stated to be caused by the inhalation of substances floating in the atmosphere of the coal-pit, such as the products of the combustion of gunpowder, the smoke from the miner's lamp, and the other foreign matters with which the air of the mines is heavily charged, in consequence of their defective ventilation. In the mines in which gunpowder is used, the disease is most severe in its character, and most rapid in destroying the pulmonary tissue. The carbon in some cases is expectorated in considerable quantity for some time previous to death; in others, it is retained, and accumulates to a great extent in the lungs.

As the disease advances, the action of the heart becomes feeble; and the appearance of the blood indicates a carbonaceous admixture. The carbonaceous deposit seems to supersede or supplant the formation of other morbid bodies in the substance of the lungs—such as tubercle; for in individuals belonging to families in which there exists an undoubted phthisical diathesis, tubercle is never found on dissection.

The views expressed in this communication called forth the following remarks.

PROFESSOR CHRISTISON called attention to the new and important fact, of the carbonaceous matter being found in the circulating mass. He attached great importance to Dr Makellar's researches.

PROFESSOR ALLEN THOMSON remarked, that the presence of this carbonaceous matter in the blood, by no means proved, that it was formed in, or from the blood.

DR HUGHES BENNETT said, that the antagonism of this carbonaceous disease to tubercle, was a fact of great interest and importance, especially in connection with two other recent observations; viz. 1st, That the depositions of carbon in the lungs of old people, (which French pathologists describe,) are not found associated with tubercle; and, 2d, That under the supposed cicatrices of pulmonary tubercular cavities, a layer of carbonaceous matter is commonly found.

Dr Makellar's paper called forth some interesting observations from the President, Professor Simpson, and others.

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BLACK PHTHISIS,

OR

ULCERATION INDUCED BY CARBONACEOUS ACCUMULATION IN THE LUNGS OF COAL-MINERS

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.

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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 *post-mortem* 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, Dr J. C. GREGORY, in the report of a case of peculiar black infiltration of the whole lungs, resembling "Melanosis," (*Edinburgh Medical and Surgical Journal*, No. cix., October 1831); Dr CARSEWELL, in an article on "Spurious Melanosis," (*Cyclopædia of Practical Medicine*, Vol. iii); Dr MARSHALL, in a paper in *The Lancet* for 1836, entitled "Cases of Spurious Melanosis of the Lungs;" Dr WILLIAM THOMSON, now Professor of Medicine in the University of Glasgow, in two able essays (*Medico-Chirurgical Transactions of London*, Vols. xx. and xxi.), wherein he gives a number of very interesting cases, collected from various coal districts of Scotland, illustrating different forms of the disease; Dr PEARSON, in the *Philosophical Trans.* for 1813, on the "Inhalation of Carbon into the Pulmonary Air Cells;" and in a paper, by Dr GRAHAM, in vol. xlii. 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,^[1] 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.

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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.

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The locality^[2] 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.

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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^[3] 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,^[4] 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^[5] 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.

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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,^[6] 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 mucocarbon, 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.

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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 coal-mine, 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.

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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 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 1833-34, 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, dyspnoea, 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.

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CASE 1. George Davidson, collier from his youth. When I first saw him professionally, in May 1834, 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 (August 1836) he was entirely disabled, from general exhaustion. By this time his cough had much increased, and there was considerable dyspnoea, accompanied with sharp pain in the thoracic region, both in walking quickly, and when lying down. Pulse 80. 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 (October 1836) 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

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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,^[7] 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 Dec. 1836. 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!

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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.^[8]

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,^[9] 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.

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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 laminae. 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 10 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.

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This case comes under the third division of the disease, where the lungs were cavernous, and where there was free expectoration of carbon.

CASE 2. 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 1829, 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 1836. 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 dyspnoea, with a quick pulse (90), 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 (Jan. 1830), his cough had increased much, his palpitation of heart, dyspnoea, 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 1832, 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 dyspnoea, 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 Preston-Hall, where the work was difficult and the pit confined, he having only twenty-four inches of coal seam which obliged him to labour lying on his side or back.^[10] 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 1833, 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 oedematous 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, (September 1833,) 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

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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 air-passages. 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 r le 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 dyspnoea 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 November 1836; 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.

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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 were 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.

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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.^[11] 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

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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.

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CASE 3. D. S. was aged 39 years at his death, in August 1838. 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 1834, 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 85 in the minute. There was present much heat of skin during the night, which subsided towards the morning.

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The remedial measures were blisters and expectorants, which relieved him considerably. The cough recurred in paroxysms, accompanied by severe headaches, with little frothy mucous expectoration, and there was occasionally observed a slight tinge of blood in the sputum. At this period, his appetite was good, and with the exception of his cough and difficulty of breathing at night and morning, he seemed usually very well. Though labouring under his disease, he continued at his employment of stone-mining, and would not be convinced of its injurious effects.

July 1835. There was considerable increase of the palpitation when he attempted the recumbent position, or moved hurriedly. The remedies ultimately seemed to produce little effect. His general exhaustion advanced rapidly, and obliged him to relinquish all mining occupation. At the end of the summer of 1836, when I saw him more regularly, and was enabled to watch his symptoms with more attention, these having materially changed for the worse, percussion elicited dulness over the chest, with the exception of the upper part of both lungs, where the mucous râle was heard louder than usual. The heart's action was strong and irregular, particularly so for some time after a fit of coughing, when he suffered excessively from headach, succeeded by a tendency to drowsiness. The pulse was slow and languid, not exceeding 50 in the minute. His countenance had assumed a greyish inanimate aspect, his eyes became sunk, his robust frame bent and so emaciated from this peculiar disease, that though his age did not exceed 38 years, a stranger looking at him, supposed him to have attained the age of 70. No treatment seemed to have any effect in allaying the cough, nor was he permitted to lie down. From his feeling of dyspnoea and thoracic oppression, his nights were almost sleepless, his extremities œdematous, usually cold and bloodless.

During the greater part of the time he was confined to the house, the bowels were constipated, requiring daily purgatives. The urinary secretion was small in quantity and high coloured, but in neither discharge was there any thing very unnatural. In this almost inanimate condition he lingered on, when about six months before his death, during a paroxysm of cough, he expectorated a mouthful of thick black matter, and continued so to do periodically, at intervals of about three weeks, seeming to experience relief after voiding the carbonaceous sputum.

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There was little change in the symptoms of this man till death. He took little or no food, from his appetite being almost entirely gone, and from gastric irritation being constantly present. His cough and dyspnoea continued severe, with drowsy headaches and difficulty in keeping the body warm. The arterial action was exceedingly low. The pulse was 40 in the minute, and difficult to discern. The strongest stimulant produced no increase of action, the sitting position was the only one in which he was at all easy, and in which he remained day and night till he ceased to live.

Post-mortem examination, twenty-four hours after death.—The body was much emaciated. The chest large, and integuments tightly drawn over it, the ribs unyielding. In removing the anterior part of the chest, the lungs adhered strongly to the ribs, and were covered very generally with patches of dark-red false membrane, corrugating the pleura. Each side of the thorax contained fully a pint of light-brown fluid. In removing the left lung, it felt firm and developed, and in dividing it throughout its lobes, a variety of small cavities and indurated masses of carbon were found to pervade its substance, exhibiting a sooty appearance, extending throughout the whole structure. The indurated nuclei were ascertained to be impacted lobules, and the small cavities were these disorganized and softened, and communicating with the bronchial tubes. Part of the upper, and the whole of the inferior lobe, were soaked with carbon, and felt indurated. The right lung was similarly disorganized with the left. The greater part of the superior lobe was permeable to air, and the interlobular tissue contained carbon, in small, hard granules. The middle and inferior lobes contained several hard, indurated bodies, progressing to a state of softening, and in separating a portion of the latter lobe, it was found to sink in water. There was emphysema of the margin of the inferior lobes. There appeared considerable irritation and softening of the mucous membrane of both bronchi, extending from the root of the lungs to beyond the bifurcation of the trachea. There were several enlarged bronchial glands at the apex of the lungs, containing black fluid.

The pericardium contained about eight ounces of straw-coloured fluid. There was a light-brown exudation, extending over serous lamina of the pericardium and the surface of the heart. The heart was flaccid, the right auricle and ventricle were enlarged and attenuated, and both vena cava at their junction with the heart were much dilated, the valvular structure natural. The liver was large, soft, and easily torn. The abdominal viscera in general appeared healthy; slight effusion into the cavity of the peritoneum. In this case head not examined, but which no doubt would have shown marks of extensive congestion, as in other cases.

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The above case comes under the second division of this disease, where the irritative process resulting from the foreign body pervading the lungs, had advanced so far as to produce a variety of small cysts, and circumscribed, indurated masses, the former containing *fluid*, and the latter *solid* carbon, and it is evident in tracing its progress, that there must have been a very rapid increase within the system in the carbon originally deposited in the pulmonary structure by inhalation. There was very limited black expectoration shortly before death, and this merely the contents of a few small cavities communicating with the bronchial ramifications, while both lungs were extensively infiltrated with that matter which, had the patient lived, would have produced general softening, and more extensive excavations by the coalition of the various indurated tubulæ.

