On the economical applications of charcoal to sanitary purposes : a lecture delivered at the Royal Institution, Albemarle Street, on Friday evening, March 2, 1855 / by John Stenhouse.

ON THE

ECONOMICAL APPLICATIONS

OF

CHARCOAL

TO

SANITARY PURPOSES.

A LECTURE DELIVERED AT THE ROYAL INSTITUTION,
ALBEMARLE STREET,

ON FRIDAY EVENING, MARCH 2, 1855,

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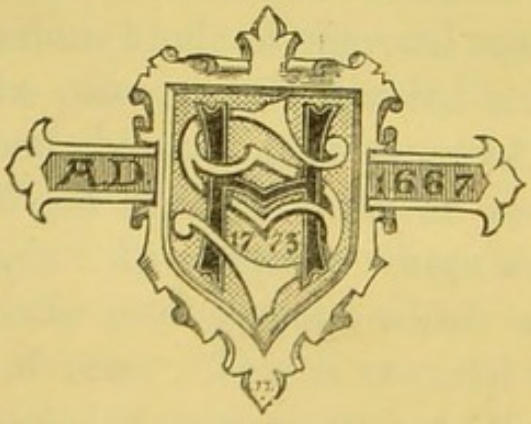
Second Edition.



LONDON:
SAMUEL HIGHLEY, 32, FLEET STREET.

1855.

LONDON:
T. E. Metcalf, Printer, 63, Snow Hill.

ON THE

ECONOMICAL APPLICATIONS

OF

CHARCOAL TO SANITARY PURPOSES.

Mr. President, Ladies, and Gentlemen,

The subject to which I would wish for a short time this evening to solicit your attention, is the Economical Applications of Charcoal to Sanitary Purposes.

Charcoal, of greater or less purity, is invariably produced when organic substances, whether vegetable or animal, are heated to redness in close vessels. The various kinds of charcoal most commonly in use may be conveniently divided into three species, viz., wood charcoal, peat charcoal, and animal charcoal. Wood charcoal may be prepared in a variety of ways. In countries where wood is abundant, it is made into faggots, which are piled up into a kind of cone. This is covered with a mixture of turf and clay, so as to exclude the air, except by a few small openings at the top and bottom. The faggots are then lighted, and in consequence of the very limited supply of air, burn with a smothered flame, and are in fact subjected to a rude

kind of destructive distillation, the object in view being to char the mass with as small a diminution of its carbonaceous portion as possible.

During this operation a considerable amount of volatile products are evolved, consisting of smoke, empyreumatic, oils, tar, &c., about sixteen per cent. of charcoal being obtained when the process is properly conducted. The charcoal produced in this way constitutes a black shining mass, which retains the form of the pieces of wood employed in its preparation. In this country, where wood has a comparatively high value, charcoal is usually manufactured by distilling wood in cast-iron cylinders—the smaller branches of oak, birch, ash, and the harder kinds of wood being used for this purpose. By employing cast-iron cylinders much waste is avoided, and large quantities of vinegar or pyroligneous acid, as it is called, creosote, wood-spirit, &c., are also obtained

Peat charcoal is manufactured by precisely similar operations. It is much more friable than wood charcoal, and is therefore very easily reduced to the state of fine powder.

Animal charcoal is usually obtained by the destructive distillation of bones in cast-iron cylinders. It contains very little carbonaceous matter—seldom more than about twenty per cent.

It has long been known that the various kinds of animal and vegetable charcoal, especially when dry, possess the power of absorbing effluvia, and the greater number of gases and vapours. This subject was first investigated by M. Löwitz, a German

chemist, settled at St. Petersburgh, who, towards the close of the last century, between the years 1785--91, shewed that charcoal might be advantageously employed to deodorise and purify a great number of substances. The subject was afterwards taken up by Compte Morozzo, who made many interesting observations on the quantity of different gases absorbed by charcoal; it is, however, to the indefatigable M. Theodore de Saussure that we are indebted for by far the most complete and satisfactory series of experiments on the absorption of gases by charcoal.

