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ON THE

PHILOSOPHY

OF

STINKS

WHICH DO NOT AFFECT PUBLIC HEALTH,

WHILST THE NEGLECT OF

HOUSE VENTILATION

FILLS OUR GRAVE-YARDS.

Read before the Royal Society of Victoria, April 11, 1870,

BY

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ON THE
PHILOSOPHY OF STINKS,
AND
NON-VENTILATION OF HOUSES.*

It would, doubtless, have been more attractive if, instead of the Anglo-Saxon word which heads this paper, an essay had been announced "On the Philosophy of Perfumes." But if "a rose by any other name would smell as sweet," it must be admitted that the subject matter of our discussion could not be characterised as either aromatic or fragrant; and that, therefore, to call things by their right names, the only fitting term to employ is that which conveys the idea of exhalations of strong fetid odours, obnoxious to our sense of smelling. The very urgency of the question at the present time, to which public attention has at last been aroused, will obviate the necessity for any apology in introducing to the notice of this Society so unsavoury a subject.

Medical men may object that this is an infringement upon their province, as conservators of the public health; and engineers may flout my remarks on sewerage as impertinent, coming from one who is not entitled to append the mystic

* In deference to a suggestion made prior to the reading of this paper, the manuscript was entitled "On the Philosophy of Street Odours," not *Stinks*, a good Anglo-Saxon term, and far more expressive.

letters, C.E., to his name. To both these classes, however, it may be replied, that the subject of the laws affecting the health of man is one that is open to all alike. It is one that I have well studied, and have written upon for the last twelve years, and, being guided by experience gained during a long life passed in all quarters of the globe, mostly amongst large bodies of men—many times in the midst of pestilence and death—possessing an average observant and inquiring mind, my attention has been aroused by the phenomena I have witnessed, and I have therefore no hesitation in claiming attention upon a subject which, in my opinion, has for years past been mistaken, or altogether neglected, by those appointed to watch over the public health. In place of devoting their attention to the subject of pure air, and free ventilation of public buildings and private dwellings, our sanitary guardians have confined their study to the Philosophy of Stinks, from which they have deduced false conclusions; for, however disagreeable and obnoxious to the olfactory organs, stinks do not vitally affect the public health, whilst the absence of ventilation does, to a fearful extent. No sooner is the wolf-cry raised of some zymotic bugbear, than we are invaded by these misguided guardians of our sanitary state, and urged to seize the lime-pail and white-wash brush; but the more important matter of securing a free current of air in the humbler habitations of our population is wholly ignored. And yet it is a well-known fact that cognate diseases are unknown in well-ventilated hospitals, unless imported by new patients.

An example of this may be cited in the report read by the Health Officer of the city of Melbourne to the Medical Society of Victoria, on the 2nd of March, in which Dr. Girdlestone states that “Deficiencies in the sanitary laws and requirements of a rapidly-increasing population have permitted accumulations of exposed sewage, and a super-

saturation of the soil, to generate volumes of foul air, which assail us in yards, streets, and houses, and constitute the greatest enemy to health and life we have to cope with. Poisonous gas in the air we breathe is given off from decaying animal excreta, or from refuse organic matters, in a moist state, on the surface or in the ground—in short, from defective sewage and drainage. We have here all the known conditions for the propagation of the cholera poison, namely, ground saturated with water which is impregnated with fæcal decomposition. The swamps near the town are, in fact, large open cesspools, with pestilential mud flats superadded in dry seasons. The exhalations from these swamps are often intolerable. The very recent occupation of this continent is, I believe, the real reason of the non-appearance of certain serious epidemics. It must be remembered that, only 34 years ago, the entire white population of Victoria was 224 persons, and that four years ago it was over half a million. The most common zymotic diseases do not thrive on a virgin soil. If a correct medical history of the goldfields, where many thousands of men, women, and children have suddenly pitched on one spot, could be taken, I think it would be seen that an outbreak of scarlet fever, measles, hooping-cough, or diphtheria, was never found at a new rush, or any other place, until the ground had been inhabited for two or three years, and received a certain amount of impregnation.”

