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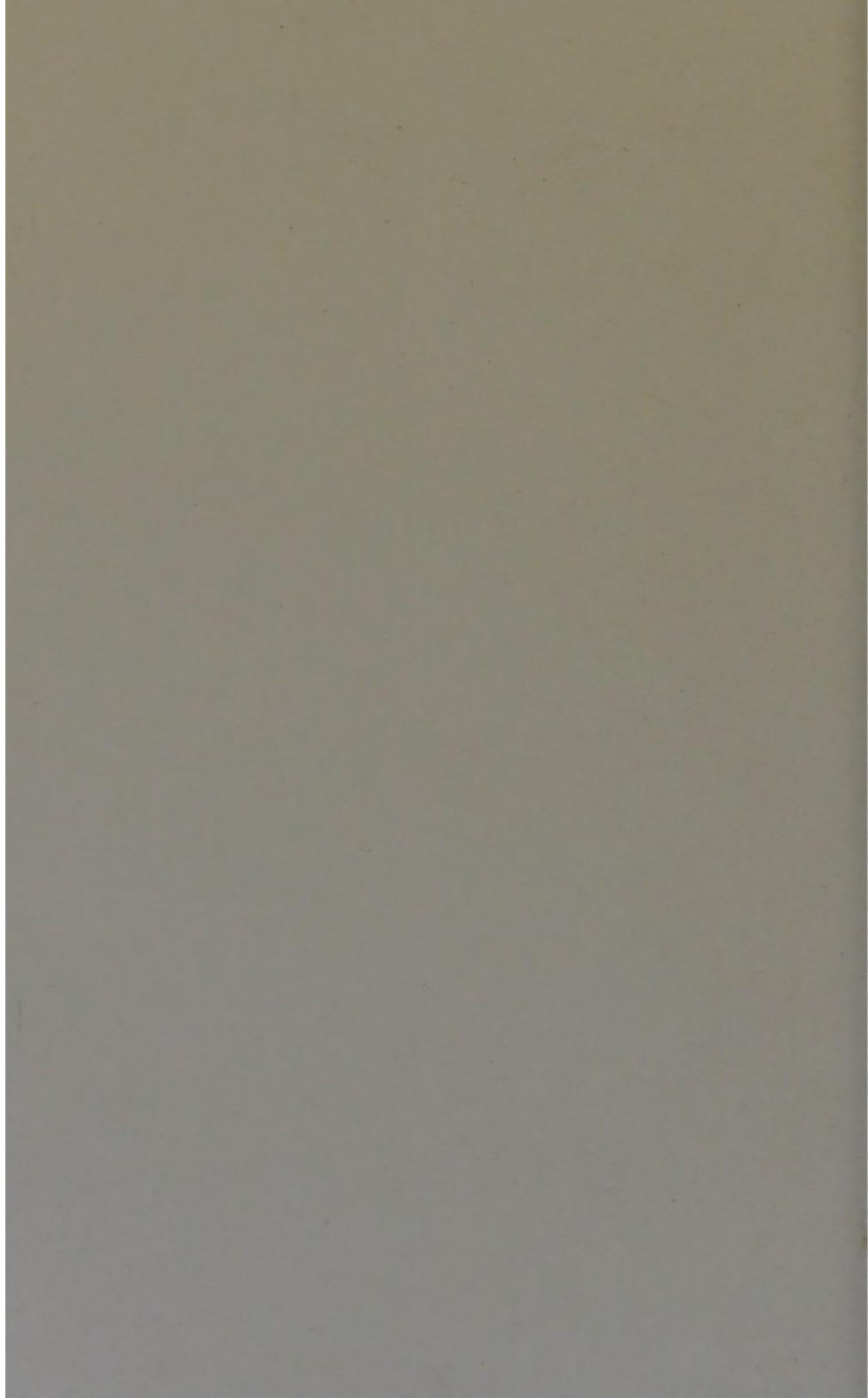
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ON
MELANOSIS OF THE LUNGS,
AND
OTHER LUNG DISEASES ARISING FROM
THE INHALATION OF DUST.

(Reprinted from "The Medical Press and Circular," November, 1866.)

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MELANOSIS OF THE LUNGS

AND
OTHER LUNG DISEASES ARISING FROM
THE INHALATION OF DUST

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ON
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THE subject of this paper has occupied my attention before, but as I am induced by the results of some recent researches to modify my opinion on certain material points, I take it up once more.

Melanosis of the lungs and its principal symptom during life, black expectoration, has been occasionally treated in weekly and monthly journals, but it has not yet found its proper place in the handbooks of medical science. It is well worth while to investigate how far it can be considered a disease *per se*, and by what means endangered persons may be protected.

Melanosis of the lungs means black lung disease; and as the blackness of the lung-tissue is a most essential part of the pathological exhibition after death, we may as well retain this name, whatever may be our opinion on the nature of this blackness. In the same way we may speak of red lung disease, erythronosis, and blue lung disease, glaukonosis.

The class of people who are subject to melanosis are those who work in an atmosphere contaminated with dust, such as coal-miners and miners in general, knife-grinders,

needle-pointers, quarrymen, stonecutters, millers, and besides it has been found sometimes in aged people who had no trade.