CASE IV. J. T., aged 45 when he died, May 1837. He became a collier in early life, in the neighbourhood of Glasgow, and came, at the age of 22 years, to East Lothian, to engage in collier labour at Blind Wells, near Tranent. From his own account, he was rather of a delicate constitution, and ill-fitted for the work of a coal-pit, consequently, after labouring a few years, he was, at the age of 26,—owing to cough and difficulty of breathing,—obliged to relinquish the employment of a miner. He left East Lothian, and retired to the west of Scotland, where he became a country merchant, and continued so occupied for upwards of fifteen years. During that time, he was occasionally troubled, particularly in the morning, with his cough and hurried breathing, which was increasing in severity, but at no period had he expectorated black matter, nor was there any indication that his sufferings arose from carbonaceous disease. On account of becoming reduced in circumstances, he was under the necessity, though labouring under chest affection, of returning to his former employment of coal-mining at Blind Wells, at the age of 41, August 1834. He had not been long engaged as a miner, after his return to East Lothian, when his cough increased considerably, with laborious breathing, palpitations, and overpowering headach. Both now and formerly, he wrought solely as a coal-miner, and at no time of his life did he work as a *stone-miner*. Having a family to provide for, he struggled on laboriously under much suffering from his chest affection, till general exhaustion compelled him to leave off work, and seek regular medical advice, July 1836. From his statement regarding the cause of the disease, I was led to understand that his cough, which never left him from the time he was first seized, was induced, at an early period, by bad air generated in the coal-pit at Black Wells, from the work being ill ventilated, and from the general use of coarse linseed oil for the lamps.

When I first saw this man professionally, he was labouring under general weakness; his pulse was not above 40 in the minute, small and thready. He suffered from drowsy headach, anorexia, cold and slightly oedematous limbs. He had incessant cough, with tough mucous expectoration. During a severe paroxysm, he vomited a mouthful of black paint-like fluid, followed by considerable relief, and ever after till his death, he continued to expectorate the same substance in great quantity, often to the extent of 15 oz. daily. In examining the chest with the ear, the sound, from the distinct pectoriloquy, indicated a cavernous state of both lungs; otherwise the bruit was obscure.

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The remedies were merely of a palliative character, knowing the patient to be rapidly sinking. In this exhausted state he remained for some months; his appetite was almost entirely gone; the oedema of limbs increasing. There was also a leaden hue over the surface of the body, which was constantly cold. At this stage, the quantity of urine voided was small and dark in colour. Bowels obstinate; occasional vomiting. The pulse ranged from 38 to 40. The lips and ears were livid, and his drowsiness became more overpowering as death approached.

Post-mortem examination.—The body was much emaciated; the ribs were prominent and unyielding. On removing the anterior part of the thorax, the lungs were found firmly adhering to the pleura costalis, and of a dark blue colour. There was an effusion to the extent of about sixteen ounces of light-brown fluid, found in the cavities of the pleura. The greater part of the effusion was into the left side. The lining membrane of the chest was almost wholly covered with false membrane of a dark brown colour. The right lung filled almost completely the right cavity of the thorax, while the left lung appeared much contracted, particularly towards the apex. The pleura of both lungs was much puckered, and interspersed with dark red patches around the adhesions. Three or four of the substernal glands were found considerably enlarged, and filled with black fluid, and a cluster of the anterior mediastinal and lymphatic glands contained fluid having the same appearance. The right lung appeared solid to the feel, when removed from the body. It was rough and irregular over its surface, from a variety of indurated substances projecting from beneath the pleura. In making a section of the whole lung, each lobe was almost completely saturated with thick inky fluid, and was observed to be here and there hard and granular, particularly in the course of the larger bronchi. Portions of this lung were pervious to air and emphysematous, but the greater part was disorganized, and contained carbonaceous matter in a solid and fluid state. The left lung was light and flaccid, when compared to the right. The upper lobe was extensively excavated. The parenchymatous substance was found ragged and unrespirable, and many large blood-vessels crossing from either side of the cavity, pervious to blood. With the aid of the magnifier, a variety of open-mouthed bronchial twigs and minute blood-vessels were visible, communicating with the cavity. The upper part of the inferior lobe was partially excavated, and containing about four ounces of fluid carbon. The lower margin of this lobe was firmly impacted.

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The mucous membrane of the trachea and bronchial divisions appeared, when washed and freed from the black matter, red and softened. The lining membrane of larynx was partially ulcerated, and the rima glottidis slightly oedematous. There were various small lymphatic glands on the back part of the trachea, which contained black fluid.

The pericardium considerably distended, and contained nearly twelve ounces of light-brown fluid. Evident marks of inflammatory action were observed externally. On its internal surface it was thickly coated with false membrane of a brown colour. The heart was pale, soft, and attenuated. The right auricle was much dilated, and its walls exceedingly thin. There were no further morbid appearances. Head,—External congestion of an inky colour was found on the surface of the brain, which was to all appearance otherwise healthy. There was an effusion into both lateral ventricles. The abdominal viscera were natural. The liver was much larger than usual, soft, and highly congested with inky-coloured blood.^[12]

It is evident, from the symptoms and history of the above case, that the patient had contracted

the disease of which he died at an early period of his life, and that during the fifteen years he refrained from mining operations, the pulmonary structure retained the carbon inhaled while labouring in the coal-pit, and this is one of the many cases which can be produced as examples of the fact that the foreign matter once deposited in that structure originates a process of accumulative impaction and ultimate softening of the organ, which is gradually carried on till it is entirely disorganized. This case comes under the third division of the morbid action, viz. where extensive excavation of the structure is produced.

CASE V. A. G., aged 52 at his death. He was a collier from his boyhood, and wrought during the greater part of his life at Penston colliery in the parish of Gladsmuir. He was a short-set robust man, and while labouring at Penston, he enjoyed usually good health, free from cough or any affection of the chest. When he had attained the age of 48 years, (1833), he removed from the Penston to the Pencaitland coal-work, and about six months after making this change, he began to experience a slight difficulty of breathing, accompanied by a troublesome cough and feverish nights. The pulse was 84. Various soothing remedies were administered, which relieved for a little the pectoral symptoms; and as he felt no decided physical debility, he continued as usual at underground work. In 1835 I saw him often, and found that his pulmonary symptoms were becoming more marked; his cough was excessively annoying in the morning and when going to bed; his expectoration was frothy mucus, with dyspepsia, palpitation, and occasional headach. The resonance of the chest on percussion was very slightly impaired, and the respiratory murmur was variable, being occasionally louder at one time than another, and often much obscured, from the mucous secretion.

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Labouring under this chest affection he still continued his daily employment till the spring of 1836, when he was entirely laid aside, being unable to go below ground, or to take the slightest fatigue, for the smallest exertion produced a fit of coughing; and during a paroxysm of this kind, he expectorated a few black sputa, which in a few days disappeared, and gave place to the usual frothy mucous expectoration. This bronchial discharge was accompanied by considerable relief to the cough and dyspnœa. By this time, (June 1836), on applying the ear to the chest, the resonance is dull, and respiratory murmur obscure. The action of the heart was slow when compared to its former state. The pulse not beyond 45 in the minute. By the end of this year he appeared in a half dead state,—but a mere shadow in regard to flesh. He was expectorating at intervals of some weeks, when the cough became more severe, a few carbonaceous sputa, and suffering severely from gastric irritation.^[13] During the last week of his life, he expectorated considerable quantities of black fluid, and died exhausted, January 1837.

Post-mortem examination, which was conducted hurriedly, exhibited extensive effusion into both sides of the chest. The adhesions of the pleura were strong, and evidently of long standing. There was very general carbonaceous infiltration throughout the lungs, without excavations to any extent. Various empty cysts, which could contain a hazel-nut, were found in the superior and middle lobe of the right, and throughout the whole of the left lung; in which bronchial twigs terminated. The pericardium was distended, with limpid effusion. The right side of the heart was dilated, and filled with dark treacly-looking blood; and when washed, it appeared pale and bloodless. Its walls were thin, various patches of brown exudation extending over both pleuræ. There were several enlarged lymphatic glands, found at the root of both lungs, filled with black fluid.

In examining the head, the pia mater was found much congested; but there was no effusion discovered into any of the ventricles of the brain, nor any other indication of disease.

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In tracing the history of this patient, connected with the disease, it will be observed, that until he came to Pencaitland colliery, he had no symptom whatever of chest affection. Penston coal-work is exceedingly well ventilated, and the miners who labour there seldom, if ever, suffer from the black expectoration, owing to the evolved smoke of every kind being freely carried off from its underground works, while it is quite the contrary at Pencaitland, where many colliers, on leaving Penston, are seized with the disease. This case comes under the second division of the disease, where the irritative process, the result of the foreign matter in the lungs, has proceeded so far as to produce a variety of small cysts, containing fluid, or semi-fluid carbon, following the course of the bronchial ramifications.

CASE 6. D. L., aged twenty-six years at his death, in August 1837. He was the son of a collier, at Pencaitland, and engaged at an early age in putting the coals to his father; and when he was fit for full collier-work, in 1831, he was employed at the same coal-work. He was a tall, well-formed, robust young man, and not at all liable to chest affection. For some time he wrought, as a coal-hewer, but latterly was induced, (1834), for higher wages, to become a stone-miner in the same coal-pit, where gunpowder was used extensively in the operations. About six months after he commenced stone-mining, he became affected with a short tickling cough, expectoration of pearly tenacious phlegm, hurried breathing, tightness across the chest, frequent pulse (95), heat of skin during the night, and occasional throbbing in the head. Being young, and fearless of any danger from the occupation, although warned of the consequences, he continued to prosecute it, and twelve months (May 1835) after he first began, the cough had increased much in severity.

The expectoration was diminished, and had become more difficult to void from the bronchi, and the breathing was more oppressive, accompanied by a painful tightness across the chest in the morning. The body was considerably reduced in bulk to what it previously had been. The pulse ranged from 80 to 90; the appetite was impaired, and there was in the morning a tendency to retching. The nocturnal heat of skin continued, without any moisture, though his body was drenched with a clammy sweat during the hours of labour. The respiratory murmur was harsh and extensive at the upper part of both lungs, while the sibilant ronchus was heard occasionally in the lower lobes. The heart's action was regular, but impulse strong, on applying the hand to the cardiac region. The remedies resorted to were blisters, bleeding (at an early stage), expectorants, and tonics, which, to a certain degree, relieved the more urgent symptoms.