Now, I am very far from meaning to assert that the question of drainage is unimportant; still less is it my intention to propound the paradox that stinks, although disagreeable, are not unwholesome; yet, I must beg leave to maintain, from evidence which shall be adduced, that, however disagreeable, it is not true that they are necessarily dangerous. I am well aware that there is an almost universal opinion that such is the case; nevertheless, that this is a fallacy, we have abundant testimony to show. Our

likings or dislikings in the matter of smell or taste are by no means accurate criteria of what is wholesome and what is injurious. Unfortunately, we like many things that are notoriously hurtful, and many things that are unpleasant are notoriously beneficial. Even the odours of a too composite river, or an ill-drained district, unpleasant as they may be, are very far from carrying pestilence and plague with them wherever they go. And so far from its being a demonstrated fact that the exhalations from a foul river cause cholera and fever, the evidence at present seems decisively opposed to such a conclusion. The public, generally, entertain no doubt that the emanations from drains and sewers will produce these diseases, but an English physician of some note, Dr. Parkin, has conclusively shown that the evidence we possess in regard to these matters is altogether against the theory that cholera, fever, and other diseases, are owing to the decomposition of organic matter and the use of impure water. His evidence is founded on experience of very various climates and latitudes—the intertropical regions of the East and West, the burning sands of Arabia, and the snow-covered steppes of Russia, as well as the more temperate regions of Europe and America—evidence which, if not conclusive, is at least exceedingly interesting, and entirely conformable to my own personal experience.

Nearly half a century ago, the writer was on campaigns in India, where every day's march was a tour of daily pleasure, the camping ground a place of virgin purity; our drink the fresh purling waters of running rivers; but in the midst of this security and rural peacefulness the dread cholera would swoop down on our canvas city, and hurl to the grave every one whom it attacked. In one tent I have seen five men dying out of nine; but, upon removal to another spot, ten or twenty miles away, the disease would disappear like a baffled raid of Parthians. Clearly, in these cases, it was not the supersaturated soil, or the stagnant drainage, or the

bad water ; but, as I shall have occasion to show, and the fact has been recently demonstrated by a succession of observations, we were in the line of the aerial highway taken by the pestilence. That ill-ventilation has more to do with the propagation of disease than deficient drainage I can also testify. I have seen men dying of dysentery and fever by the dozen, whilst living in magnificent (but ill-ventilated) bomb-proof barracks ; and the mortality would cease immediately upon the men being removed into camp.

The injuriousness of imperfect drainage is said to arise from the obnoxious influence of all organic matters, animal and vegetable, when in a state of decomposition. That putrid flesh and vegetables are disagreeable both to taste and smell, no one will deny ; but it remains to be proved that they are as injurious as unpleasant. Some putrescent matters are injurious when eaten, although many can be, and are, eaten with impunity. The surprising fact that the Indians kill their game with poisoned arrows, yet suffer no harm from the flesh thus poisoned, is intelligible to the physiologist, who sees that the poison of the arrow enters the blood of the animal ; but the poison of the poisoned flesh does not enter the blood. It is on the same principle that we can explain why an anatomist may spend day after day over putrid bodies (in an atmosphere the stench of which makes a stranger sick), yet suffers no harm beyond what would result from sedentary confinement in any other room ; nevertheless, let this anatomist scratch himself with the scalpel which he has used, and this little wound may be his death. He could breathe the air laden with the products of decomposition, and if oxygen were sufficiently abundant for respiration, no harm would ensue ; but he could not admit decomposing matter into his blood without serious injury. Thus putrid substances are proved to be poisonous in the blood ; but the gaseous products of putrescence are not proved to be poisonous. A stink is at

any time unpleasant, but it does not follow that it must be poisonous. Of course, if, from confinement, the gaseous products are so abundant as to prevent respiration, the effects of imperfect respiration will ensue; but these are not cholera or fever. When people breathe impure air, the inspirations are quicker than under ordinary circumstances.