I have had occasionally patients under my care who had a peculiar black expectoration. I have examined specimens of black lung, and seen many in different museums, and, for those who take an interest in the subject, I may state that they will find the most in Edinburgh, where there are eight in University College; sixteen in the College of Surgeons; in almost every museum of the London General Hospitals are specimens, the most in Guy's—namely, six. On the Continent their number is not so large; in Paris I found only two; there are a few in the Berlin-Charité-Museum, and in Vienna and Munich.

I first give the literature. Scotch physicians have paid great attention to the subject. Pearson already, in 1813, wrote on black infiltration of the lungs and bronchial glands by coal-dust, but not before 1831 more numerous and more ably written papers on the miners' disease were published. Dr. Gregory, in the *Edinburgh Medical and Surgical Journal* (No. 109) exposed his views on the black infiltration of the lungs, resembling melanosis, which he had no doubt was produced by coal-dust. He had the lungs subjected to distillation, and found the same result as with coal-dust. Thompson and Simpson had the same views, and published many cases six years later. One specimen is now at Guy's. The patient, Leishmann, was sixty years engaged in coal mines, and suffered for five years after he left off work from asthma and black expectoration. Once the sputa were for two months white. The lungs contained cavities of walnut size, and black fluid. Of another case, Hall, it is mentioned that shortly before death he expectorated as much as fifteen ounces of black fluid per diem, and that he had no hectic fever. Had not worked for three years.

Of seven other cases of black lungs observed by Thompson one was that of a blacksmith. In all cases the disease was slow in its progress, and the symptoms trifling

in the beginning, only a little dyspnœa with bronchitis ; and it was especially remarked that the black expectoration remained long after they had given up their occupation.

Dr. Graham, Professor of Chemistry in Edinburgh at this time, examined different specimens of black lungs, and gave as his opinion that the colour was caused by lamp-black. Dr. Marshall published cases in the *Lancet*, 1836, and was of a similar opinion.

In 1845, Dr. Makellar wrote in the *Edinburgh Monthly Journal* on black phthisis or induration induced by carbonaceous accumulation in the lungs of coal-miners.

He states that there are two classes of workmen in coal-mines, those who are stone-miners, and work by blasting, and those who are holers or hewers. The first are much more attacked by the disease and die sooner. Of all those who had to cut a certain tunnel through a rock, and who were strong and young men, not one reached the age of thirty-five. He is strongly opposed to the doctrine that the lungs secrete the black matter, but thinks that the way in which the miners work explains that the evil is to be found in the small bronchial tubes. They lie on their side, have hardly breathing space, and must make up for it by deep inspirations. First they are able to expectorate whatever comes into the lungs, but after a time the bronchi are not able to produce secretion sufficient to bring the coal-dust away ; and when they become dry, irritation sets in, and soon cavities are formed. Makellar always found cavities and no tubercles. Even young men of tuberculous parents died of coal-miners' disease without tubercles, so that he suggests that these diseases may exclude each other. Makellar thinks there are three anatomical stages—one, where the black matter is in the bronchi and tissue ; the second, where small cavities are found ; a third, where the cavities are large and occupying even a whole lung. What he mentions about the physical examination is not worth relating.

A case which came under my notice at Edinburgh, was

under Dr. Begbie's care. Dr. B., who published it in the *Monthly Edinb. Journ.*, July, 1856, treated it as infiltration of the lung with carbonaceous matter, black expectoration, in a farm labourer. The patient had never anything to do with coal-mines or soot. He had phthisis, and the left lung was principally affected. He had black sputa. The post-mortem showed the left lung infiltrated with a black fluid; it contained a large cavity and several smaller ones, only very few tubercles. It is to be observed that the patient, although a farm labourer, was during the last years of life obliged to work the greater part of the year in or near a mill, and to breathe an air charged with dust.

Louch, who gives a vivid description of the mode of life and work of the coal-miner, thinks, as well as Dr. W. T. Cox, that the blackness of the tissue is not generated in the lungs, but purely of extraneous origin.—“*Mines of Cornwall*,” *Brit. and For. Med. Chir. Review*, 1860.

The knife-grinders' lung disease has been described by John Charles Hall of Sheffield (*Brit. Med. Jour.*, 1857). Sheffield, which owes its prosperity to its numerous factories of hardware, supplies the market with knives and forks, razors, files, scissors, pins, needles, &c. These useful implements are manufactured by dry or wet grinding. Forks and needles belong to the first class; razors, knives, and scissors are first dry—afterwards wet-ground. Those workmen who have only to do dry grinding are much more subject to lung disease than the others, and they rarely live after thirty; razor and scissors-makers follow next. Owing to the steel grit entering the lungs, these get diseased, but since better ventilation by fans has been carried on, the state of the workmen's health has improved.

The symptoms and course of the disease are very like that of coal-miners' disease. The workmen suffer first from indigestion, and lose their healthy colour, which becomes dusky. Soon a dry cough and asthma begins to trouble them, afterwards that peculiar black expectoration super-

venes. In addition to black pigment, the sputa contain particles of siliceous matter and steel-dust, especially shortly after work. Since needles are partly made by machinery, needle-pointers suffer less. At the post-mortem, Hall and others found the lungs black, the bronchi dilated, cavities rarely, and their walls covered with a smooth membrane. Pleurisy and pneumonia were sometimes present, tuberculous disease and emphysema occasionally.

Dr. Peacock and Moldenhauer found a remarkable amount of siliceous matter by the distillation of a part of a razor-grinder's lung.—*Brit. and For. Med. Rev.*, 1860.