The only kind of charcoal which Saussure employed in his experiments was that made from box wood. His mode of proceeding was to heat the charcoal to redness, to cool it under mercury, and to introduce it, when cold, into the gas he wished to examine. The table exhibits the amount of gas absorbed by a single volume of charcoal.

Ammonia	90·	Bicarburetted hydrogen	35·
Hydrochloric acid	85·	Carbonic oxide	94·
Sulphurous acid	65·	Oxygen	92·
Sulphuretted hydrogen	55·	Nitrogen	75·
Nitrous oxide	40·	Carburetted hydrogen	5·
Carbonic acid	35·	Hydrogen	17·

The absorption of these gases, which is complete in twenty-four hours, has nothing chemical in its nature, but is quite analogous to the peculiar attraction of liquids by very small tubes, usually called capillary attraction.

Saussure's experiments, as we have seen, having been all performed with one species of charcoal—

namely, that from box-wood—nothing was known of the comparative efficacy of other kinds of charcoal in the absorption of gases; I was, therefore, induced to make a few experiments on the subject. The kinds of charcoal which I employed were three in number. Firstly, ordinary wood-charcoal, as obtained from the pyroligneous acid manufacturer; secondly, peat charcoal; and, thirdly, animal charcoal. You will at once perceive from the results before you in a tabular form, that wood charcoal has rather the highest absorbent power for gaseous ammonia, sulphuretted hydrogen, and sulphurous acid.

Half-a-gramme (five decigrammes) of the following kinds of of charcoal absorb the undermentioned uumber if centimetres of different gases.

	Ammonia	Hydrochloric acid	Sulphuretted hydrogen.	Carbonic acid	Oxygen	Sulphurous acid.
Wood .	98·5	45·0	30·0	14·0	·8	32·5
Peat .	96·0	60·0	28·5	10.0	·6	27·5
Animal .	43·5	—	9·0	5·0	·5	17·5

Animal charcoal is decidedly inferior to both wood and peat charcoal, as an absorber of gases and vapours; but, as a decoloriser, it is immensely superior to either of them.

Great efforts have been recently made, chiefly in Ireland however, to persuade the public into a belief of the superior efficacy of *peat* charcoal for sanitary purposes. A single glance at the table shews that this is not warranted by the fact, and

that peat charcoal is slightly inferior, as an absorbent, to ordinary wood charcoal. Notwithstanding this, however, I lately saw it ostentatiously announced in the newspapers, that thirty tons of peat charcoal had been sent to Scutari, for the use of the hospitals in Turkey, by the Irish Amelioration Society, who did not appear to be at all aware that wood charcoal is the ordinary fuel employed in Turkey and most other Eastern countries, where it can always be had of the best quality and in any quantity that may be desired.

This proceeding with regard to the peat charcoal reminds one of the old proverb of "carrying coals to Newcastle," though, unfortunately, it is but too much of a piece with most of our doings in regard to the hitherto ill-starred expedition to the Crimea.*

My attention was particularly drawn to the importance of charcoal as a deodorising and disinfecting agent, about eighteen months ago, by my friend, John Turnbull, Esq., chemical manufacturer, of Glasgow. Mr. Turnbull, about six months previously, had placed the bodies of two dogs in a wooden box, on a layer of charcoal powder of a few inches in depth, and covered them over with a quantity of the same material. Though the box was quite open, and kept in his laboratory, no effluvia was ever perceptible; and, on examining

* As the price of peat charcoal, however, is considerably less than that of wood charcoal, in some situations and for certain purposes, peat charcoal will be found the more economical of the two.

the bodies of the animals at the end of six months, they were found to be in a very advanced state of decay. Mr. Turnbull sent me a portion of the charcoal powder which had been most closely in contact with the bodies of the dogs. I submitted it for examination to one of my pupils, Mr. Turner, who found it contained comparatively little ammonia, not a trace of sulphuretted hydrogen, but very appreciable quantities of nitric and sulphuric acids, with acid phosphate of lime. Nearly eighteen months ago, I buried the bodies of a full-grown cat and two rats in about two inches of charcoal powder, and kept them ever since in my laboratory. During the whole of this time not the slightest odour has been perceptible, nor have any injurious effects been experienced by the eight or nine persons by whom the laboratory is daily frequented. On recently examining the state of the animals, I found that almost all the nitrogenous portions had disappeared, and that what remained consisted chiefly of bones and a portion of fat, and even this latter substance was in a state of rapid decay.