Majendie arranged a cask in such a way that the bottom could hold putrid substances, whilst animals were placed on a grating with a double bottom, exposed to the emanations which constantly escaped. Rabbits, guinea-pigs, and pigeons, were left thus for a month, but did not experience any ill result. Dogs, on the contrary, began to lose flesh on the fourth day, and although they preserved their gaiety and appetite, died at the end of ten or fifteen days. But the dogs showed none of the symptoms of poison; they showed none of the symptoms observed in dogs into whose veins putrid matters had been injected. Their death was obviously caused by imperfect respiration. Rabbits and guinea-pigs require less oxygen in a given atmosphere than dogs, by reason of their smaller size; but that exhalations from decaying matters are not injurious when respiration is unimpeded, seems evident from the experience of leather dressers, knackers, butchers, and others.

Mr. Henry Mayhew, the author of "London Labour and the London Poor," tells us that he went on one occasion to see the operation of cleaning a cesspool. "The smell," he says, "although the air was frosty, was for some little time, perhaps ten minutes, literally sickening; after that period, the chief sensation experienced was a slight headache; the unpleasantness of the odour still continuing, though without any sickening effect. The nightmen, however, pronounced the stench 'nothing at all;' and one even declared it was refreshing! Nightwork, or the emptying of cesspools, is carried on, and has been carried on for centuries, after this method:—A gang of four men are set to work; one, who

is called the *holeman*, goes into the cesspool, and fills the tub ; another, called the *ropeman*, raises the tub when filled ; and the two others, the *tubmen*, carry away the tub when raised, and empty it into the cart." Mr. Mayhew, who always derived his information from the people he wrote about, gives an account of a conversation with one of these men, who said, "I niver vos sick as I knows on ; I've been queerish of a mornin', a good many times, but I doesn't call that sickness ; it's only the lush, and nothink more. The smell's nothink at all, ven you gets used to it. Lor' bless yer, you'd think nothink on it in a veek's time."

There can be no doubt that this is merely a plain statement of a well-known fact. The experience of all whose continual avocations lead them to dwell among odours—whether perfumes or stinks—is to the same effect. Mr. Newman informs us that the leather dressers in Bristol are not only healthy, but more so than the neighbouring poor, although, during the last part of the process, the stench is almost intolerable. In the tanyards at Bermondsey there are about seven hundred workmen, all remarkably healthy. The same robust health also attends the workmen employed in similar establishments in Victoria.

Again, Dr. Chisholm says that, in a manufactory near Bitton, for the production of the muriate of ammonia and sulphate of soda, and where the distillation of medullary oil produces the most nauseating fetor, no fever is known to arise, although the neighbourhood is thickly populated. The same exemption has been remarked at a manufactory near Bristol, for the conversion of dead animals into a substance resembling spermaceti, and where the same putrid exhalations are given out. Further, slaughter-houses, which, according to theory, ought to be centres of pestilence and fever, have been signally exempt from them, as was noticed during the plague and during the cholera. Dr. Tweedie says, "Though every description of mechanic was at some

time or other admitted last year into the Fever Hospital, I do not recollect a single instance of a butcher being sent to the establishment."

At Montfauçon, in Paris, there is one of the most extensive knacker-yards in the world. Thousands of horses, dogs, and cats are slaughtered there; the flesh and offal, after the animals are skinned, being allowed to remain and putrefy, for the purpose of manure. Duchâtelet says that "Every one can examine the fetid odour produced by heaps of flesh left to putrefy for months in the open air, and in the heat of the sun; to which must be added, the gases given out from mountains of skeletons, not properly cleansed from the soft parts, and the emanations arising from a soil saturated from year to year with blood and animal liquids. But, if you interrogate the numerous workmen who belong to the establishment, they will answer that they are never ill, and that the effluvia which they inhale, far from injuring them, contributes to keep them in good health. If you examine them, you will see that they have all the appearance of the most perfect health. One man had a wife and five children, the robust health of all of whom was remarkable, for they had all the year worked and slept in a place which was actually unapproachable to the members of the Commission on account of the stench." He also notices the longevity of those knackers. "Many of them are sixty or seventy years old, quite robust and active. Inquiries showed that their parents died at an advanced age; of the last three knackers that died, one was sixty and another seventy, and a third eighty-four."