Dr. Greenhow found in a grinder's lung a few apparently crystalline bodies embedded in the tissue besides the black deposit.—*Trans. of the Path. Soc. of London*, 1865.

At the present time most of the medical men in England and Scotland connected with mines with whom I have had conversation about the matter, do not believe the black deposit in the lungs of coal-miners to be anything but coal-dust.

In recently published handbooks on lung diseases, such as Walsh's, or on medicine, such as Aitken's or Tanner's, I find only a short space bestowed upon the subject of melanosis.

French authors have paid some attention to it. To begin with Bichât (*Traité d'Anatomie Descriptive*, t. iv., p. 22, 1819), he thought the black found in the small bronchi was contained in small glands projected into them. Breschet (*Considérations sur une Altération Organique, Appellée Dégénérescence Noire, Mélanose, &c.*, Paris, 1821), thought the origin of the black deposit in different parts of the body to be extravasated blood. Trousseau and Leblanc (*"Récherches Anatomiques et Pathologiques," Archives de Médecine*, t. 17, 1828), although they only examined the black deposit in horses, must be mentioned. They thought that melanosis consists in blood corpuscles deposited in the tissues, and in the deposited mass pigment went astray

which was originally destined for the choroidea, the skin, &c. M. Foy, a chemical analyst, found the black deposit near the kidney of a horse containing thirty-one per cent. coal-like matter (*principe éminément carboné*). Andral believed the black matter to originate in a transformation of the blood. (*Anatomie Patholog.*, t. 1, p. 458, 1839). Cazenave the same (t. 19, p. 343).

Guillot was one of the French authors who paid great attention to the subject in question, and, especially, to chemical and microscopical examination of the diseased lungs. He washed the black parts of lungs with muriatic or sulphuric acid, and boiled them as well, and always had a black mass left, which was unchanged by acid chlor. or boiling in concentrated solution of caustic potash. He prevailed upon Melsens and Dumas to assist him in his examinations. Melsens made it first his object to isolate the black mass; he dissolved the albuminous substances by acids, and the oleaginous matter by alkalis. When he had the black mass as pure as possible he found it had the character of coal, it glimmered on platina without a flame. Alkalis at a high temperature had no effect. Caustic potash dissolved it by destroying it. Boiling sulphuric acid seemed to have no effect; after long boiling and settling there was an almost clear fluid over a black deposit. Concentrated boiling nitric acid dissolved the mass after a considerable time. Muriatic acid had no effect. All this led Guillot to suppose that the black matter was for the most part coal, especially as he sometimes found it had a metallic appearance.

As for anatomical microscopical researches, Guillot says the black mass exists only sparingly. When examined, the larger particles are found to be composed of many smaller ones; they may be compressed between glass, so that they are not wider than the 200th part of a millimètre, as irregular as the large masses. These molecules are as dark under the microscope as seen with the naked eye. They sometimes fill the lungs to a large extent, sometimes only partly, but visibly. It certainly

may be seen by the microscope that the black colour does not depend upon blood extravasation or pneumonia. The black matter when getting deposited to a greater extent, obliterates the smallest veins and arteries, and compresses the smallest ends of the air tubes. At last parts of the lungs get so much infiltrated that they are hard when cut, like pasteboard which had been in water, and sink, when submerged in it.

Guillot often found the black matter and tuberculosis in the same lungs. He thought it particularly worthy of notice that both had their seat in the upper part of the lungs. The tubercles seemed to become harmless when the black matter surrounded them. It effected the obliteration of the small bloodvessels which nourished the tubercle. The walls of tuberculous cavities often contained a great deal of that black matter, and cicatrices of the lungs became black by it.

The symptoms are described in thirteen cases:—Cough, often for many years, mostly dry, and worse in winter time. Expectoration as in bronchitis, often black, often sunk in the vessel. Hæmoptysis supervened, but mostly near the end of the disease (hæmoptysis senilis). Auscultation and percussion are not much taken note of. The sound was often dull in the infra-clavicular and supra-spinal region; râles, dry or moist, were often bronchophonia, rarely found.

Cruveilhier (*Anatomie Pathologique du Corps Humain*, liv. xiii.) described a case of melanotic lung in a female who died of puerperal fever. He found the lungs black, and the left upper to be softened, and a cavity whose walls were black as coal. He compared the colour to that of blood-pigment altered by acids, and the softness to that of gastromalacia. [The specimen may be seen in the Musée Dupuytrén.] In 1862 some valuable cases were published by Maurice (*Gaz. Med.*, 1862); Villaret, Kuborn, Crocq (*Press Med. Belge*, 1862), who considered the black deposit as nothing but real coal. Monneret (*l'Union*, 1863,) found the lungs of a brassfounder black. Valleix,

who has published a work on internal diseases (second edition, 1866), has a very short note on melanosis. He admitted two kinds of melanosis—first, one where, in consequence of a peculiar alteration of the cells of connecting tissue, black matter accumulating without being expectorated; the second is the miners' disease, said not to be connected anyhow with the first.

As regards German writers on the subject, Haller made an observation (*Orpuscula Pathologica Obs. xvii.*) on black striped sputa of adult men—he had them himself. Reisseisen, in a prize essay, 1808, wrote on the black masses in bronchial glands, which he thought was brought there by lymphatic vessels, and not further divulged in the organism. Heusinger, on pigment and coal production, &c., Eisenach, 1823, comes to the following conclusions:—

1. All pigment in the body is carbonaceous.
2. Abnormal pigment is like the natural.
3. Abnormal pigment is a transformation of the colouring matter of the blood.
4. It has some connection with the formation of fat.
5. Pigment is the atrabile mass of old.
6. It shows the prevailing venosity of the system.