The putrefaction of animal and vegetable substances is, in general, a process of imperfect oxidation. Hence, under ordinary circumstances, when this is the case, a variety of more or less complex secondary products is formed, which usually possess very disagreeable odours, and exert exceedingly injurious effects upon the animal economy. For these substances the general name of miasmata has been given. Not much is known of their nature, but they are believed to be heavy,

complex, notrogenated vapours, which are decomposed by oxygen, chlorine, sulphurous acid, nitric acid, and other disinfecting agents. From the experiments already detailed, it is evident that powdered charcoal, instead of retarding, hastens the decay of putrifying substances with which it is in contact. In all the modern systems of chemistry, however, such, for instance, as Professor Graham's, the last edition of Turner's Elements, &c., charcoal is described as possessing antiseptic properties, while, as has just been shewn, the very reverse is the fact.

Common salt, nitre, corrosive sublimate, arsenious acid, alcohol, camphor, creosote, and most essential oils, are certainly antiseptic substances, and therefore retard the decay of animal and vegetable matters; none of these, however, are oxidisers. Charcoal, on the contrary, from the considerable amount of condensed oxygen contained within its pores—amounting to between nine and ten volumes—not only absorbs, but rapidly oxidises the effluvia and miasmata emitted by decaying substances, and resolves them into the simplest combinations they are capable of forming—their carbon being converted into carbonic acid, and their hydrogen into water. The reason why antiseptic properties were until recently universally ascribed to charcoal, appears to have been simply this—that charcoal masks or conceals its operation by absorbing and oxidising the products evolved. Now, we have hitherto been accustomed to judge of the existence and progress of putrefaction by

the offensive effluvia evolved, and when we have missed these, we have been apt to imagine that decay has either been prevented or ceased to progress. This inference, though natural, is in such cases as those we have been considering, wholly fallacious. It is just as if wishing to know whether there were any fires in a house which we happened to see at a little distance, we were to look at the chimneys to observe if any of them smoked; and if we found that to be the case, we might safely conclude that there really were fires burning in the rooms; should the house, however, be furnished with Dr. Arnott's smokeless grates, or any other equally effective apparatus, if, were we still hastily to conclude that because we saw not a trace of smoke issuing from the chimneys that there could be no fires within the building, we should certainly arrive at a very erroneous conclusion indeed.

When putrefying animal and vegetable substances are covered with charcoal powder, the effluvia and miasmata which, under ordinary circumstances they would evolve directly into the atmosphere, are absorbed and oxidised within the pores of the charcoal, where they undergo a species of what is called low combustion, which as effectually destroys them as if they were at once passed through a furnace; it is, therefore, on its absorbing and oxidising power that the great efficiency of charcoal as a deodorising and disinfecting agent depends.

The porosity of charcoal is much greater than many persons are aware of. Liebig states, at page

132 of his "Letters on Chemistry," that "the pores in a cubic inch of beech-wood charcoal must at the lowest computation be equal to a surface of 100 square feet;" and several other experimenters have estimated the porosity of a cubic inch of charcoal at even more than double that amount.

Hence the extraordinary efficacy of charcoal in the absorption and oxidation of gases and vapours is most satisfactorily accounted for. The oxidating power of charcoal is easily demonstrated by an old experiment of Thenards. When some pieces of dry charcoal are introduced into sulphuretted hydrogen gas over mercury, the charcoal absorbs about fifty-five times its volume of the gas; the charcoal is then transferred into a jar of dry oxygen; in the course of a short time a tolerably energetic action ensues; the sulphuretted hydrogen is decomposed; heat is evolved; water is formed; and the whole of the sulphur is deposited within the pores of the charcoal.