Henry Mayhew tells us that the London dustmen are mostly tall, stalwart fellows; there is nothing sickly-looking about them, and yet a considerable part of their time is passed in the yards and in the midst of effluvia most offensive, and, if we believe zymotic theorists, as unhealthy to those unaccustomed to them; nevertheless, the children,

who may be said to be reared in the yard, and to have inhaled the stench of the dust-heap with their first breath, are healthy and strong. It is said, moreover, that during the plague in London, the dustmen were the persons who carted away the dead, and it remains a tradition among the class to the present day, that not one of them died of the plague, even during its greatest ravages. In Paris, too, it is well known, that during the cholera of 1849, the quarter of Belleville, where the night-soil and refuse of the city is deposited, escaped the free-est from the pestilence; and in London the dustmen boast that, during both the latest visitations of the cholera, they were altogether exempt from it.

“Look at that fellow, sir,” said one of the dust contractors, who are also the nightmen, speaking to Mr. Mayhew, and pointing to his son, a stout, red-cheeked young man of about twenty: “Do you see anything ailing about *him*? Well, he has been in the yard ever since he was born. There stands my house, just at the gate, so you see he hadn’t far to travel, and when quite a child he used to play and root away here among the dust all his time. I don’t think he ever had a day’s illness in his life. The people about the yard are all used to the smell, and don’t complain about it. It’s all stuff and nonsense, all this talk about dust-yards being unhealthy. I’ve never done anything else all my days, and I don’t think I look very ill. I shouldn’t wonder now but what I’d be set down as being fresh from the seaside by those very fellows that write all this trash about a matter that they don’t know *that* about;” and he snapped his fingers contemptuously in the air, and thrusting both hands into his breeches pockets, strutted about, apparently satisfied that he had the best of the argument. He was, in fact, a stout, jolly, red-faced man. Indeed, the dustmen, as a class, appear to be healthy, strong men, and extraordinary instances of longevity are common among them. I heard of one dustman who lived to be 115 years old; another,

named Wood, died at 100; and the well-known Richard Tyrrell died only a short time back, at the advanced age of 97. The misfortune is, that we have no large series of facts on this subject, so that the longevity and health of the dustmen might be compared with those of other classes.

Graveyards have for some years been regarded as centres of pestilence and fever; and certainly the perfume of a graveyard is far from agreeable. Besides, when fever is raging in a district, it is not difficult, of course, to find that a graveyard is somewhere close at hand; but this is extremely imperfect evidence of any necessary connection between the two; and it becomes still more suspicious when we find that at Bridgetown, Barbadoes, eight thousand bodies were buried in six weeks, in a space of two acres, yet neither fever nor any other disease attacked the inhabitants afterwards. The same remark applies to nearly all the large towns in the West Indies, in consequence of the practice of burying cholera victims in one spot. In the burial-grounds near Seville, ten thousand bodies had been recently interred, when, in 1800, the French Government sent a commission to inquire into the cause of yellow fever; and although a fetid odour was exhaled from the decomposing bodies, no ill result followed to the thousands of the inhabitants who went daily to visit the graves of their relatives and friends. And what shall we say to the Cemetery of the Innocents at Paris? In the course of thirty years, ninety thousand bodies had been buried there by one grave-digger, and it was calculated that more than six hundred thousand bodies had been buried there during the six previous centuries. In a space not exceeding two acres, it had been the custom to bury the bodies of the poor in common pits, and they were placed so close to each other as to be separated by planks only half an inch thick. These pits were twenty feet wide and twenty deep, and each contained ten to fifteen hundred bodies. It is difficult to

understand how Paris escaped from continuous attacks of cholera, and how the grave-digger managed to breathe this atmosphere during thirty years, if grave-yard exhalations are the fatal poisons they are declared to be.

I may be permitted to pause here for a moment, to protest against the inference being drawn, from my foregoing remarks, that I am advocating, or even palliating, the existence of mephitic nuisances in the vicinity of populated places. The very reverse is the fact; although, in order to arrive at the second branch of my subject, it was incumbent upon me to say so much in regard to the misplaced energies of our sanitary guardians. It is due alike to public order and decency, as well as to our self-respect, that dirty gutters or lanes should not be tolerated in a highly civilised community like ours; yet, whilst I have shown conclusively, that out-door dirt, and all animal excrement, *when freely exposed to the air*, do not generate fevers and the host of foes to health attributed to that cause, it is no less imperative a duty to show that the want of House Ventilation is by far a more formidable evil, although almost ignored by those who are appointed conservators of the public health.