In October 1835, the disease having made rapid progress, all the symptoms had become more marked. The cough, from its frequency and severity, was extremely exhausting, and the expectoration had become more copious, and of a semi-black colour. The mucous râle was evident in the upper part of both lungs, while the inferior lobes were dull to the ear, and on percussion. The heart's action, at this stage, was less strong, but no peculiarity in its function could be discovered. The cardiac region exhibited every indication of effusion into the pericardium. His body was now considerably emaciated, and the anterior part of his chest was so much contracted, as to oblige him to stoop to a great degree. Under this load of disease, he continued his employment of a stone-miner, gradually losing flesh, with a rapidly increasing black expectoration; and having several dependant on his exertions, he resolved to work, while he could keep on foot, which he did till September of the following year, (1836) when his once powerful body was so reduced, from disease, and his cough so incessant, that he was unable to move or speak without great fatigue. He preferred the sitting position, as giving him most freedom in breathing. The pulse was rather slow and small; the heart's action languid, and there was an evident increase of dulness upon percussion over cardiac region. At this, the closing period of the disease, (November 1836) he first complained of drowsiness, accompanied by headach. The countenance was pallid; the eyes sunk and inanimate, and the body tending to be cold; the urinary secretion of a dark brown colour, and precipitates a dark deposit. The bowels were exceedingly obstinate, with little change in any of the symptoms; he lingered till January 1837.

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Post-mortem examination.—The body was much emaciated. The thorax was large, and well arched. On removing the anterior part of the chest, the lungs appeared to be fully developed, and of a dark blue colour. There were several very slight adhesions between the pleuræ, and the effusion into both cavities was small in quantity. The pleura costalis was almost free from any exudation, but there were a variety of small patches of false membrane throughout the pleura pulmonalis. The left lung exhibited general carbonaceous infiltration. The upper lobe was partially excavated. The pulmonary structure, internally, was ragged and easily torn, and these cavities communicated with the bronchial divisions, the walls of which formed various septa. The inferior lobe was almost impervious to air. The minute bronchial ramifications and corresponding lobules were impacted with dense carbon. There were several clusters of small cysts throughout this lobe, containing carbon in a fluid state. A portion of this lobe sank in water from its density, and when squeezed with the hand, thick fluid carbon, containing hardened particles, could be expressed from it. The right lung was similar in external appearance to the left. The upper lobe was crepitant, though infiltrated with carbon into the interlobular cellular tissue. The air-cells were gorged with tenacious mucus. The middle lobe was partially excavated. The cellular tissue was considerably disorganized, and similar in diseased structure to the upper lobe of the left lung, with the exception of a portion affected by vascular emphysema. The inferior lobe was much condensed, and loaded with carbon of a very bright black. The mucous membrane of the bronchial tubes was thickened, and slightly ulcerated. Various lymphatic glands were found at the root of both lungs, containing black fluid. The pericardium was considerably distended from effusion of a straw-coloured fluid. The internal surface of the pericardium was rough, and both laminæ appeared thickened from inflammatory action. Effusion into cavity of chest to the extent of twelve ounces. The heart was natural in appearance, but thin in substance. The tricuspid and mitral valves were thickened, and exhibiting minute granulations on their surface. The right auricle and ventricle were dilated considerably. Aorta, and other vessels proceeding from heart, were natural. The stomach was small, and exceedingly spongy in its mucous lining. The intestines were healthy. The kidneys were small, and peculiarly yellow in the internal structure. The liver was large, and engorged with dark thick blood; several small carbonaceous cysts throughout its substance. The spleen was large, soft, and much congested. The mesenteric glands free from black matter.

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Head.—The arachnoid thickened and opaque; there was very general congestion of pia mater with dark black blood, and when removed, convolutions studded over with innumerable dark points. The surface of the brain was apparently healthy, with an effusion of a light pink-like fluid into the lateral ventricles. The internal substance of the brain natural.

This case is interesting, as showing the very rapid course, in some instances, of the disease to a fatal termination, and also how soon the strongest man can be brought under its destructive influence. This is the only case in which carbon was discovered in any of the other organs, as exhibited in the liver. The above case comes under the third division, showing extensive excavation of the pulmonary structure.

CASE VII. James R. aged 54 at his death, 1836. He was a large muscular man, and wrought as a coal-miner in early life at Pencaitland, and, as far as could be ascertained, he had never been

engaged at stone-mining. At the age of thirty he was obliged to desist work, on account of a difficulty in his breathing, which he considered to be asthma, and he was occupied above ground, as the engine-man, during the latter part of his life. The slightest exertion produced exhaustion and palpitation of the heart; his bowels were obstinate, and his urinary secretion small in quantity. His cough was particularly troublesome in the morning, and was relieved by a free expectoration of frothy mucus. In this condition he continued, with the cough gradually increasing, for nearly twenty years, as I understand, when he began to void black sputa, which daily augmented in quantity till his decease, August 1836.

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For some weeks previous to his death, his pulse had become slow and thready, 36 in the minute. The œdema of the upper and lower extremities was extensive; the dyspnœa increased considerably; the countenance was livid; and the body remarkably cold. Stimulants in considerable quantity were administered without the smallest effect. Drowsiness supervened; and he was for some days previous to dissolution in a torpid condition, while at the same time he was quite collected when roused.

Post-mortem examination.—On examining the body, the chest was large and well formed. The effusion into the cellular substance was very general. The cartilages of ribs were ossified, and both lungs were adhering strongly to the pleura costalis. There was large effusion into both cavities of the chest, to the extent of three English pints in whole. The pleura pulmonalis was much thickened and rough, with false membrane, and many patches of puckering. Several lymphatic glands in the anterior part of the mediastinum contained black fluid. The left lung was carbonaceous throughout its substance. The upper lobe partially excavated and ragged; the inferior lobe infiltrated and emphysematous. The right lung was of corresponding black appearance. The lower lobe had a firm and condensed feel, and when divided, exhibited a mass resembling indurated blacking. The middle lobe was in part permeable to air; and there were several small cysts containing liquid carbon, connected with minute bronchial ramifications. Various indurated knotty bodies were extended throughout its substance. In the upper lobe, the carbon was confined principally to the interlobular cellular tissue, and when pressed in the hand, gave out thick, black, frothy serum. The mucous membrane of bronchial divisions, when freed from the black matter, was swollen and eroded as far up as the bifurcation of the trachea. At several parts these passages were considerably contracted.

The heart was enlarged, and dilated in all its cavities. The valves of the right and left ventricles wore thickened, from congestion of very minute veins, and were granular to the feel. The substance of the heart was soft. There were eight ounces of effusion into the pericardium, resembling that formed in the cavities of the thorax. The liver and the spleen were large; the former peculiarly yellow and oily. Several very large veins, containing inky-looking blood, were seen ramifying its substance. The spleen was very friable. The kidneys were small, and apparently healthy.

Brain not examined.

This case comes under the third division of the disease. R.'s case is peculiarly striking, from the length of time (twenty years or more) that the carbon was concealed within the pulmonary tissue, and also because he had never been engaged, as far as known, as a stone-miner; so that this case, along with others, illustrates the fact, that where the morbid action is the result of lamp smoke, from the combustion of coarse oil, and not gunpowder smoke, the disease is much slower in its progress, but ultimately fatal.

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CASE VIII. R. D., aged 37, at his death, 1839. He was the brother of George Davidson, subject of the first case in this Essay. He began to labour as a miner, with his brother, in early life, at Pencaitland coal-work. He first began as a coal-miner, and after being so engaged for five or six years, he removed to Penston coal-work, which adjoins. He continued healthy for a considerable length of time, and at his brother's death, December 1836, he was free to all appearance from any affection of the chest. He returned, 1836, to Pencaitland coal-work, where he engaged as a stone-miner, knowing that such employment was destructive to life; and from that change he dated the commencement of his disease. Cough, palpitation, dyspnœa, headach, quick pulse (90 in the minute), made their appearance, soon after he began trap labour, and these symptoms gradually increased, till he was laid aside in the course of two years, (1838,) when he first expectorated black sputum.^[14] As his exhaustion advanced, the carbonaceous expectoration became more copious, and he discharged from the lungs at an average twelve ounces of fluid, resembling liquid blacking, daily; and he died in a manner similar to his brother, Case No. 1. Some weeks previous to his death, his pulse rapidly sank to about 45 or 50, and became exceedingly feeble;—cold extremities, œdema of the legs and arms, lividity of lips, eyelids, and ears, preceding dissolution.

Post-mortem examination.—The chest was contracted; the ribs unyielding, with extensive adhesions of the pleuræ. Both lungs were of a dark-blue colour, much puckered from patches of false exudation. There was extensive effusion into both cavities of the chest; and the right lung showed carbonaceous infiltration throughout its whole extent. The superior lobe was excavated, so as to contain a small orange; and about six ounces of thick, black matter were found in it. The middle lobe was crepitant, though soaked with black fluid; several impacted lobules were scattered throughout its substance. The inferior lobe was indurated, resembling a piece of moist

peat. The left lung was cavernous in both lobes, and the cysts were empty, the contents having been expectorated. A small portion of the upper lobe was pervious to air. There were several enlarged bronchial glands at the root of both lungs; and the tracheal glands contained black fluid. The liver was large, and its substance soft.

Head.—There was extensive congestion of the blood-vessels of the brain, with effusion into the lateral ventricles. The viscera of the abdomen were extensively congested, with slight effusion into the peritoneal cavity.