All porous substances, such for instance as platinum black, pumice stone, &c., possess the power in common with charcoal of absorbing and condensing gases within their pores. Some of these, especially sponge platinum, are even much more powerful absorbants and oxidisers than charcoal. When, therefore, even a few grains of platinum black are thrown into a mixture of oxygen and hydrogen, the two gases are brought within the sphere of their mutual attractions, when they instantly combine with explosive violence.

Since, therefore, charcoal as we have seen is such

a powerful oxidiser, it is manifestly injudicious to incorporate it with manure, which is not to be immediately applied to the ground. For no sooner is the manure and charcoal in contact, than a species of low combustion ensues, and the manure is soon greatly deteriorated. Notwithstanding this very obvious objection, this is the very process which a Company, called the "Health of Towns' Improvement Institute," established in Dublin, is constantly recommending. They propose that the whole of the offal from Dublin and other large cities, instead of being run into the common sewers, as at present, should be collected and mixed with peat charcoal. To say nothing of the enormous expense of such a proceeding, the deterioration which the manure undergoes would of itself, in my opinion, be a serious if not a fatal objection to their scheme.

Now this alleged deterioration does not rest on hypothetical grounds merely, but is an ascertained fact. Some six or seven years ago, my friend, Mr. Turnbull, of Glasgow, who is not only an extensive charcoal and artificial manure manufacturer, but also largely engaged in agricultural pursuits, happened to mix up a quantity of charcoal powder with some excellent manure made by boiling down the flesh and bones of horses into a pulp, with oil of vitriol. After keeping the mixture for some months, Mr. Turnbull was surprised to find that it had diminished in weight, and had greatly deteriorated in value, and he asked me what I thought could be the cause of this. I told him I thought the charcoal had oxidated the manure, and that it

had undergone a species of low combustion, which, if long enough continued, would almost entirely destroy it.

When reflecting on the wonderful power of charcoal as a deodoriser and disinfectant, as exhibited in the cases already described, where, as we have seen, a layer of charcoal powder, not more than an inch in thickness, was capable of absorbing all the miasmata from such an extensive source of corruption as the putrid body of a large animal, it struck me that a thin layer of charcoal powder interposed between wire-gauze, would be equally effectual in preventing the noxious effects which too frequently result from the very minute quantity of putrid infectious matter floating in the air, of what are generally known as unhealthy situations.

These considerations led me to the construction of the so-called charcoal air-filter for the purification of the atmosphere, which was first publicly exhibited and described by me, at the meeting of the Society of Arts, on the 22nd of February, 1854.

Charcoal powder has, during many centuries, been advantageously employed as a filter for putrid water, the object in view being to deprive the water of numerous organic impurities diffused through it, which exert injurious effects on the animal economy.

It is certainly somewhat remarkable, that the very obvious application of a perfectly similar process to the still rarer fluid in which we live, namely, the air, which not unfrequently contains even more noxious organic impurities floating in it than those present in water, should have, up till within little

more than a year ago, been so unaccountably overlooked.

The charcoal air-filter consists of a thin layer of charcoal powder interposed between two sheets of wire-gauze, and can be readily applied to buildings, to ships, to the gully-holes of sewers, to respirators, and to various other purposes. One of these charcoal air-filters was fitted up in the justice-room of the Mansion-house, about three months ago, where it has ever since been in successful operation.

This room, as many of my hearers are probably aware, is ventilated from a very narrow street, containing a large urinal and several other nuisances, and was often so offensive as to have become the subject of general complaint. Since, however, it was furnished with a charcoal ventilator, through which all the air entering it was made to pass, the atmosphere of this apartment has become quite unexceptionable. As the most satisfactory proof of the successful operation of the air-filter at the Mansion-house, I need only state that within the last few weeks the City authorities have fitted up a similar apparatus in the Justice-room at Guildhall.