That this is the fact, there can be no doubt, as the same health-officer to whom I have alluded, makes this admission in his paper read before the Medical Society of Victoria on the 2nd of March. He says that "Ventilation for the discharge of impure air from the interior of houses has not received so much attention from builders and architects as it demands, judging from buildings lately erected. There are two most noticeable faults in offices and in rooms intended for the reception of several persons. The ventilators, when there are any, are not large enough, and are placed too low down in the wall; two, three, or more feet below the ceiling; the heated air in such cases must collect

above the ventilator ; frequently a sixth of the cubic space of the entire room is above the ventilator. The remedy is obvious. When a ventilator is made in a wall for the exit of foul air, the top should be as high as the ceiling line, never below it. Of all the various inventions, apertures through the tops of the walls, or ceiling, in ordinary buildings, when the outer atmosphere can be reached this way, are the best ; a door placed obliquely, with its opening looking upwards, which can be closed at pleasure, called the Sheringham valve, can be added, if required. The size (says Parkes) for the openings in any room containing healthy persons should be 48 square inches to each ; for hospitals, 72 square inches to each. Experience shows that this space is barely enough ; there are, however, very few rooms to be seen in this town with a ventilating area of 12 inches by 4 inches for each person. The common practice of placing an iron scroll, or lattice-work, at the front of a ventilator, curtails the room originally left for a current of air by one-half or two-thirds, a deduction which should invariably be taken into consideration."

The splendid Town Hall of Melbourne is an instance of neglect in the ventilation of public buildings. The great Hall, and one or two next in importance, are ventilated, but the large proportion of *the office-rooms*, which will have human beings sealed up in them every day, are without the least attempt at ventilation ; there is no provision made for the escape of the respired air, or for the ingress of fresh air. Windows and doors should not be classed as ventilators, as circumstances of climate or privacy may require that both be shut. The Royal Arcade, again, although a tasteful addition to our street architecture ; yet even here there has been manifested a most glaring offence against the sanitary condition of its future occupants. The building consists of two long parallel ranges of shops, of moderate size, with fixed show windows ; therefore the flooring joists of the

rooms above the basement floor, and the ceiling joists above that, could have been laid parallel with the entire length of the Arcade, and thus have formed a hollow tube, or air recess, from end to end, one on each side, into which a ventilator, fixed in the centre of the ceiling of each room, with exterior outlets in Bourke-street and Little Collins-street, would have carried off, in the most efficient manner, the impure exhalations. To guard against the possibility of any infringement of the Building Act, a slide valve at each end would instantly cut off any tendency of the ventilating tube to conduct flames from any building to the adjoining one, in case of fire, as the recess would, under such circumstances, be full of foul air and smoke, and could not support combustion. There was, however, another available method of ventilation. The basement floors could have been ventilated beneath the fireplaces of the upper rooms, and the latter into the space between their ceilings and the roof. I do not include in these remarks that portion of the Arcade occupied by the Turkish Baths, as the proprietor understands the life value of ventilation independent of temperature. An inspection of this Arcade, however, recalled forcibly to mind the instructive episode related by Dr. Neill Arnott, in reference to the death of a number of monkeys in the London Zoological Gardens, a few years ago. These animals having been brought from a warmer climate, all sorts of contrivances of hot air pipes, etc., were resorted to, to keep them "warm and comfortable." For ventilation in cold weather openings were made in the skirting of the room close to the floor, with the erroneous idea that the carbonic acid produced in the respiration of the animals, being heavier than the other air in the room, would separate from this and escape below. When all this was done, some sixty healthy monkeys were put into the room; and a month after, fifty of them were dead, and the remainder dying. Had the ventilating apertures been

opened in the ceiling, which had been prepared for the summer, the air would have been rendered at once salubrious, and all the animals have lived.