Brockmann has written on the metallurgic diseases in the Harz Mountains, Osterode, 1851. He considers the black matter to be pigment, and relies on examinations which Vogel and Frerichs were prevailed upon by him to make, but have not been published elsewhere. Vogel found the black matter more in the parenchyma than in the bronchi. The highest state of the disease found at the post-mortem was when the whole lungs formed a black mass. Cavities were very rare. The specific gravity of the parts not abnormal. Accidentally miliary tubercles were found; four times scirrhus tumours, and sometimes concretions.

Fluid in the pericardium or thoracic cavity were not so very rare.

As for chemical examination, it proved the existence of

two pigments—one vegetable, one organic. The first did resist very much the action of acids, the last dissolved in chloric or nitric acid. One hundred parts contained 72·95 carbon, 4·75 hydrogen, 3·89 nitrogen, 18·41 oxygen. The ashes (12·48 per cent.) were composed of 10·6 per cent. siliceous matter, 1·88 per cent. sulphate of lime. By other analyses iron and phosphates were found.

As for symptoms, Brockmann, in addition to those mentioned by English writers, considers the dusky hue of the face, and the yellow sclerotica worthy of attention. He did not find the colliquative symptoms of phthisis in cases of pneumo-melanosia; the disease often halts for a longer time than tuberculosis. He recommends change of occupation, tonics, expectorants, and remedies which act on the liver.

Virchow's researches on pigment are well known. He describes in his works all the pigments of different colours—yellow, yellow-red, brick-red, brown, brown-red, and black; granular or diffused, free granules or pigment in cells, and crystalline pigments. They are transformed from hæmatin, which may have transudated from the blood-corpuscles and diffused into other parts, and afterwards, by another process, formed into granules and crystals. But, as well, blood-corpuscles may stick together and unite their hæmatin, which then is transformed into granules and pigment in a similar manner. Micro-chemical examination proved the pigment granules to resist much the stronger agents.

A strong solution of caustic potass was one of the most effective agents. It acted the soonest on the diffuse yellow pigment, very little, or not at all, on black granules. Concentrated acids changed the colour in this order—brown, green, blue, violet, rose, yellow. The chemical analysis showed that the lung pigment was the most carbonaceous of the colouring agents. This was the order—hæmatin, cholepyrrin, eye pigment, lung pigment.

Virchow considers lung tubercles to favour the produc-

tion of pigment, as in children with tuberculous diseases the lungs get dark.

Pigment may be deposited in large masses in the lungs, as Virchow found in an old pauper (*Wiener Wochenschrift*, March, 1856). It then may be found in all variations of form, as granules, round, edged crystals, which may be confounded with vegetable coal. Virchow suggests that pigment is very nearly related to bilifulvin, which crystallizes in yellow or yellow-reddish needles, both being generated out of hæmatin. In 1864, however, Virchow, relying on more recent researches, admitted that the black deposit in melanotic lungs was real coal, and the crystals as well; that even part of the lung pigment was of extraneous origin.

A rare case of black lung, complicated with tuberculosis, Barthelmes narrates in his "Dessertatio Inauguralis" (Nuremberg, 1855). The patient, a miller, had blackish or grey pelleted sputa. They consisted of mucus, pus, and pigment granules; no elastic fibres were found. At the post-mortem there were cavities as large as walnuts, filled with grey-blackish matter. The walls were covered with this matter; the tissue underneath partly of slate-grey colour, partly quite black. In the fluid pressed out of the lower lobes of the lungs numerous pigment granules were found not dissoluble by water, alcohol, ether, diluted acids. The author in question does not differ from Virchow's opinion (in 1855), but suggests that the cause of the production of so much pigment in old people may be found in fatty degeneration of the capillaries. This leads to the escape of pigment into the circulation and congregating of it in the tissue.

Rokitansky admitted Virchow's conclusions on pigment, but this was in his edition of 1859. I have not seen a later one.

In 1860 Traube (*Deutsche Klinike*, 49, 50) throws the weight of an important case into the scale of those who considered the blackness of the lungs caused by coal. A man whose business was to pack charcoal in baskets was under

Traube's care, and had black expectoration. In this Traube found the same charcoal particles whose appearance differed from pigment. And as the patient died of hydrops, the post-mortem was made and the lungs found black, and the charcoal particles in the alveoles of the lungs. This patient had a dusky-coloured skin during life; and in a very recent case the coal particles were even found by Traube in the tissue.