The utility of charcoal ventilators inserted into the framework of buildings, of ships, and in other situations where foul air is apt to accumulate, as in water-closets, in the close wards of hospitals, in the many back courts and mews, lanes of great cities, is, therefore, abundantly clear; all the impurities would, with such an arrangement, be absorbed and retained by the charcoal, and a current of pure air alone admitted into the apartment.

In this way pure air would be obtained from exceedingly impure sources.

Such an arrangement as this, carried out on a pretty large scale, would be especially useful to persons necessitated to live in pestiferous districts within the tropics, where the miasmata of ague, yellow fever, and similar diseases, are prevalent.

The proper amount of air required by houses in such situations might be admitted through sheets of wire-gauze, or coarse canvass, containing a thin layer of charcoal powder.

Under such circumstances, also, pillows stuffed with powdered charcoal, and bed-coverlets having the same material quilted into them, could not fail to prove highly beneficial.

A tolerably thick charcoal ventilator, such as I have just described, could be very advantageously applied to the gully-holes of our common sewers, and to the sinks in private dwellings, the foul water in both cases being carried into the drain by means of tolerably wide syphon-pipes, retaining always about a couple of inches of water.

Such an arrangement would effectually prevent the escape of any effluvia, would be easy of construction, and not likely to get soon out of order.

The air-filters, or charcoal ventilators, at the Mansion-house and Guildhall, are each of them several feet in diameter. The layer of charcoal is about an inch and a half in thickness, and consists of fragments from the size of a pea to that of a largish bean. The one at the Mansion-house, as as previously stated, has been in operation three

months, and has never required any alteration, such as the renewal of the charcoal or otherwise.

[Models of charcoal-ventilators, as in use at the Mansion-house and Guildhall, constructed by Mr. W. B. Rooff, together with charcoal bandages for gangrenous and other foul wounds, manufactured by Messrs. Darby and Gosden, 140, Leadenhall Street, were then exhibited to the Meeting].

Before describing the charcoal respirators to which the air-filter has likewise been so successfully applied, perhaps the audience will pardon me while I enter into a few details respecting the history and construction of respirators in general.

Respirators are an older invention than is usually supposed. They were first proposed and pretty fully described by the late Dr. Beddoes of Bristol, in the fifth of his "Medical Essays or Hygëia" as early as the year 1802. Dr. Beddoes had remarked that travellers when ascending high mountains, such as those of Switzerland, were speedily attacked with a superficial inflammation of the face, eyes, and chest. This he ascribed to the action of the dry cold air at these great altitudes, which rapidly chills the skin and absorbs the moisture of the mucous surfaces. These injurious effects, Dr. Beddoes observes, may be almost entirely prevented by covering the face with several layers of crape, which effectually prevents the too rapid abstraction of heat and moisture. "It is obvious that the construction of these muzzles ought to vary according to the case. Each individual will soon find how many folds of whatever material he

may choose to employ will communicate heat and moisture enough to the air he breathes, without injury to the freedom of respiration." Persons not considerably affected, need only wear such a guard on first going abroad, provided they are on foot, and the weather be not too sharp. Walking soon communicates to the mucous surfaces, as well as to the skin, a degree of activity, during which the functions of the chest are more easily and pleasantly performed; and in this situation a cool atmosphere received directly into the lungs will not produce inconvenience. Of course, the muzzle may be discarded. It is obvious that the consumptive and the asthmatic will be enabled, by the same means, to indulge safely in air and exercise at times when otherwise they must debar themselves the use of both."

From these extracts, it is evident that Dr. Beddoes, so early as 1802, was perfectly aware of the mode of construction and operation of respirators.

Dr. Arnott informs me, that about seventeen or eighteen years ago, the principle and mode of constructing respirators were fully described by him in a lecture delivered in this very room; and a short time afterwards, a patent was taken out by Mr. Jeffreys for the manufacture of respirators.

Mr. Jeffreys' respirator consisted of a numerous series of narrow metallic tubes, through which the expired and inspired air was made to pass. The expired air communicated a portion of its heat to the metallic tubing, and in this way the temperature of the inspired air was considerably elevated.