A good deal has lately been written and said about the benefits of fumigation, and especially in favour of the system introduced by a Scotch medical man (Dr. Dewar), of employing sulphurous acid in various ways, either as a very dilute solution, a mist-like spray, or in its pristine state as the fumes of burning sulphur. But experience has shown that to trust to fumigation of any kind without proper ventilation, is only to aggravate the evil sought to be cured; pure air is the one thing needful, and no fumigation can create *that*; it must be brought in from the open heavens. Sulphuretted hydrogen is the type of those poisonous gases that most speedily destroy life; like prussic acid, it suddenly stops all motion when breathed in any quantity. Even when diluted to an extreme degree, such gases diminish the influence of the vital air on the blood, and favour the incursion of all those diseases which are propagated through the air. Where they are unavoidable, their decomposition and destruction are expedited by the action of light, especially when assisted by pure air.

There was a sad neglect of sanitary provisions in the early days of this colony. When our fine streets were laid out, provision should then have been made for their eventual easy and economical drainage, as well as for the enforced ventilation of houses, and an unyielding restriction against repeated subdivision of building blocks. But the vital object of ventilation is never thought of; the drain from the yard and the kitchen is led to the main street gutter under the floors of the apartments, in pipes, the joints of which are not luted; and when the wind sets up the drain mouth, these back draughts waft in the sulphuretted hydrogen gas, and the smell is nauseating. These are evils apparent to the senses; but there are long streets of houses

which are so situated that the subsoil drainage from too densely crowded localities on a higher level drain under them. Thus, from the houses on the summit of the double watershed, each with its privy sieve, the liquid filth passes on from house to house on the lower level, acquiring increased intensity the further its gravitating tendency carries it, until a convenient hollow is found left in the unlevelled foundation soil under the floor of each room, where it seethes and putrefies—Death's manufactory, where he sits and keeps high court, holding the doctor and his medicines in obstinate defiance.

About a year ago, the London *Lancet*, speaking on this same subject, said :—“ We know of no such general, dense, reckless ignorance as the builder's ignorance of drains. His idea of the subject begins and ends with this—a so-many inch pipe, a trap, and a concealment. Concealment has as great charms for the builder as it is said to have for many women of high repute for tidiness, who often meddle with and thrust out of sight things which are of great importance, but which they are incompetent to understand. And this is very much the case with the builder. He will bury a drain-pipe in a wall where its integrity can never be tested ; carry it, quite unnecessarily, under floors ; display, in fact, endless ingenuity in concealing what ought to be ever easy of examination. With a blind, unhesitating belief in a trap, which is often out of order and never safe, he will so multiply the sources of danger to a household as that the very completeness of the main drainage system shall become, thanks to his blundering, a curse rather than a blessing. Plenty has been written on the subject, and the builder, with very little trouble, could make himself acquainted with what, with due submission, we must look upon as a part of his business. But just as he perpetuates all the worst features of our houses—the chimneys which do not draw, and the fireplaces which waste the fuel, the ceil-

ings which are not ventilated, the roofs and walls which let in the heat in summer, the cold and damp in winter—so he meddles and muddles the drains.”

Carlton should have been the healthiest suburb in Melbourne, from its elevated position and perfect drainage facilities in two directions. Yet, owing to the repeated subdivision of building blocks, the want of ventilation and drainage, it is one of the most sickly, from the intensified mischief caused by its back-slum right-of-ways, where are kept hundreds of horses, cows, goats, fowls, with ducks filtering the green filth of the gutters through their bills, amidst a colony of young children, who (thanks to a natural instinct) will play and sit out of doors. On visiting one of these places on one occasion (never to be forgotten), the death-smell I experienced on entering one of these shanty cabins was horrible. The stench from the one bedroom, for a family of six children, besides father and mother, made me recoil as if stricken with a blow. Having inquired of the woman why she did not open the shutter at the back of the bedroom, she replied that the “old man didn’t like to have it opened!” Luckily for this woman and her children, they are necessarily in the open air nearly all the day; but the “old man,” who sticks like a limpet to the house, is doomed to an early grave; he is about forty, and looks sixty years old. Here is another proof that defective ventilation reduces the oxygenation of the blood, preserves an unhealthy warmth, stupefies the feelings, and allays the pangs of hunger. In many cases, it is a race between typhus and starvation.