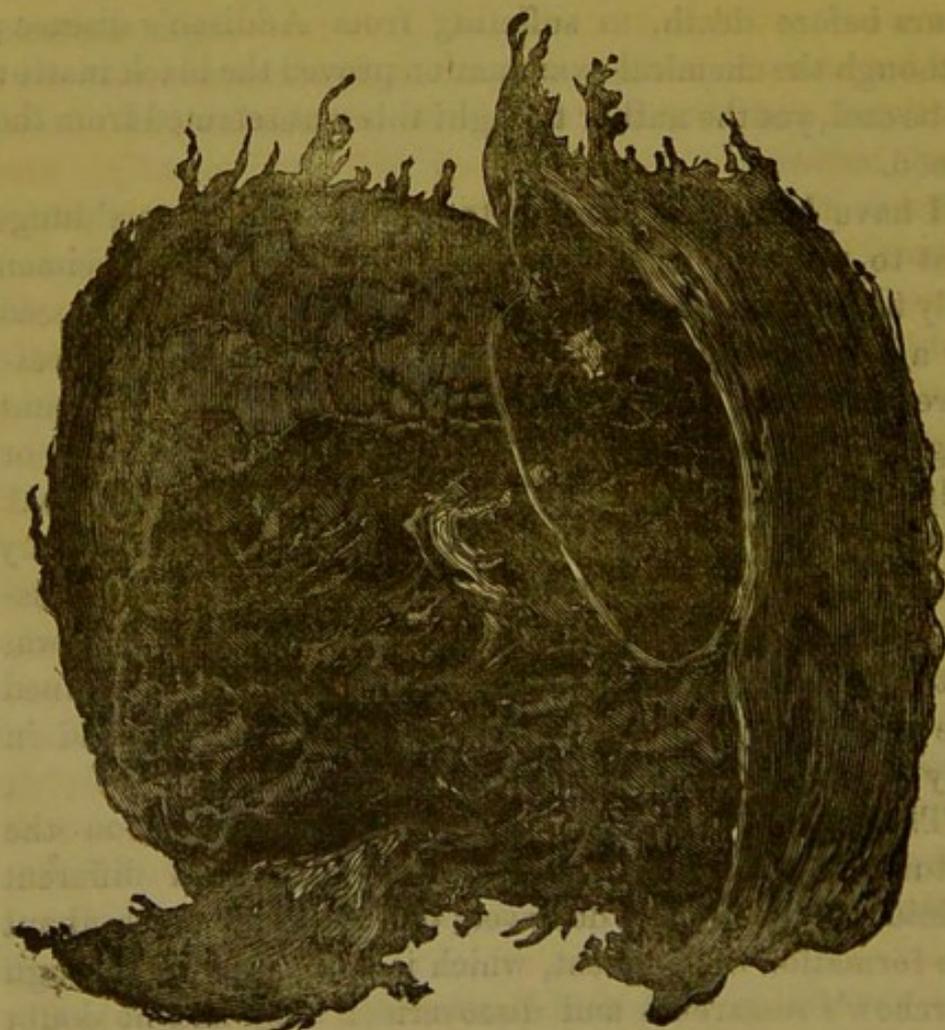
Forster (*Handb. d. pec. Path.*, 1863), and Friedreich (*Virch. Arch.*, 1864), hold as yet up the theory of no real coal entering from without.

Hartung, from Austria, published a case, 1865, in *Schmidt's Jahrb.*, of a man whom he had considered, a few years before death, as suffering from Addison's disease; although the chemical examination proved the black matter to be coal, yet the author thought this was secreted from the blood.

I have had twice occasion to examine coal-miners' lungs sent to me by Drs. Goodsir and Whitley, one specimen only five days after death. I found the black colour produced by a black granular mass, which could be divided by pressure into very minute granules, having sharp or blunt edges, but always very irregular. On this mass nitric or sulphuric acid acted as little as it did on pulverized coal. The only way to solve the part which was soluble was by boiling it for a continued time in a strong solution of caustic potash, but then part was left undissolved, which was not different from coal. The tissue of the lungs contained the most of the black deposit, but it was not missed in any other part. (See specimen on next page.)

The literature pretty well demonstrates that on the nature of the black deposit there have been different opinions. The earlier observers did not know much about the formation of pigment, which is better known through Virchow's researches and discoveries; they had no doubt that the black matter in the coal-miners' lungs was of extraneous origin and real coal. They often found the whole lungs of the miners intensely black, and were naturally led

to think this owing to the inhalation of coal-dust. When it was found that coal-dust and black pigment could hardly be distinguished by chemical and microscopical examinations, many thought it more natural to consider the black deposit of internal origin, especially as in some cases the patient had had nothing to do with coal-mines. But in recent times it has been clearly proved that dust-particles, which can only have entered the lungs from without, such as silica or indigo, or tobacco, or iron ochre, are deposited in the tissue of the lungs, not only in the bronchi, and we may suppose, on that account, the same to be the case with coal-dust.



There is another great difference between former times and now—viz., that the black lung disease in miners is

much rarer now than it was. The mines, especially in Scotland, were badly or not at all ventilated thirty years ago; and it is very gratifying here to state, that it was chiefly owing to the exertions and complaints of the medical men whose works I mentioned above that this was changed, and an Act of Parliament passed by which certain regulations were enforced. I recently visited some mines—for instance, those near Nottingham, and found the disease in question hardly known.

As it is not yet proved that the blackness of a coal-miner's lung is caused by coal-dust exclusively, we may examine the opinions of those who think so, and of those who believe that it is caused more or less by pigment. It is stated by the first that coal-dust must accumulate in the lungs of the miners, that as the air is charged with coal particles, and they are obliged to breathe long and deep, the sharp-edged particles must find their way into the tissue. The coal particles are found in the bronchial glands, being brought there by the lymphatic vessels in the same way as in the case of Dr. Hoppe and Pohl, in Greisswald, where a patient had his abscesses dressed with coal-powder, and this was afterwards found in the lymphatic vessels and glands. The expectoration of the miners out of work is often quite black, containing the same black matter as found in oil-soot.