Mr. Jeffreys is certainly entitled to the very great merit of having brought respirators into general use, and I believe their manufacture has long been to him a source of very considerable emolument. As constructed by Mr. Jeffreys, however, the respirators were both complicated and costly, their price for many years being about two guineas each. When one of these respirators is worn for some time, it not only readily condenses much of the superfluous moisture of the breath, which considerably impedes the free passage of the air, producing a strain upon the lungs, but the solid matter, more or less of which is always evolved from the lungs, condenses in the apparatus, and renders it exceedingly disagreeable, and occasionally positively injurious. That a considerable amount of solid organic matter is constantly given off from the lungs is easily shewn by a very simple experiment. You have only to breathe through a tube inserted into pure distilled water, and on setting it aside for a time in a warm place, it speedily becomes putrid, and is found to contain ammonia, clearly proving that solid nitrogenous matter had been evolved from the lungs. In certain cases, such as those of diseases of the lungs and throat, the amount of this animal matter is often greatly increased.

With regard to the charcoal respirators, my object in constructing these instruments was very different from what Mr. Jeffreys and other respirator makers had in view,—namely, merely to *warm* the air; my object being to *purify* the air

by filtration, and thereby deprive it of the noxious miasmata which, in unhealthy situations, it not unfrequently contains. This it effectually does by absorbing and oxidising them in the way already described. I found, however, that the charcoal respirators not only purified the air, but warmed it sufficiently, while they were free from several disadvantages to which ordinary respirators are incident.

There are three different forms of the charcoal respirator.

The first form is constructed for the mouth alone, and does not differ in appearance from an ordinary respirator, but is only half its weight, and about one-fifth of its price. The air is made to pass through a quarter of an inch of coarsely powdered charcoal, retained in its place by two sheets of silvered wire-gauze covered over with thin woollen cloth, by which means its temperature is greatly increased. This charcoal respirator possesses several advantages over the respirators ordinarily in use :—

1stly. Where the breath is at all fetid, which is usually the case in diseases of the chest, under many forms of dyspepsia, &c., the disagreeable effluvia are absorbed by the charcoal, so that comparatively pure air alone is inspired.

This, I think, may occasionally exert a beneficial influence on diseases of the throat and lungs.

2ndly. The charcoal respirator for the mouth alone will certainly prove highly useful in poisonous atmospheres, where miasmata abound, if the simple

precaution is only observed of inspiring the air by the mouth, and expiring it by the nostrils.

3rdly. The charcoal respirator is exceedingly easy to breathe through, as, owing to the non-conducting nature of the material of which it consists, it does not condense the moisture of the breath to an inconvenient extent.

The second form of respirator is ori-nasal—that is, embracing both the mouth and nose. It is only very slightly larger than the one already described, and does not cover the nose as the ordinary ori-nasal respirator does, but merely touches its lower extremity, to which it is adapted by means of a piece of flexible metal covered with soft leather. It is obvious, however, that a respirator might be easily constructed to cover the greater portion of the nose, without being particularly cumbrous. Such an arrangement would, under certain circumstances, be very advantageous; and, in fact, respirators on this principle have already been manufactured.

When this respirator is worn, no air enters the lungs without first passing through the charcool, and any effluvia or miasmata contained in the atmosphere are absorbed and oxidised by the charcoal. This form of respirator, therefore, is peculiarly adapted for protecting the wearer against fevers and other infectious diseases.

The third form of the respirator is also ori-nasal, but is much larger, and therefore more cumbrous than the preceding variety.

It is intended chiefly for use in chemical works,

common sewers, &c., to protect the workmen from the noxious effects of the deleterious gases to which they are frequently exposed.

I think it but justice to myself to state, that I have no pecuniary interest in any of those respirators. Though strongly urged to do so, I refrained from securing them by patent, on the ground that inventions for the prevention of disease and death ought to be sold at the lowest possible price, and should not, therefore, be encumbered with the expense and restrictions attendant upon patent rights.