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It will be observed in referring to the history of this case, that till the time this man became a stone-miner, and carried on his operations with the aid of gunpowder, he had no symptom of the disease of which he died, and it is evident that the disease, if commenced at all, had made little or no progress till after his return from Penston colliery to Pencaitland, and after he had inhaled the residuum of gunpowder combustion, therefore the disorganization of the pulmonary structure was to all appearance effected between the summer of 1836 and December 1838, showing decidedly the very irritating character of gunpowder smoke upon the delicate tissue of the air-passages.

CASE 9. J. D., aged 37, at his death, April 1844. He was a well formed man, with a fully developed chest. At so early an age as seven years, he engaged in the labour of the coal-pit at Preston-Hall, Mid-Lothian, and he continued to prosecute that employment for a period of 15 years, when he was obliged to relinquish the work on account of an affection of the chest, being, as he termed it, "touched in the breath." During the subsequent 15 years of his life, he had never once entered a coal-pit, nor had he any connexion with coal-works, but earned his bread by the trade of a travelling merchant. He had suffered much in his wanderings, from his breathing,^[15] for more than two years continuously, while loss of appetite, and thoracic irritation, had rendered his physical frame as weak as that of a child.

When I first saw this man, which was about a month before his death, he laboured under rending cough, with a scanty tough mucous expectoration—oppressive dyspnoea, ascites, general anasarca, occasional giddiness, and throbbing headach on motion, or on assuming the standing position. His countenance was of a light blue or slate colour, and his upper and lower extremities had much the same appearance. His lips, eyelids, ears, and nose, were swollen and livid, and his eye-balls effused, and apparently projecting from the sockets. His sight was impaired and hazy. There was continued feeling of cold, with occasional rigors, and difficulty in keeping the extremities warm. There was considerable exhaustion upon the slightest exertion. The half reclining posture was the only one in which he was comfortable. The pulse was exceedingly slow, not above 36 in the minute, it was small, and often imperceptible at the wrist. There was considerable weight and feeling of oppressive fulness in the region of the heart, which was dull on percussion. On applying the ear to the chest, little or no râle whatever was discernible, and the action of the heart was almost inaudible. He had a sensation as of great weight in the head, and difficulty in raising it. He suffered from restless nights, short hurried breathing, with a feeling and dread of suffocation, evident fulness and enlargement in the region of liver, and inability to turn to the right side. The urine was small in quantity, of a bluish colour, and coagulable, irritability of stomach, and the bowels were obstinate and difficult to move, even with drastic purgatives. The treatment was merely palliative, no stimulant seemed to have any effect in exciting the system. Ascites and general anasarca were considerable, giving the body a large appearance. For some days previous to his dissolution, there was increased lividity of countenance, and little or no action of heart. He had at no time expectorated carbon, even during many severe paroxysms of cough. Upon inquiry, I found that this man had been a companion in labour to R. R. (whose case No. 2, is fully reported,) at Preston-Hall colliery, and from the morbid appearances found in R.'s chest, and from the character of the coal-work in which both were engaged, I was induced to believe Duncan's to be a similar case. In ascertaining his early history, I found him to be a robust powerful man, though troubled with a cough and hurried breathing from his first becoming a collier, circumstances very usual with those who engage in difficult mining operations, and which they erroneously attribute to want of air, nothing more.

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Post-mortem examination, twenty-four hours after death.—The body was much swollen from effusion. On removing the anterior part of the chest, both lungs were much compressed from an immense effusion of a light brown fluid into the cavities of the chest to the extent of a gallon. The lungs were of a deep black colour, and irregularly spotted with dark brown patches of exudation. There were considerable adhesions of the pleuræ, and marks of very general chronic inflammation and false membrane over the greater part of the pleura costalis. There were adhesions of the left lung to the pericardium, which was much thickened, and contained about 14 ounces of a turbid fluid. On removing the left lung, it seemed large, and felt partially consolidated, and on dividing it throughout both lobes, it contained a mass of semi-fluid carbon, of a bright black colour, similar to paint. In this lung, the air-cells were almost entirely disorganized, unfitting it for the function of respiration. The upper lobe was divided into a variety of cysts, filled with carbonaceous matter in a fluid state, into which many of the smaller bronchi opened, and through which various blood-vessels passed uninjured. The inferior lobe, when emptied of its contents, was so much excavated that the parenchymatous substance felt light and flaccid. On dividing the right lung^[16] it exhibited a pure black mass, but not so fully disorganized as the left. Portions of each lobe were permeable to air, while other parts formed cysts, containing fluid and solid carbon, the inferior lobe showed an almost solid mass. The mucous membrane of the respiratory passages was inflamed and spongy throughout the divisions, the small ramifications were irritated and choked up with tough, frothy phlegm. There were several

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large bronchial glands at the root of the left lung. In tracing the divisions of the bronchi more minutely, from the root of the lungs into their substance, clusters of glands were observed filled with inky fluid, and narrowing considerably the air-passages, and in washing carefully a portion of the upper lobe of the right lung, and removing as far as possible the carbonaceous matter, several lymphatic glands were seen with the aid of the magnifier, imbedded in the interlobular cellular tissue, resembling small black beads. The tracheal glands when examined, contained black fluid, similar in appearance to what was found in the bronchial glands. The mucous membrane of the trachea was soft and irritated, smeared with tough bloody mucus, the lining membrane of the rima glottidis was thickened and slightly granular.

The heart was much enlarged, and soft, with spots indicating chronic inflammatory action on and about the right auricle. Both auricle and ventricle on the left side of the heart contained a deep-dark blood. There were several large lymphatic glands imbedded around the great vessels proceeding from the base of the heart, containing black fluid, the other cavities appeared healthy, though attenuated in substance. The coronary veins were congested. None of the cervical glands contained black fluid, though several of them were enlarged. The cavity of the abdomen much distended from ascites; the contained fluid was to the extent of about six Scotch pints of a straw colour; the viscera much compressed, and matted together, with light brown exudation. The peritoneum was rough, and coated with the same exudation. The stomach and all the intestines correspondingly contracted; the mesentery appeared healthy; the liver was much enlarged, and darker than usual; the inferior lobe extending downwards, near to crest of ileum; the whole organ loaded with inky-coloured blood; the substance easily torn. The kidneys presented a natural appearance; the adipose substance in which they were imbedded was œdematous; the medullary substance of each presented a yellowish colour.

Head.—The integuments were œdematous. On exposing membranes, considerable effusion under arachnoid; very general venous congestion, extending over the convolutions, and to the base of the brain. Effusion into the lateral ventricles of a light yellow; the choroid plexuses thickened, and of a dark venous appearance; substance of brain firm and apparently healthy.

From the history of this case, it will be found that D. had at no time shown any indication that carbon was infiltrated into the lungs. At an early age he came under the influence of the smoke of coarse linseed oil, and of gunpowder, while labouring in an unhealthy and ill-ventilated pit, which produced a cough common amongst colliers, who may be placed in similar circumstances; and it is evident, that during the last fifteen years of his life, the carbon—having previously taken up a lodgment in the pulmonary tissue—was gradually accumulating, and thereby producing painful dyspnœa, and the other formidable symptoms connected with the circulating organs, which followed as results, till it had almost entirely saturated the cellular structure, and rendered the lungs unfit for the functions of respiration, consequently impeding the necessary change, through the medium of that function upon the blood.

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There was a marked similarity in the morbid appearances between this case and that of Reid, (No. 2). They both wrought in the same pit at Preston-Hall, and were affected in a similar manner. Both had enlarged liver, and the left lung principally disorganised. Both had extensive anasarca and other effusions, and both had coagulable urine. Neither expectorated black matter, and both died from the bursting of a carbonaceous cyst into the bronchi, producing suffocation. Duncan lived longer under the infiltration than Reid did; and this was no doubt owing to his being younger, and also his healthy occupation latterly.

I have preserved a quantity of the contents of a cyst in the left lung of this patient, for chemical analysis; also a portion of the blood from the vena cava, and a little of the black fluid from the bronchial glands.^[17]

CASE 10. (The subject of the following case is still alive, 1845.) J. S., aged thirty-six. He was born of collier parents, in the parish of Pencaitland, and at as early an age as eight years, went under ground to assist his parents in the transmission of the coal, and when fit for work became a coal-hewer. From his infancy he was rather of a delicate constitution, with flat and contracted chest. When I first saw him, which was about eight years ago, (1837), he was in full employment as a coal-hewer, complaining of shooting pains through his chest, tickling cough in the morning, with scanty tough expectoration, and frequent palpitations. He was repeatedly under treatment for bronchial affection, which was usually relieved by expectorants, blisters, and *continued* counter-irritants. Each attack of bronchitis was the result, as he expressed it, of "breathing bad air in the pit," in which he was obliged to relinquish labouring, as the lamp would not burn, from the state of the atmosphere. He never wrought at the stone-mining nor blasting. In examining the chest with the ear, at this stage of the affection, the mucous râle was distinctly heard, and exceedingly loud throughout the greater part of the chest. The heart's action was strong, but natural; pulse 70, full and bounding. About four years ago, he removed from Huntlaw to Blindwell, a coal-work towards the sea-coast, an extension of the same coal formation. At this time, 1841, he had very troublesome cough, particularly in bed, scanty frothy expectoration, annoying dyspnœa, preventing him taking sufficient nourishment, headach, obstinate bowels. He continued under all these ailments to labour with much difficulty, till the summer of 1843.^[18]

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In reviewing the morbid appearances in the cases now detailed, it will be observed, that in the majority of them, the left lung exhibited the greater amount of diseased structure. This fact is particularly interesting, as in *tubercular* phthisis, a similar predominance of disease is found on the left side.

In almost all the cases, there was found very extensive effusion into the serous cavities, and particularly into those of the pleura and pericardium. Both pleuræ were much thickened, and all the marks of a long standing pleuritic and pericardial inflammatory action were seen. The substance of the heart, in all the cases, was soft and attenuated; the right auricle and ventricle were dilated; and there was thickening of several of the valves. The liver and spleen were usually large and congested. In all the cases, as the disease advanced, the pulse came down to a very unfrequent and thready beat. From the great extent of the venous congestion, the disease often assumed the aspect of asphyxia; and in some instances the colour of the patients resembled that of persons labouring under cyanosis.