On the other hand, it is stated that it is unlikely that coal particles get into the ends of the bronchial ramifications, as these are not continued in straight but in much broken lines, and as the ciliated epithelial cells of the lung remove all the dust particles very quick, and all foreign bodies are driven from the lungs by coughing. I may as well add that the action of the elastic fibres of the smaller bronchi and air vesicles is very powerful, as demonstrated by asthma, where they are in morbid contraction. Further, it seems strange that coal particles are not found in the blood, whereas pigment circulates with it, so Frerichs, for instance, found in ague (Frerichs on melanæmia *Zeitschr für Klin. Medicin.*, 1855, Baud vi. Heft. v., p. 321.) Tigri sul

pigmento nella mitza, nel fegato e nel sangue.—*Gaz. Med. Tosc.*, 1855, No. 31, p. 2557.

There is further the specific gravity, which mostly has been found more in accordance with the supposition of an organic matter being present in the lungs. Brockmann invariably found that the black lungs did not sink. I found so in two specimens. Guillot found the lungs sinking in fluid, but the specimens he examined were tuberculous lungs. This certainly might be soon cleared up by medical men engaged in coal-mines.

But there is a third thing probable, that the coal particles are found in miners' lungs, and the blackness yet in some manner owing to pigment. The presence of the coal-dust is a reason of augmentation of the pigment, as it leads to congestion. In the spleen congestion leads to blood extravasation, and the blood is transformed into melanotic matter. This then circulates in the blood passing to the liver, where Frerich observed it in the smaller capillaries microscopically, and even with the simple lens in the larger capillary vessels. This melanotic matter, if present in small amount in the blood, gives the skin of the patient an ashy hue, but if it accumulates in larger patches it is the cause of discolouring it to a remarkable extent. The same has been observed in coal-miners' disease.

In the lungs congestion always leads to pigment formation. It is not necessary that there should be extravasation as in the spleen, which has not the elasticity of the respiratory organs; in that case we might have hæmoptysis, or at least sputa tinged with blood, and this has not been observed in the cases above mentioned (except Guillot's). But the pulmonary capillaries become loaded with blood, the hæmatin becomes intra-capillary free and forms the black matter. It is even quite possible that the pigment when accumulating forms obstonitious as the accumulated bile pigment forms in rare cases in the kidneys.*

* Frerich's "Diseases of the Liver," p. 102. The bile pigment is pre-eminently distinct in the straight tubules of the pyramids, the calibre of which becomes blocked up with

Besides, it might be asked by those who think the blackness to a great degree owing to pigment, how the lungs of stone-masons, quarry-men, knife-grinders, and others, show the same black colour, if it is not pigment?

There are some cases mentioned in medical literature, such as Begbie's and Barthelmes', where it is really difficult to suppose otherwise than that pigment caused the blackness, as the inhaled dust was mill-dust, which is not black. There have been others, such as Cruveilhier's, where the patient, a female, most likely had nothing to do with coal.

At any rate, however much we may be satisfied that coal-miners' lungs are coloured black by coal, we cannot deny that in other trades, where dust is inhaled and the lungs are affected and get black, this may possibly be caused by pigment.

Supposing we had to follow the course of single coal particles, I should think it to be as follows:—They first get into the larger bronchi, and later into the smaller. Here they find the epithelial cells, which they enter and fill, as proved by Traube (so far as regards charcoal particles), later yet they get into the thin walls of the air-vesicles, through the walls which are now at parts unprotected by epithelial cells, afterwards into the intervening tissue, and as fresh particles follow, they accumulate here, as Virchow found, whereas they are sooner eliminated from the other parts; at last they get into the elastic trabicular, which resist the most. That they lie in the tissue for years, which seemed to me before very unlikely, I have no doubt is a fact; they find their way back in the same manner, and are expectorated long after the person has given up his occupation; they then colour the sputum black (as in the cases of Leishman and Hall).

hard coal-like masses. It might be imagined that such a deposit would greatly interfere with the secreting function of the kidneys, and observation proves that it really does so. This coal-like, hard, brittle mass is like the material of black gall-stones, either dissolves in caustic potash slowly and incompletely, or is quite insoluble.

The accumulation of the particles leads at last to the formation of cavities sometimes of enormous size ; but in general this is rare. The specimens in the museums are the most exquisite. At the present time they must be even rarer, as the ventilation is better. Bronchiectasia may be confounded with them, the more as the walls in both cases are covered with a black smooth membrane ; this, therefore, must be carefully removed.

The progress of the morbid changes depends upon circumstances. Especially, I have to mention that there are different classes of miners, and that some are more endangered than others. There are those who blast the rock by mining powder when new galleries are made. There are the holers or hewers, who work with a pickaxe lying on the side or sitting doubled up. The third class are the fillers or putters, who have easier work and move about, especially where horses are used. The first are most in danger, the last the least.

Another difference exists as to the holidays. Even now the miners work in some Scotch mines ten days, and then have three holidays, and have to work for nine or ten hours a day. I was told in Basford, near Nottingham, that they have at present two or three holidays per week. In the Harz mines they worked till lately eight hours per day, or five days of the week, now they have mostly three free days.

The miners in metallurgic mines have not exactly to do with coals, but they nevertheless inhale soot from the oil-lamps. Soot being smoother than coal particles, may possibly rarer cause cavities. During the last ten years the disease has been observed in the mines between Glasgow and Edinburgh, in some of Belgium, near Bochum, in Westphalia (after a communication of Dr. Klosterman), in the brown coal-mines near Halle, in the Gruneberg mines (S. Casper, *Wochensch*, Bd. x., H. 2) in the Harz mountain, where there are only metallurgic mines.