These respirators have been very successfully manufactured by Mr. W. B. Rooff, of 8, Willow-walk, Kentish-town.

I am aware that some persons who admit the deodorising properties of charcoal deny that it acts as a disinfectant. I would direct the attention of such individuals to some of the facts already detailed. Thus, for instance, we have seen that the bodies of pretty large animals, covered only with a couple of inches of charcoal, have been allowed during many months to putrify both in Mr. Turnbull's laboratory and in my own.

Now, had the bodies of these animals been left to decay under ordinary circumstances, not only would the stench emitted have been intolerable, but some of the persons by whom these laboratories were constantly frequented would certainly have been struck down by fever or other malignant disorders. During the last twelve months, charcoal powder has repeatedly been most successfully employed both at St. Mary's and at St. Bartho-

lomew's Hospitals, to arrest the progress of gangrene and other putrid sores.

In the instance of Hospital gangrene, we have to deal not only with effluvia, but also with real miasmata; for, as is well known, the poisonous gases emitted by gangrenous sores not only *affect* the individual with whom the mischief has originated, but readily *infect* the perfectly healthy wounds of any persons who may happen to be in its vicinity. So that in this way gangrene has been known to spread not only through one ward, but through several wards of the same hospital.

In fact there is every reason to believe that many sick persons die not from the direct effects of the disease under which they labour, but they are actually poisoned by the putrid exhalations evolved from their own diseased bodies and those of other parties in their vicinity.

This is especially the case in over-crowded military hospitals, where dysentery, cholera, and similar diseases prevail. In such circumstances the importance of employing some means of absorbing and destroying miasmata is so self-evident, that I think it quite unnecessary to dilate upon the subject.

A short time ago I met with a passage in a recently published work, "Parkyns' Residence in Abyssinia," where it is stated that "the natives of that country, in very unhealthy districts, are accustomed before lying down to sleep, to wrap a coarse woollen cloth round the mouth and nostrils, which

acts like a respirator, and to a certain extent prevents the inhalation of miasmata."

Here, therefore, we have an example of an attempt to purify the air by filtration, a very imperfect attempt I admit, but one which I think strongly corroborates the views which I have this evening been endeavouring to enforce.

For a considerable time past, the dissecting-room at St. Bartholomew's Hospital has been thoroughly deodorised, by means of a few trays filled with a thin layer of freshly heated wood charcoal.—A similar arrangement will, in all probability, be likewise soon applied to the wards of St. Bartholomew's, and every other well conducted hospital.*

The efficiency of the charcoal, may be greatly increased, by making it red-hot before using it.—This can easily be done, by heating it in an iron saucepan, covered by an iron lid.—When the charcoal is to be applied to inflammable substances, such as wooden floors &c., of course it must be allowed to cool in close vessels before being used.

From the statements that have already been made, the utility of charcoal powder, as a means of preventing noxious effluvia from churchyards, and from dead bodies in other situations, such as on board ship, is sufficiently evident.

Covering a churchyard or burial vault to the depth of from two to three inches with coarsely

* I have not mentioned the charcoal cataplasm, the "cataplasma carbonis" in the text, both because it is so well known, having been so long inserted in the pharmacopœia, but chiefly owing to the efficiency of the charcoal in this preparation being greatly impaired by its being saturated with moisture, by which its absorbent power is greatly diminished.

powdered charcoal, would effectually prevent any putrid exhalations ever finding their way into the atmosphere. Powdered charcoal should likewise be introduced into all coffins, as it not only favours the decomposition of dead bodies, but prevents them from being injurious to the living.

I was not aware till very recently, that Mr. Jasper Rogers, C.E. of Dublin, had proposed a similar application of peat charcoal, some four or five years ago. Mr. Jasper Rogers' object, was not merely to prevent the escape of effluvia, but to retard the decomposition of the bodies, by means of the supposed antiseptic properties of charcoal. I have also recently learned that the celebrated surgeon, Mr. Ferguson, of King's College, had, about four years ago, successfully applied powdered charcoal as a disinfectant both to cases of gangrene and to purify the wards of the hospital attached to that establishment.