The lividity of countenance, and the other concomitant symptoms, which presented themselves, gave decided indications of the morbid effects of this extraneous body. It requires little explanation to show how such a diseased state of the pulmonary organs, as has been described, should produce such results, by impeding the necessary chemical change of the blood. Imperfect oxygenation of the blood, consequent on the altered pulmonary structure, must cause a general depression of all the vital organs. The excess of excrementitious matter in the circulation, must produce effusion of serum into the various cavities, and also into the cellular structure; and the appearances exhibited on the surface of the brain and its membranes, afford a full explanation of the sluggish inanimate condition of all the sufferers towards the close of their existence.

From the cases above reported, it must be evident, that black phthisis is the result of foreign matter inhaled and retained within the pulmonary structure.

It is a melancholy fact connected with mining occupations in the locality described, that few or none who engage in it, escape this remarkable disease. I have never known one collier in many hundreds, who, even in his usual health, was not, as he expressed it, more or less "touched in his breathing;" and after much experience in auscultation in such pulmonary affections, I am the more convinced that the dyspnœa from which they suffer, arises from impaction of the minute bronchial ramifications induced during their labour below ground, surrounded by an impure atmosphere. The East Lothian colliers, of all miners throughout the kingdom, are certainly most subject to this disease; and those at Pencaitland are so to a fearful extent. In the late inquiry for the Parliamentary report, such has been manifestly brought out, and I am quite able to corroborate the conclusions at which the commissioners have arrived. It has been supposed by many that this carbonaceous affection was caused by inhalation of coal-dust. Now, when it can be proved, that there is as much coal-dust at one coal-work as at another, the question comes to be, why should colliers, labouring at one coal-work, be subject to the disease; while those engaged at another, escape? For instance, there is as much coal-dust at Penston and Huntlaw, where there has never been black spit, as there is at Pencaitland, Preston-Hall, and Blindwells. I conclude, therefore, that this cannot be the cause, otherwise they should all be liable to the disease. Again, those who labour as coal-bankers at the mouth of the shaft, are obliged to inhale much coal-dust in shovelling and arranging the coal received from the pit, and have the sputum tinged to a certain extent by it—which resumes its natural appearance when the collier leaves the labour producing it. They are not subject to the miners' cough, nor is there carbonaceous infiltration found in the lungs of such labourers after death. The females and boys, when, as formerly, both were allowed to labour, could not fail to inhale much of the coal-dust in which they were generally enveloped in their daily occupation; but no carbonaceous deposit has ever been found in the pulmonary tissue of either the one or the other. There are very interesting facts connected with the history of this disease, showing the length of time which the carbon can be retained, brought out by two cases on record, the one published as formerly mentioned by Dr James Gregory, in the *Edinburgh Med. and Surg. Journal* for 1831, denominated, "Spurious Melanosis;" the other, a case published by Dr William Thomson, (*Medico-Chirurgical Transactions of London* for 1837), and which was reported to him by Dr Simpson, now Professor of Midwifery in Edinburgh.

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Dr Gregory's case is that of John Hogg, who had been in the army for more than twenty years, had seen much service as a soldier in America and the West Indies, and had served in Spain during the Peninsular war. On his return to his native country, he was engaged for a short time before his death as a collier at Dalkeith. I understand, upon inquiry, from those who were connected with Hogg, that he wrought in early life as a miner at Pencaitland coal-work, and was obliged, though a young man, to relinquish such employment on account of a chest affection, and exchange the pick for the musket. From the history of this case, and from the character of his occupation in early life, I apprehend that the carbonaceous deposit took place when he was first labouring as a miner at Pencaitland; and that he carried the foreign body in his lungs, throughout his campaigns.

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The case reported to Dr Thomson by Dr Simpson is that of a George Hogg, who lived at Collinshiel, near Bathgate. In early life, this man laboured at Pencaitland coal-work, where the greater number of the cases now under consideration occurred; and it is stated as a certainty, that he contracted the black phthisis while occupied in that district; for I find from those who knew him at an early period, that his breathing was much affected while at Pencaitland, and he was long supposed by his fellow-miners to have imbibed the disease,—indeed he removed from Pencaitland on account of it. The two Hoggs were relatives, and natives of East Lothian.

It is evident, from several of the cases, that it is no uncommon feature of this affection for the carbon to remain concealed in the pulmonary tissue for very many years; and as both the Hoggs were miners at Pencaitland, I have not the smallest doubt that it was then and there that the disease had its origin; for I have never known a collier who was a stone-miner who did not

ultimately die of the carbonaceous infiltration.

Apart from colliers and coal-mines, as a proof that carbonaceous particles floating in the atmosphere are inhaled and lodged in the bronchial ramifications, I may state the following circumstance, which came under my own observation several years ago. After a gale of wind, which had continued for more than a week, off the coast of America, in the July of 1832, I was applied to for advice by several of the seamen, on account of a tickling cough, followed by a peculiarly dark blue expectoration, which I was told was almost general amongst the crew. I was certainly at a loss, and put to my shifts, to render a reason; but, upon investigating the matter further, I found that, during the gale, the chimney of the cook's apartment in the *'tween-decks* was rendered inefficient, whereby the sleeping-berths were constantly filled with smoke. I found almost all the seamen, to the number of nearly a hundred, suffering considerably from cough, and expectorating an inky-coloured phlegm, which continued more or less for about a fortnight. I ordered soothing expectorants, and the dark sputa were profusely voided, and ultimately disappeared; but whether any of the carbon had made a permanent lodgment in the pulmonary tissue, is what I have never been able to ascertain. I am now convinced, in recalling this occurrence, that whatever be the situation, should carbon be floating in the air, it can be conveyed into the air-cells; and had these seamen been longer subjected to this foul atmosphere, a permanent lodgment of the carbon would undoubtedly have been the consequence, and the disease now under our consideration to a certainty produced. I further remember seeing, several years ago, a case of partially carbonized lungs in a person who had lived for a length of time in a smoky and confined room in Glasgow. The patient died of dropsy, consequent, no doubt, on the pulmonary affection; and on examining the chest, the upper lobe of both lungs, and the bronchial glands contained black matter, similar in appearance to that found in the colliers.

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While engaged in committing these remarks to paper, I have been led in my investigations to compare the various kinds of labour carried on in coal-pits with the underground operations of many of the railways now in progress throughout the kingdom; and being convinced of the very injurious effects produced upon miners while prosecuting these operations in confined situations where gunpowder is used, I shall be much surprised if the same results do not follow the hazardous undertakings connected with railway tunnelling, where gunpowder is had recourse to, and in the course of years find in our public hospitals cases of carbonaceous lung arising from this cause.^[19]

It is no uncommon occurrence, in examining the pulmonary structure of those who have resided in large and smoky towns, to find both the substance of the lungs and bronchial glands containing black matter; and this is the case especially with persons who, in such situations, have passed the prime of life. But few, though not living in crowded towns, have not, at some period of their life, come in contact with smoke, and been obliged to breathe it, minutely combined with the air. It is not, therefore, to be supposed improbable, that a portion of the infinitely small particles, thus suspended in the atmosphere, should effect a settlement in the more minute air-cells, and in course of time, be conveyed to the interlobular cellular tissue by the process of absorption, and thence to the bronchial glands. There are several cases on record, from amongst iron-moulders,^[20] where the pulmonary structure has been found heavily charged with carbonaceous matter, from the inhalation of the charcoal used in their processes, and where, during life, there was a free black expectoration.^[21]

There is, then, little doubt that the bronchial glands, from their appearance in miners, moulders, and others, are the recipients of a portion of impurities which have been carried into the pulmonary structure by inhalation, and also those left after the process of oxygenation of the blood; and when it is fully ascertained, from the character of the atmosphere in the coal mine, that deleterious matter in this form must be conveyed to the air-cells during respiration, there is little difficulty in coming to the conclusion, that the black fluid found to such an extent in these glands in the collier and moulder, is similar to, and a part of, that discovered infiltrated into the substance of the lungs. If we trace the black matter in the lymphatic vessels, (which has been done), from the pulmonary organs to the bronchial, mediastinal, and thoracic glands, and from thence to the thoracic duct, we cannot but admit, that it does find its way into the venous system, and thereby contaminates the vital current.^[22]

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Dr Pearson of London, in his very valuable paper, published in the Philosophical Transactions of 1813, on the coaly matter in the bronchial glands, was convinced beyond a doubt, that it was of foreign origin, and possessed the properties of carbon conveyed into the lungs from without. He, at that period, was not in possession of such facts as have been recently elicited on the subject of deleterious inhalation; but the very interesting materials which he brought to bear on his argument, have, I think, most satisfactorily proved the assertion which he makes, that "the lymphatics of the lungs absorb a variety of substances, especially this coaly matter, which they convey to the bronchial glands, and thus render them of a black or dark-blue colour." "The texture and proportion of the tinging matter of the glands was," he says, "different in different subjects, whether the lungs to which they belonged were in a healthy or diseased condition. In persons, from about 18 to 20 years of age, some of the bronchial glands contained no tinging black matter at all, but were of a reddish colour; others were streaked or partially black." Again, he says, "I think the charcoal in the pulmonary organs is introduced with the air in breathing. In the air it is suspended in invisible small particles, derived from the burning of coal, wood, and other inflammable materials in common life. It is admitted that the oxygen of atmospherical air passes through the pulmonary air-vesicles or cells into the system of blood-vessels, and it is not improbable, that through the same channel various matters contained in the air may be

introduced. But it is highly reasonable to suppose, that the particles of charcoal should be retained in the minutest ramifications of the air-tubes, or even in the air-vesicles under various circumstances, to produce the coloured appearances on the surface, and in the substance of the lungs, as above described."