Of other trades, the blacksmiths come next. I had several under my care : one, a foreman in an engine-factory, had a remarkable black expectoration for a time, which

he got rid of by taking a holiday and using expectorants besides. Traube had a similar case in the Berlin Charité, a man Ferbitz, who, I think, died there. I had some others whose cases I did not take particular notice of at the time. Their lungs may be expected to be black should they spit black when not engaged in their business. I found in the Registrar-General's report, published in the London morning papers of June 6, 1866, the death mentioned of a blacksmith (forty-seven years) of melanosis of the lungs (six months).

In aged people the lungs have been found black after death (Guillot, Virchow); but I do not know a reliable case where these had black expectoration during life. In their case we may reasonably suppose that pigment is the cause of the blackness, when they had nothing to do with coal during life.

Chimney-sweepers, metal-workers, coal-burners, china-scourers, china-workers, millers, brass-founders, are occasionally mentioned as having black expectoration. I had a tincase-maker (23) lately at the City Dispensary, who spat black, and by inquiring I found that he worked near a charcoal fire, by which the irons they use were heated, and the workshop was full of dust. He had asthma. By the physical examination I found normal vesicular breathing present everywhere; slight dry and moist râles in the lower lobes. Spirometric capacity, 2950 cub. cent. (height, 168 cent.; circumference, 75; mobility, $4\frac{1}{2}$); it should have been 3300 cub. cent.

A large class of sufferers from dust inhalations are knife-grinders and needle-pointers. In their case it has been proved that stone grit or silica enters the lungs. Marshall Hall had a great many cases in Sheffield. Dr. Greenhow found microscopically only a few siliceous particles in the tissue of a razor-grinder; but Dr. Peacock and others extracted a remarkable amount of silica from the lungs by incision and distillation. The change in the lung tissue had this similarity with coal-miners' lung, that there were dense bands pervading the tissue, the colour black, but

not so intensive, but how it could be even so without the pigment augmented to an abnormal extent, I cannot see.

The danger to the lungs in different trades where dust is inhaled must be the greater the more the pulverized matter is like stone or silica; consequently those miners who blast suffer the most, because the pulverized rock enters their lungs, which already contain coal-dust in more or less masses.

Indigo-dust has been found in the lungs of indigo workmen (Friedreich), and tobacco of tobacco manufacturers; but the most remarkable case is that observed by Professor Zenker, of Erlangen, where iron ochre was found in the lungs of a young woman (31) who was engaged in paper colouring. He calls it siderosis. The whole lungs had a colour like red brick, and the iron ochre particles were seen even by the simple lens. The epithelial cells were filled with such particles, and the intra-lobular tissue contained them in great number. The bronchial glands were coloured red as well (*Tagebl. d. Naturforscherverf.*, 1866). This case has been made by Zenker the subject of a most elaborate paper, wherein the whole matter is treated with great clearness and thought.

The diseases caused by inhalation of Scheele's green by artificial flower-makers, which caused such painful sensation a few years ago, belong also to the class of inhalation diseases, as the noxious matter is first introduced into the lungs; but there is this difference, that the noxious matter being a strong poison it soon affects the whole constitution. I hope that this disease belongs to the past. Melanotic cancer has nothing to do with the subject which engages our attention, as it has nothing in common with it but the colour, which is caused by pigment, or more likely coal deposited into its tissue; otherwise it belongs to that large family of tumours, which are only the symptoms of a certain blood dyscrasia, leading invariably to a fatal end.

There has been a controversy as to the melanotic and tuberculous process excluding each other. Brockmann observed that miners, even of phthisical parents, suffered

from miners' disease without tubercles, and when he found tubercles he considered them only as accidental. The fact is, that both diseases have their seat in the upper lobes of the lungs, and that they meet there sometimes. In some cases, as Guillot observed, especially in aged people, excessive pigment formation puts a stop to the progress of tuberculous disease by the pigment obliterating the small capillaries which feed the tubercles. Tuberculosis often favours the formation of pigment, as the lungs of consumptive patients are mostly found very black.

If a coal-miner, whose lungs are more or less pervaded by coal particles, is attacked by tuberculosis, I should think that he must sooner succumb to the new disease, which finds the lungs already weakened and in abnormal condition.

The most constant lung disease found in combination with coal-miners' black lungs is emphysema; in knife-grinders I suppose it is less frequent, and of the other diseases caused by dust inhalation there are not a sufficient number of cases known. It is quite easy to understand that the bronchitis of which they suffer for years leads to emphysema.

Pneumonia (mostly interstitial) I suppose to be the more frequent the heavier the dust is which was inhaled. It is comparatively rare with coal-miners; I only know of one case, communicated to me by Dr. Biefel, where the sputa (*casts*) proved the pneumonia during life. They had a black colour, were fibrinous, and had a shape in conformity with the bronchial ramifications.

Pleuritic exudation is not so rare in melanotic patients, and the black particles in the fluid, which formerly were considered to be pigment, we should now hold to be real coal.