If the noxious atmosphere of these dens, when breathed, acted on a secondary part of the human system, nature might, in some measure, neutralise the effects of the poison; but this polluted air is at once brought in contact with arterial blood, which, thus contaminated, is conveyed into the heart, to be pumped into the system, to fit the recipients

as prepared cachectic victims to the falsely-called colonial fever, diphtheria, and small-pox. And yet, in the face of these things, whilst there is a great fuss made over comparatively innocuous out-door nuisances, these deadly dens of unventilation are utterly neglected by the Board of Health, which wields its sanitary broom with about as much effect as Dame Partington's attempt to arrest the ocean tide with her mop.

I have already stated that it is now an ascertained fact that, when people breathe impure air, the inspirations are quicker than under ordinary circumstances. Tredgold gives twenty respirations per minute, and the number of cubic inches of air inspired at forty, so that the number of cubic inches directly vitiated per minute amounts to eight hundred. He next takes into consideration the vapour mixed with the respired air, and the insensible perspiration always going on from the skin, and assumes that three cubic feet of air are requisite to remove these items of impurity. Lastly, he supposes a room to contain individuals in the evening, when candles, lamps, or gaslights are burning, and, in lieu of the air vitiated by this combustion, he assumes that an extra one-fourth of a cubic foot of fresh air per minute for every individual will be necessary to purify the atmosphere of the room on this ground alone. This will require that the necessary supply of fresh air should be four cubic feet per minute for every person in the room.

But there are yet other causes in action which will dispute the claim for a share of the allowance of fresh air. Independently of the vast quantity required for the combustion of the fire, the prolonged heat of a room would tend to rouse up the sluggish carbonic acid gas lurking beneath the floor, just under our feet, with (in many cases) chinks in the floor, through which would pour a more deadly stream than freshly-vitiated air. Now, under these circumstances, if each person requires four cubic feet of fresh air per minute,

it is equally a condition that each individual must respire a like vitiated quantity; and this being respired, mixed with vapour and nitrogen (both of less specific gravity than atmospheric air), aided by the higher temperature of expired air, as compared with the air of the room—for, although carbonic acid gas is heavier than the air of the atmosphere, yet, with the lighter vapour and gases with which it is expired, assisted by the heated air in the rooms, the whole of this vitiated air mounts to the ceiling, and would escape if ceilings were ventilated as they should be, but are not. It consequently becomes cool, after a while, and falls to the floor, to be again taken into the lungs.

It is of breathing this dreadfully vitiated air that the judges of our law courts most justly complain; and although a great show may be made in ventilating the ceilings of law courts, etc., there may be no provision made for the escape of vitiated air through the roof, or for the admission of fresh air at the floor line from without. So dreadful is this oppressive atmosphere, that, although possessed of very healthy lungs, I have, under similar circumstances, been necessitated to beat a hasty retreat myself; but the judge, like Prometheus, is bound to his elevated seat, where he breathes the foulest portion of the air, and his days are shortened for the good of the State, through the architect's crass ignorance, and the still more culpable neglect of the Health Officer.

A late writer in the *Westminster Review* says, "Courts of law were originally held in old town-halls, the halls of baronial castles, and even in gaols. The ventilation was invariably defective, and at times produced lamentable consequences. Once at Oxford, owing to want of ventilation, or the escape of some noxious gases into the court, the judge, counsel, jury, witnesses, and spectators, almost to a man, fell victims to a short, terrible, and then unknown disease, though it was probably cholera. The event has since been known as the Black Assize. A small imitation of this catastrophe was

attempted some time since by the ventilators of Westminster Hall. For reasons only known to themselves, they pumped the air from a main sewer into the Bail Court. The effect was magical ; not the oldest lawyers present had ever smelt such a stench before, used as they were to bad smells ; the court was cleared in an instant—judges, officers, lawyers, witnesses, and jurymen fled for their lives in the wild confusion of a rout. So far the experiment was quite successful ; but the perpetrators refused to reveal its scientific purpose.”