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"When I compare the black lines and black net-like figures, many of them pentagonal, on the surface of the lungs, with the plates of the lymphatic vessels by Cruikshank, Mascagni, and Fyffe, I found an exact resemblance."

Dr Pearson, after various chemical experiments upon the bronchial glands with caustic potash, muriatic and nitric acid, says, "I conceive I am entitled to declare the black matter obtained from the bronchial glands, and from the lungs, to be animal-charcoal in the uncombined state, *i.e.* not existing as a constituent ingredient of organized animal solids or fluids." Dr Graham of London, in his paper on this subject, recorded in the 42d vol. of the *Edinburgh Medical and Surgical Journal*, gives the following opinion, as the result of a series of investigations, with the view of determining the nature of the disease in question. He says, I have had several opportunities of substantiating the carbonaceous matter in a state of extraordinary accumulation in black lungs supplied by my medical friends. The black powder, as derived from the lungs, (after an analysis,) is unquestionably charcoal, and the gaseous products from heated air, result from a little water and nitric acid being retained persistently by the charcoal, notwithstanding the repeated washing, but which re-acting on the charcoal at a high temperature, coming off in a state of decomposition. In regard to another analysis of a lung, he says, "The carbonaceous matter of the lung cannot therefore be supposed to be coal, altered by the different chemical processes to which it has been submitted in separating it from the animal matter. The carbonaceous matter of this lung, appears rather to be lamp black."

From the whole results, I am disposed to draw the following conclusions:—

1st, The black matter found in the lungs is not a secretion, but comes from without. The *pigmentum nigrum* of the ox I find to lose its colour entirely, and to leave only a quantity of white flocks, when rubbed in a mortar with chlorine water. Sepia, which is a preparation of the dark-coloured liquor of the cuttle fish, was also bleached by chlorine, but the black matter of the lungs was not destroyed or bleached in the slightest degree by chlorine, it even survived unimpaired the destruction of the lungs by putrefaction in air.

2d, This foreign matter probably varies in composition in different lungs, but in the cases actually examined, it seems to be little else than lamp black or soot.

It does not appear, as far as I can ascertain, that any of the Continental physiologists are familiar with the disease now under our consideration. Several of them, both ancient and modern, discovered black matter in the pulmonary tissues, but not connected with nor exhibiting the black phthisis. It is therefore unnecessary to refer to them in general.

The following foreign authors entertain various opinions in regard to the dark appearances in the pulmonary tissue:—

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Bichat supposes the black matter in the lungs "to be owing to small bronchial glands extending along the surface of the pleura." Breschet believes that it is formed by the blood exhaled into the cellular tissue, stating that its chemical composition leads him to that conclusion. Trousseau says that it is produced by a misdirection of the natural pigments of the body, resulting from age, climate, or disease. Andral says, that the black appearances are the result of secretion, and that it is more manifest as the individual advances in life. Heusinger's opinion is, that it is analogous to pigment, and therefore he agrees with Trousseau. Lænnec was doubtful as to the real origin of black pulmonary matter. He makes a distinction between melanotic and pulmonary matter. He found that the melanotic matter was composed almost entirely of albumen, while the black pulmonary matter found in the bronchial glands contains a great quantity of carbon and hydrogen, and also that these colouring matters have other distinguishing characters. The melanotic matter is easily effaced by washing, while the other is removed with difficulty. Lænnec further says, that he suspected that this pulmonary matter might arise, at least in part, from the smoke of lamps, and other combustible bodies which are used for heat and light; for some old men are to be met with whose lungs contain very little black matter, and whose bronchial glands are but partially tinged with this colour; and it has struck him that he observed this amongst villagers who had never been accustomed to watch.^[23]

Mons. Guillot, physician to the hospital for the aged at Paris, has undertaken a series of researches in regard to the black matter found in the lungs of old men of very considerable age. These investigations are published in the January, February, and March numbers of the *Archives Générales de Médecine*.^[24] It is his belief that death in such cases is owing, in all appearance, more or less to a suppression of the circulation of air and blood by the black substance. His impression is, "that the carbon is not procured from without, but naturally deposited, as life advances, in the substance of the respiratory organs; and that this deposit of carbon causes death, by rendering the lungs irrespirable, while, at the same time, it has much influence in modifying the progress of *tubercular* disease; so that, if the tubercular affection was not cured, its progress was so far checked, that life has been very long preserved." The black matter envelopes completely both the pulmonary tubercles which have undergone a transformation, and the caverns which no longer contain tuberculous matter. He, while regarding these as the results of black matter in the lungs, throws no light on the cause of the deposit of the particles of carbon

within the lungs.

Dr William Craig of Glasgow, in a letter to Mr Graham of London, published in the 42d vol. of the *Medical and Surgical Journal of Edinburgh*, states most interesting facts connected with this subject, particularly in regard to black matter found in the pulmonary structure of old people, which deserve considerable attention. He says—"I found that a black discoloration of the lungs was by no means a rare occurrence amongst those old people; and that it was impossible in many instances to decide, whether the black colour was owing to an increase of what is called the healthy black matter,—to a morbid secretion, or to a foreign substance being imbedded with the atmospheric air. After examining a considerable number of lungs, and finding that the division of the black matter into three kinds was not founded upon observation, and that the descriptions of them given by the best authorities were insufficient to enable us to distinguish them from one another, I begin to think, that in every instance in which black matter is found in the lungs, it ought to be considered morbid. If we examine the lungs at different stages of life, we find as a general rule that the quantity of black matter increases with age. In young children we find no traces of it, the lungs being of a reddish colour. At the age of ten years the black matter makes its appearance in the outer surface of the lungs, and in the interlobular spaces. At the age of thirty or forty, the lung presents a greyish or mottled appearance, and the bronchial glands contain more or less black matter. Between the age of seventy and a hundred, the lungs are generally infiltrated with fluid black matter, which can be expressed from the cut surfaces, and stain the hands black."

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"There are many circumstances which favour the accumulation of this black matter in the lungs; for instance, long-continued living in a smoky atmosphere, like that of this city, the inhalation of coal-dust, as in the case of colliers, or of charcoal-powder, as in the case of iron-founders. There can be no doubt that we inhale foreign substances along with the atmospheric air.

"We find the mucus which has remained in the nostrils for some time to be of a dark colour, and if we examine it with a microscope, we find, that this is owing to the presence of small particles of dust or other foreign substances, which the air may have accidentally contained. The mucus first coughed up from the lungs in the morning, is of a dark colour from the same cause, and the facts now maintained prove, that foreign substances suspended in minute particles in the atmosphere, may be inhaled into the lungs. I believe in all the extreme cases which have occurred in colliers and moulders, that there must have existed some previous disease of the lungs which prevented the foreign matter from being thrown off." "According to the views which we have taken of the subject, there are only two ways by which black matters may be deposited in the lungs; first, by a morbid secretion; second, by a foreign substance inhaled with the atmosphere. The former is a rare disease, while the latter is very common. I am inclined to think that the true melanosis generally occurs in the form of rounded tumours, which, when cut in two, present a uniform black colour without any trace of air-cells, while in the spurious melanosis the deposition is general, and black matter flows freely out when the cut surfaces are pressed. At first the lung is crepitous, and swims in water; but as the black matter increases, it becomes solid, and, as in the case of colliers who die of this disease, resembles a piece of wet peat in point of consistence. It is only in the cases of colliers, moulders, or others who inhale great quantities of black matter, that the lungs are rendered perfectly solid."

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There is an exceedingly interesting and valuable paper, written by Dr Brockmann of Clausthal, upon the pulmonary diseases of a certain class of German miners,—supposed to be in the Hartz mountains,—in *Neumeister's Repertorium* for December 1844, an abridged translation of which is to be found in the September number of the *Monthly Journal of Medical Science*.

It is very evident that the disease there considered is produced by carbonaceous inhalation, and resembles in all its features the black phthisis so general amongst the colliers in Haddingtonshire. The morbid appearances described by Dr Brockmann are very similar to the first and second division of that disease, presenting a very general carbonaceous infiltration of the pulmonary tissues; but in none of the stages are there to be found the extensive excavations discovered in the lungs of the coal-miner. Dr Brockmann makes three divisions of the morbid appearances, "The essential (wesentliche), accidental (zufällige), and secondary. The first shows an entirely black (pechschwärze) colour of the lungs through its whole substance, enclosing not only the air, blood, and lymph vessels, but also the connecting cellular tissue, the nervous substance, pleuræ pulmonalis, and bronchial glands." In such a state, it is usual for the lung to remain perfectly normal, and to exhibit the greatest varieties.

The accidental (zufällige) is evidently the disease in a more advanced form, corresponding in a great measure with the second stage of the morbid action, found in the pulmonary organ of the collier. It is to be regretted that no accurate description is given either of the character of the mine, or the nature of the employment in which the miners are engaged, whether they be coal, silver, or lead mines, and if they are in the habit of burning coarse lint-seed oil.

There is a very striking similarity between what Dr Brockmann calls the secondary anatomical changes, and many of those exhibited in the collier; first, membranes; second, collections of fluid into the pleuræ and pericardium; third, the softened heart, and very general emaciation; fourth, the extensive venous congestion, with thick black blood.

The liver is described by Dr Brockmann as being small:—in the collier it is usually puffy, and much congested.