At present this seems to me the right standing point—that we should not separate the different diseases caused by inhalation of dust particles. Recent observations have demonstrated that dust enters all parts of the lungs when inhaled for months and years, and that they are the cause of a disease which is very similar in its symptoms, although

some difference exists, based upon the nature of the noxious matter. Melanosis caused by the inhalation of oil-soot may be the mildest form of the inhalation diseases; it may as a disease *per se* rarely now lead to death, but it does so certainly. Some inhalation diseases I may have overlooked, and not named; I am sure there will soon be some more mentioned in medical literature. Some I have mentioned will not be many more times observed. At least I trust that they will soon prohibit paper-colouring by iron ochre in Germany.

SYMPTOMS OF MELANOSIS AND SIMILAR INHALATION DISEASES.

The symptoms of these diseases are trifling in the beginning, so that they mostly are overlooked by the patient. Slight indigestion, uneasiness of the chest, may in most cases exist for many years before they complain; gradually, however, dyspnœa troubles them more, and in the later stages the dyspnœa is of very alarming nature. It is in general so constant, that you always hear mentioned the miners' asthma, the grinders' asthma, &c. A slight cough with some mucus expectoration is early present, but occasionally the colour of the sputum becomes black, and in the more serious cases it has that remarkable appearance of black ink, and is sometimes expectorated in considerable quantities when cavities are formed. Microscopically we find the coal particles which are inhaled, or whatever other dust may be the noxious matter. Blood has been exceedingly rarely observed, and elastic tissue only in cases where tuberculosis was present as well. The fibrinous ramificated sputa (bronchial casts) we might expect to find under favourable circumstances by close observation. Fever is in general not present—on the contrary, the pulse is usually slow and weak; it is on account of supervening inflammation that heat and frequency of the pulse show themselves.

A dusky hue of the skin has been frequently observed (recently by Traube), and mental depression, hypochondric mood, is rarely absent.

The physical examination has not found, as yet, the amount of attention it ought to have. Undoubtedly it is not in accordance with the importance of the disease. The percussion found is usually rather louder and more extended than in the normal condition; slight râles, dry and moist, are found at different places, but the breathing in general of the vesicular type.

All this is changed by complications with pleuritis, pneumonia, &c. If the ictus cordis is essentially diminished is not yet known. The spirometric experiment shows the capacity of the lungs reduced.

The prognosis depends partly on the nature of the inhaled noxious matter, partly on the circumstances of life in which the patient is.

As for diagnosis, I mention that the disease might be confounded with Addison's disease on account of the colour of the skin.

The treatment has to be divided into preventive and curative.

As for coal-miners, the principal thing is ventilation. This may be done by fans, funnels, as on board ship, by exhaust-pumps and bellows, and by fires. The last are the best, and I found them in the best ventilated mines; they are in Durham and Nottinghamshire, only there is a considerable difference in the results. In some mines, where the air was good in the mains, the remoter galleries participated less in the beneficial effect of ventilation, and the air contained less oxygen and more sulphuretted hydrogen. I am quite sure that in many places the fires are too small—for instance, in Derbyshire. It is also important that the double-doors and deal partitions should be placed judiciously. Workshops should as well be ventilated; knife-grinders should have ventilating fans. It is further important that the operatives in all these trades should have sufficient holidays. In some cases a mechanical contrivance may be invented to keep the dust from the lungs.

If a patient applies for advice, and we find out the nature of his disease, we must counsel him to leave off his

noxious occupation at once ; by this he will be more benefited than by anything else. Although I have not had much occasion to try remedies, I should think that expectorants will do good mostly, and a tonic *regimen* will certainly do no harm. Complications of the lung diseases, with inflammation or congestion in the abdominal organs, have to be treated according to the present state of science.

Change of air and habits or other circumstances of his whole life may sometimes save the patient.

In order to further our knowledge of the disease and the treatment thereof, it would be desirable to have numerous cases and histories from medical men attending coal-miners, needle-pointers, &c. A better light might be shed on much that is doubtful if they put down their observations regularly, following up more important cases from the commencement to the end, not omitting the post-mortem. The physical examination of the lungs, that of the sputa and urine, ought not to be neglected, and all intercurrent diseases, especially pneumonia, taken note of. By this it might, for instance, at the post-mortem be accounted for why parts of the lungs show an abnormal specific gravity, the case-book relating several attacks of inflammation. It ought to be stated, also, if the liver and spleen have contained black deposit in excess, in accordance with the hypochondric propensities observed during life.

The tissue of the lungs might be more minutely examined by the microscope, in order to find out if the melanic matter is more present in the tissue or in the mucous membrane, and the solubility of this matter might be tested thoroughly by concentrated solutions of caustic potash. The examinations for iron by hydrochloric, and silica by hydrofluoric acid, &c., in an interesting specimen, would be gladly undertaken by competent authorities.

All other particulars, as ventilation, number of holidays, mode of life, ought to be specified in the cases.

In conclusion, I once more draw the attention of the reader to the state and condition of the British miner,

who is instrumental in bringing to day the yearly amount of 98,000,000 tons of coal, which constitute a considerable part of the wealth of this kingdom, but who lives a life full of care and bare of joy, and born to a cruel fate, dies at last a cruel death. Not able, in most cases, to think for himself, drudging along his dreary path of existence, he wants commiserating friends to take up his cause. Wherever medical men are in a position to befriend him, to ameliorate his condition in general, I wish and hope they may do so by all means. And those who profess to take an interest in all matters of hygiene and public health, I wish may visit the mines and miners, to look after the ventilation of the first, and the mode of life of the latter, and consider in what better way they may be protected from disease.



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