Had I been aware of these facts I should certainly have mentioned them in the paper which I read before the Society of Arts about a twelvemonth ago, and I now gladly avail myself of the first opportunity which has presented itself of doing these gentlemen all the justice in my power.

In addition to the cases I have already described, in which charcoal respirators cannot fail to prove eminently useful, I may mention a few others.

For instance, charcoal respirators would entirely prevent the so-called painter's cholic, which usually terminates in paralysis of the extremities. These diseases are produced in house-painters by the ab-

sorption of the oxide of lead which is carried up in vapour by the turpentine with which such pigments are mixed.

In those large casemated batteries with three or four tiers of guns, it is well known that after the first two or three volleys the gunners are almost suffocated with the dense fumes of sulphide of potassium, of which the white smoke of gunpowder consists; were they furnished with respirators, however, and especially if a circulation of air was kept up by means of a blowing apparatus, I have little doubt but that they might maintain their fire from morning till night with scarcely any inconvenience.

As is well known, there exists in India a belt of pre-eminently unhealthy country of from forty to eighty miles in breadth, which extends along the base of the Himalaya and Nielgherry Hills. This belt of country, which is situated where the moisture of the hills comes in contact with the heat of the plains, is covered with the most luxuriant tropical vegetation. During nine months of the year it is so exceedingly unhealthy from the exhalations evolved from putrifying vegetable matter that it cannot be traversed without the most eminent risk. For this reason the communication between Upper and Lower India is seriously interrupted during a considerable portion of the year. Were the parties traversing these and similar districts (such as the Delta of the Niger, and many other localities), furnished with charcoal respirators, I confidently believe they would be enabled to travel through these regions with comparative impunity.

The reception of the charcoal respirators by the public has been remarkably favourable, several thousands having already been sold in the course of the last six months.

A few days ago, during an interview which I had with Dr. Sutherland, who has just gone out as chief medical inspector to Scutari and Balaklava; that gentleman informed me, that so strongly was he convinced of the utility of charcoal respirators, that he had memorialised Government to allow him to take out 500. Dr. Sutherland's request was met with the usual stereotyped official reply, "that respirators did not belong to his department." Dr. Sutherland was, therefore, obliged to content himself with taking out a single dozen for the use of himself and his brother inspectors.

It is evident that no experiments as to the efficiency of respirators can be deemed at all satisfactory unless made on a very considerable scale. In order, therefore, to ensure their speedy adoption, I have prevailed upon Mr. Rooff to offer to supply the Government with the use of 1000 respirators for six months for somewhat less than £90.

A similar offer will speedily be made to the French and Austrian governments by whom, I think, it highly probable it will be accepted; I must confess, however, that I should be rather sorry that an invention, originating in Great Britain, should first be extensively applied by any of the continental governments.

If our soldiers and sailors, when placed in unhealthy situations, were furnished with charcoal

respirators, and if the floors of their tents, and the lower decks of ships, were covered by a thin layer of freshly-burnt wood-charcoal, I think we should have little in future to apprehend from the ravages of cholera, yellow-fever, and similar diseases by which our forces have been, of late, so cruelly decimated. If found more convenient, the charcoal powder might be covered with coarse canvas, without its disinfectant properties being materially injured.

In conclusion, I would confidently hope that the time is now nearly come, when the propagation of disease by infection shall become the exception, and not the rule; when the most nervous and delicate persons will be enabled to attend unharmed on their friends, labouring under even the most malignant infectious disorders; and when we will be enabled to traverse some of the most pestiferous districts of the world, with no greater apprehension than we now would pass through the mews, lanes, and alleys of our densely-peopled and ill-ventilated cities.

[At the close of the Lecture the earthenware pans containing the bodies of the animals, covered with about two inches of charcoal powder, from which not the slightest odour was perceptible, were exhibited to the audience.]

LONDON:
PRINTED BY T. E. METCALF, 63, SNOW HILL.