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The symptoms do almost in all points accord with those presented in the collier, as will appear

from the following quotation, from the paper. "In the first stage, there is no local, functional, or general feature by which we can ascertain that the disease has commenced; probability is all we can reach. In the second stage, the disease is more obvious. And, first, there is a change in the expression of countenance; to a fine blooming appearance, which perhaps the patient previously had, there has succeeded a dark yellowish cast,—a change which gradually spreads over the whole body. For some time the patient may have remarked a gradual loss of strength, and now he complains of want of appetite and disordered digestion, and more particularly of shooting pains in the back and muscles of the chest. Cough likewise supervenes, which may either be quite dry, or at most accompanied with a little pure mucus. There is also a greater or less degree of oppression, accompanied with palpitation of heart, not only after a severe fit of coughing, but after every exertion of the lungs. As yet no local deviation from the normal condition is seen on examination of the chest by percussion or auscultation." "The disease meanwhile passes into the third stage. The features of the patient now become more and more changed and deteriorated, and betray a deep melancholy. The colour of the face, which had been hitherto of an earthly hue, becomes blackish, as also the cornea, whereby the eye loses its lustre. The appearance of the patient becomes still more frightful from the great loss of flesh, and the dark skin hanging loose on his bones. The fat not only seems to have disappeared, but the muscular substance also—the whole frame being shrivelled. The patient complains of increasing weakness, diminished appetite, flying pains often concentrated at the pit of the stomach; and coughs much. The expectoration is for the most part difficult, and consists of masses of mucus, either greyish, or tending to a black colour. A black streak is frequently observed running through the whitish mucus; one half of it may be white, the other black, or occasional black points may be observed throughout the mass, and sometimes, though rarely, blood. Dyspnoea is usually connected with the cough. It now begins to tell upon the patient, and is so characteristic, that the disease has been named asthma metallicum. The disturbance of the digestive organs increases the disease,—the appetite is entirely lost,—the tongue is covered with a white fur—there is an oppression at the stomach after a full meal—frequent eructations, and a tendency to constipation. The distress of the patient becomes increased in consequence of the shooting pains in the muscular system." "In the fourth and last stage, all the external appearances indicate the near approach of dissolution,—the face and members become bloated, and the feet greatly swollen." "The dyspnoea meanwhile, from effusion into the chest and pericardium, becomes so severe, that the patient cannot maintain the horizontal position, the expectoration becomes copious, consisting of a black inky (dintenschwarze), or ash-coloured fluid, sometimes of mere masses of mucus streaked with black." "The disease is never accompanied with colliquative sweats or diarrhoea."

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I am sorry to find that there is no allusion whatever to the state of the pulse. Dr Brockmann, in his remarks on the essential nature of this pulmonary disease of miners, brought under his notice, seems to entertain the impression that along with the inhaled carbon, resulting from the combustion of gunpowder, there is also an organic pigment-deposit present in the pulmonary tissue, which he supposes must have been formed in the lungs.

I have long entertained the belief, which I have stated in another part of this essay, that if the carbon is once conveyed into, and established in the parenchyma of the lungs, that organ commences the formation of carbon; thus increasing the amount originally deposited. Dr Brockmann sets forth, as grounds for this view, that "if the parenchyma of the lungs were filled with carbonaceous dust, their specific gravity ought to be increased; but this is not the case. A completely melanosed lung swims in water, both as a whole and when cut into parts." It is very evident from these remarks, that the author has not seen the disease as it is exhibited in the third division of morbid action in the collier, otherwise he would have both observed the lungs considerably augmented in weight, and also so densely impacted from the accumulation of carbon, as wholly to sink in water. See for instance case No. 2, where the lungs weighed about six pounds, and parts of the cellular tissue were so indurated, as to be cut with difficulty. In this case, the patient did not expectorate.

Dr Brockmann, as he advances, puts a question here, which more fully shows that the disease under his consideration was of a mild character compared with that under our notice. "If," says he, "pulmonary melanosis arise entirely from inhalation of carbonaceous dust, why is it not observed in other workmen, who are as much, and even more, exposed to its influence, as for instance, smelters, or moulders, and colliers?" He says, further, "were the carbon inhaled in quantity sufficient to explain the black colour of the lungs, it ought also, from its mechanical irritation, to produce inflammation in the delicate mucous membrane of the organ, but there are no symptoms of this during life, nor any traces of it after death." An answer to these remarks will be most satisfactorily given by a reference to the published cases, where the disease is principally found amongst colliers and moulders, and where the pulmonary organs, particularly in the former, are found to undergo most fearful disorganization from the presence of carbon. It is very remarkable, that the author of these exceedingly interesting observations should never have found excavations of the parenchyma, when it is so general as the result of the same disease in this country, particularly in the locality to which I refer. Not knowing the character of the mine, it is impossible to judge; but I am disposed to conclude that there cannot be the same quantity of carbon floating in the atmosphere breathed by the German miner,—the disease resembles very much that milder form found in the iron moulder.

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With regard to the carbonaceous state of the blood, I am sorry that I have not yet completed my investigations on that subject. It is still my belief that the carbon being once inhaled, there is an affinity found for that in the circulating fluid, and from its not being consumed, owing to a deficiency of oxygen, there is a progressive increase going on. I am very much gratified to find

that Dr Brockmann entertains a somewhat similar opinion in respect to the state of the blood.

The effects of such a morbid structure upon the collier population in general is very marked. Previous to the late legislative act, the tender youth of both sexes were at an early age consigned to the coal pit, and obliged to labour beyond their feeble strength, in circumstances ill adapted to their years. Such early bodily exhaustion soon produced in them a pallid countenance, soft and relaxed muscular fibre, and predisposed much to disease as they advanced in life. The miner on this account was generally from his youth, thin; in fact, you never see a fat and healthy-looking collier, and, according to the advance of pulmonary disease, with them, so is the progress of emaciation. Such a state of body may well be looked for in miners, labouring as they do, from ten to twelve hours in the twenty-four under ground, breathing a heated and impure atmosphere, which with difficulty sustains life, and which is demonstrably calculated, from its deleterious qualities, to induce serious disease. The effects manifest in the parent descend, and visible in the youngest children; they are squalid and wretched-looking,—and how can such offspring be otherwise? They are exceedingly subject to all children's diseases, and peculiarly predisposed to pulmonary irritation of one kind or other.

With regard to medical treatment, little can be done after the disease has passed its first stage. Early removal from the occupation, and proper attention to nutrition, alone seem to hold out the hope of prolonging the life of the patient; but if there be carbon lodged in the pulmonary tissues, there is a certainty of its sooner or later proving fatal. Attention to the state of the digestive organs, and using every means to remove the dyspeptic symptoms, which are prominently present throughout the various stages of this disease, are indispensably requisite; and, as to nutrition, the nature of the diet should be as generous as possible. Anodynes and expectorants are the only remedies which seem at all efficacious in allaying irritation.

With a view to remove urgent symptoms, venesection has repeatedly been had recourse to, but in almost all instances I would say, with decidedly bad effects. Blood-letting does harm, producing general debility and rapid sinking.^[25]

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With regard to the prevention of this disease, ventilation, as has been stated, is very much neglected in the pits now under consideration, where the various cases have occurred; and to that neglect I ascribe the prevalence of the malady. In those pits referred to, the workable apartments are so confined, and become after a time so destitute of oxygen, as, along with the smoke from lamps and gunpowder, to render the air unfit for healthy respiration. The only effectual remedy is a free admission of pure air, so applied as to remove the confined smoke. This remark both applies to coal and stone-mining. The introduction of some other mode of lighting such pits than by oil is required. I know several coal-pits where there is no carbonaceous disease, nor was it ever known; and on examination I find that there is and ever has been in them a free circulation of air. For example, the Penston coal-work, which joins Pencaitland, has ever been free from this disease; but many of the Penston colliers, on coming to work at Pencaitland, have been seized with, and died shortly after, of the black spit: for instance, G. case No. 5, and D. case No. 8, are such.

How this is to be accomplished, is for the scientific man to say. With all due deference, I may be allowed to suggest various modes which might be adopted to free the underground atmosphere of the noxious ingredients. Could fresh air not be forced down by the power of the steam-engine, which is at every coal-pit? Could extensive fanners not be erected and propelled by the same machinery?^[26] I am much surprised that no attempt has been made to light these pits with portable gas in some way or other. As far as I can understand, such an application of it would not be difficult. A small gasometer could be erected, and the necessary apparatus procured at little expense, and by such means, I would suppose, it could be carried to any part of the mines, which are not extensive.

Many proprietors may grudge the expense involved in such improvements, and thus prove a barrier to these necessary alterations; but I would ask any candid and generous mind, what is expense when the object in view is the removal of a disease to which many human beings fall a sacrifice?^[27]

It must appear to every one that these collier diseases are crying evils, the preventive of which is based, as will be seen, on thorough ventilation; and in order to protect the miner, there should be a vigilant attention paid to the economy of underground works. No one need be surprised at the result of such a noxious atmosphere; and it becomes a duty with the government to protect these poor people by laws, and to adopt those measures which are best calculated to preserve their health; and should there arise difficulties of an insurmountable character in the ventilation of these pits, why continue the mining operation in such situations at such a sacrifice of human life?^[28]

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In the course of my investigations in regard to pulmonary carbonaceous infiltration, I was led to consider the circumstances of those engaged in other occupations than coal-mining. Any one who has carefully examined the structure of the human bronchial glands, at different epochs of life, must have been struck with their appearance in those who, from their vocation, are compelled to breathe a sooty atmosphere, or who have lived in ill ventilated dwellings.

I am further convinced, from the results of my recent investigations, that the bronchial glands in such persons invariably contain carbonaceous matter which has been inhaled at some period of life. Having long entertained the belief that the lungs of chimney sweeps, for example, would, in all probability, be found to contain carbon, within the last few months two cases, of an exceedingly interesting character, connected with the present inquiry, have presented themselves,—the one of pulmonary disease, evidently resulting from the bronchial and lymphatic glands being impacted with inhaled carbon derived from soot,—the other a case of melanosis occurring in a young person. Though the two diseases differ materially, they have often been confounded with each other and assigned to the same cause. My object in here reporting a case of stratiform melanosis, in connection with a disease having an external origin, is to afford an illustration of the fact, that all black deposits found in the system are not carbon. There exists a marked chemical distinction between the melanotic and the carbonaceous matter; and the anatomical situation of the two is also different.

CASE.—A chimney sweep, aged 50, of the name of Campbell, residing at Stockbridge. The short history of his case I procured from his friends, as I did not see him during his illness. He had been a soldier in early life, and had seen much foreign service. After he relinquished the army, he became a chimney sweep, in which capacity he was constantly engaged for nearly twenty years. He had had, for a considerable time, a troublesome cough with tough expectoration. He experienced a difficulty of breathing in making any exertion, and he had considerable œdema of the limbs. From these symptoms he believed that he was subject to *asthma*. He had only been confined to bed for two days previous to his death.

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Post-mortem Appearances.—The body exhibited extensive anasarca; the thorax was well arched; the cartilages of the ribs were ossified. On removing the anterior part of the chest, the pleuræ were found to adhere strongly, and appeared rough and puckered from extensive exudation of a brown colour, which extended very generally over the serous membranes. Both cavities contained nearly three gallons of light brown fluid. The pericardium was considerably distended with a straw-coloured fluid, and several flakes of lymph floated throughout the effusion. Both auricles of the heart were enlarged, and distended with exceedingly dark blood. The walls of both ventricles were much thickened. The valvular structure of the auricles was congested and granular. The lungs were removed from the chest with difficulty, owing to the very general pleuritic adhesions. Both exhibited extensive emphysema. In dividing the lungs, and tracing the bronchial ramifications, each lobe was found to contain clusters of enlarged and indurated bronchial glands, impacted with thick black matter; and prosecuting the investigations, the minute lymphatic glands were observed clustered in a similar manner, and containing black fluid. In the substance of the upper lobe of both lungs, the bronchial glands were of a bright black colour; they were particularly large, and so numerous as to press considerably upon and obstruct several of the bronchial tubes. In fact the upper lobe of both lungs exhibited the plum-pudding structure. At the bifurcation and back part of the trachea, the bronchial glands were numerous, and of a deep black colour. A considerable mass of the glandular structure was removed for chemical and microscopic examination.

The second case was that of a boy aged six years, who was under treatment for an affection of the heart and kidneys, and who died apparently from disease of these organs. He was, during his whole life, of a relaxed and weakly constitution, exceedingly sallow in the complexion, with a very deep blue tint of the sclerotic coat of the eye. In the course of the post-mortem examination, there was discovered, in the lower and lateral part of the right pleura, a cyst containing about an ounce of semi-fluid melanotic matter; and also the morbid secretion presented the stratified appearance described by Dr Carswell in his article upon Melanosis, extending over the inferior half of the costal pleura and the corresponding part of the diaphragm. It formed a distinct layer on the surface of the serous membrane, resembling ink or blacking, and could with difficulty be removed. The black deposit resembled much in appearance the foreign matter found in the pulmonary organs of the coal-miner, and therefore was submitted, as well as the bronchial glands in the other case, to chemical analysis, with the view of ascertaining if there existed any analogy in the component parts of each.

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Dr Douglas Maclagan submitted both these substances to the action of concentrated nitric acid, and the results were, that the glandular structure of the chimney sweep contained a very large proportion of carbon, while of the contents of the melanotic cyst, the same process did not leave a vestige of colouring matter,—evidently proving the distinction which exists between those two dark deposits, and making it sufficiently obvious, that melanotic matter is composed of the constituent elements of the blood, and has its origin within the body. There cannot remain a doubt as to the nature of the chimney sweeper's case; for, from the knowledge which we have of his occupation, and from the chemical properties manifest after investigation, I think I am entitled to declare the black matter obtained from the bronchial glands to be carbon inhaled with the air during his labour, and not existing as a constituent ingredient of organized solids or fluids.

The microscopic examination showed the carbon most distinctly in a molecular form.

It is my intention to return to this subject at a future time.

NORTHUMBERLAND STREET, EDINBURGH,
January 1846.

FOOTNOTES:

- [1] Vide an admirable series of papers on this subject in the volume of this Journal for 1843, by Dr Calvert Holland.
- [2] About ten miles east from Edinburgh.
- [3] Generated from the decay of vegetable and other substances in the *formerly wrought* pits, which communicate with those at present in use.
- [4] It is proved, from the difference in the chemical character possessed by the melanotic matter, as compared with the matter found in the lungs of miners.
- [5] It will be observed, that, though the small blood vessels are destroyed, no hemorrhage takes place, owing to the formation of a carbonaceous plug.
- [6] The air of the coal-pit is so charged with carbon as to prevent the collier from distinguishing his neighbour when at work.
- [7] Note from the evidence of a collier examined before the Government Commissioners in 1842, No. 147 of Report. "Colliers in this part of the country are subject to many oppressions; first, Black spit, which attacks the men as soon as they get the length of 30 years of age;" second, Note 150, "The want of proper ventilation in the pit is the chief cause, and no part requires more looking after than East Lothian," the men die off like rotten sheep. Note, 153, the witness, 32 years old, says, "I am unable to labour much now, as I am fashed with bad breathing—the air below is very bad, and till lately no ventilation existed."
- [8] The black sputum retains its colour after being submitted for some days to the action of nitric acid.
- [9] This is the only case in which I at any time observed colliquative sweats as a symptom of this disease.
- [10] To convey an impression of the nature of the labour in which the man was engaged I shall simply extract a few remarks from the evidence of the miners at this coal-work, taken by Mr Franks for the Government's Commissioners, Note 105. "At all times the air is foul, and the lamps never burn bright. The seam of coal is 24 inches, and the road only three feet high." Note 108—"Experienced colliers do not like the work, and many are touched in the breath." And in such a situation man is doomed to labour! Note 114—"Most of the men here are *fashed with that trouble*; Foster, Miller, Blyth, and Aitken are all clean gone in the breath together. Colliers here drop down very soon."
- [11] It is evident in this disease that the bronchial ramifications are destroyed, while the arteries, with the exception of the minute twigs, are preserved.
- [12] One of the lungs (the left one) now described, I sent to Dr John Thomson, late Professor of Pathology, and will probably be found in his collection, which I understand is in the College of Surgeons.
- [13] After a free expectoration of black matter, there was an evident mitigation of all the pectoral symptoms, and as the carbon again accumulated in the lungs, the sufferings of the patient were very considerably increased.
- [14] This sputum was subjected to the action of nitric acid, which produced no effect upon its colour.
- [15] When pulmonary disorganization has proceeded far, from the presence of carbon, there is a languor in the vital action from defective oxygenation of the blood, which produces a gradual reduction in the temperature of the body, requiring double clothing, and even that addition is, with the aid of stimulants, not sufficient to keep the patient warm.
- [16] This lung is in the possession of Sir James Clark, of London.
- [17] The above substances were submitted separately to the action of nitric acid and caustic potash, and the result was that a large proportion of carbon was precipitated.
- [18] Since writing the above the patient has died; and I regret that, owing to neglect in communicating with me, I have been prevented examining the morbid appearances.
- [19] Several of the Pencaitland colliers are at present engaged in the tunnelling operations near to Edinburgh, connected with the North British Railway.
- [20] Dr Hamilton's of Falkirk paper in the Edin. Med. and Surgical Journal, Vol. xlii.
- [21] I have very lately, through the kindness of Mr Girdwood, surgeon at Falkirk, had an opportunity of examining two or three iron-moulders in that district. Both from the nature of the employment in those iron works, and the character which the pulmonary affection exhibits, the fact of inhalation is fully established. The moulder is at a certain stage of his labour enveloped in a cloud of finely-ground charcoal, a portion of which cannot fail to find its way to the lungs in breathing. He is subject to tickling cough, and as the disease advances, the respiratory sounds, which indicate considerable bronchial irritation, present themselves, and ultimately become dull, and in some parts obscure.

Of the several cases which I saw with Mr Girdwood, one, who has not been labouring for some years as a moulder, occasionally expectorated black matter, and in the other two, there was general dullness of both lungs; and, I doubt not, impaction.
- [22] It has not been in my power hitherto to procure so satisfactory a chemical analysis of the blood as I would wish, but through the kind assistance of Dr Douglas Maclagan, who has

undertaken to conduct the process, I expect very soon to be able to lay it before the profession.

[23] I found little or no black matter in the lungs of farm servants, who are much in the open air.

[24] *Vide* MONTHLY JOURNAL for 1845, p. 702.

[25] At any time when these colliers required venesection, particularly towards the last stage of the disease, the blood appeared peculiarly dark and treacle-like.

[26] Could oxygen not be prepared and forced down?

[27] I am happy to find that the attention of the noble proprietor of the Newbattle coal works is now directed to this subject.

[28] I cannot pass from this subject without an observation on the beneficial results which have been the consequence of Lord Ashley's valuable colliery Act. The female Labourers, and particularly the unmarried, have improved not only in their appearance, but also in general physical development, since they have abandoned the unhealthy labour of the coal-mine. They are no longer the squalid, filthy, and ill-favoured race they formerly were. There is now exhibited on the face of the collier girl the bloom of health and cheerfulness; and when we descend to their domestic economy, there is observed a comfort in the management of their households, which formerly did not exist. Their children are now particularly cared for, both in health and when suffering from disease; and we must regard this early watching as an important step to the removal of that predisposition to pulmonary irritation, so general in the collier community.

*** END OF THE PROJECT GUTENBERG EBOOK AN INVESTIGATION INTO THE NATURE OF BLACK PHTHISIS ***

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