A writer in the *British Quarterly Review* very truly says that it is impossible to introduce any object into an apartment, provided it is warmer or colder than the surrounding medium, without setting up currents in the air, however stagnant it might be at the moment. A snowball or a red-hot shot straightway originates a number of little breezes, and becomes the focus of general disturbance. Miniature winds begin to flow in various directions ; and, although incapable of making any impression upon the senses themselves, their presence may be faintly recognised by the mode in which they convey the smoke of some burning body, or the fragrance of some artificial perfume.

When a man enters a room, the warmth of his breath and person will produce its effect by moving the cobwebs on the ceiling at a distance of about thirty feet in a single minute of time. If a fop comes in with an intensely scented handkerchief in his hand and a cigar in his mouth, the smell of the one and the smoke of the other will be certain to reach your olfactories, wafted by currents he has himself instituted, however much you may object to both. Every individual may, therefore, be called a self-acting ventilator. Without effort, or even consciousness on his part (for we do many clever things in happy ignorance of our prowess), he divests himself of the steaming envelope of air which would infallibly stifle him were it allowed to grow stagnant, and supplies himself with pure draughts of the vital fluid. Of

course, if the stock of respiratory materials is limited, or already polluted, the best ventilating engine can only discharge its functions ineffectually. However well the machinery may work, it will be of little avail if the lungs have to grind the same air over and over again.

As a fitting contrast to the deadly effects of overcrowding without ample ventilation, I may here point to the impunity with which the sewer hunters of London pursue their calling, whilst passing much of their time in the midst of the noisome vapours generated by the sewers, the odour of which, escaping upwards, from the gratings in the streets, is dreaded and shunned by all as something pestilential. It might naturally be supposed that these men would exhibit in their pallid faces the unmistakable evidence of their unhealthy employment. But this is far from the fact. Strange to say, the sewer-hunters are strong, robust, and healthy men, generally florid in their complexion, while many of them know illness only by name. Some of the older men, who head the gangs when exploring the sewers, are between sixty and eighty years of age, and have followed the employment during their whole lives. The men appear to have a fixed belief that the odour of the sewers contributes in a variety of ways to their general health; although they admit that accidents occasionally occur from the air being in some places fully impregnated with mephitic gas.

Contrast the condition of these men, in such an atmosphere, with that of miners in Cornwall, where, from the air not being artificially renewed, as in the mines of the north of England, Dr. Farr shows the mortality to be immense. The effect of one of these ill-ventilated "close ends," is to cause perspiration to break out freely while one is standing still, although the thermometer marks only 64 degrees, or less. There is a feeling of tightness about the neck; the chest heaves with a gasp instead of rising steadily; the shoulders take a share in working the bellows; and generally

there is distress and a feeling like nightmare. Men at work in bad places pant, and seem to breathe painfully ; their faces are red or purple ; their veins swelled ; their brows wet and begrimed with soot. They seem to labour hard, though their work is not harder than quarrying stones elsewhere. In such places candles flicker, and sometimes go out altogether ; no puffing or drawing will light a pipe, or keep it lighted. There is no laughter, no fun ; no busy, cheery clatter of active labour at these "close ends ;" there is silent toil ; for carbonic acid is not laughing gas.

Dwellers in houses should never forget that a large room with only one person in it, requires to be ventilated as well as the smallest ; it is only a question of time for a single individual to exhaust it of its vital air. Yet, notwithstanding this obvious result, medical men continue to call out for more cubic space in each successive hospital which is built, in lieu of calling science to aid in promoting ventilation, which shall be thoroughly effective without showering currents of cold air on to patients. And I must take leave to remark here, that in the course of a long experience I have observed that medical men, as health officers, never appear to trouble their heads about an enforced system of ventilation, as well in the humblest cottage as in the largest buildings of public resort.

Nevertheless, the health officer and committee farce is played out upon smoky chimneys and out-door puddles. But as to smoke, do they know what the celebrated analytical chemist, Piesse, says in its favour.

"Justice demands," he says, "that the good qualities of smoke should be shown. In an artistic point of view, smoke is undoubtedly a great evil, because it blackens our buildings, and casts shadows upon them when there should be light ; nevertheless, smoke is not an unmitigated evil ; in a sanitary or chemical point of view, it is very beneficial, for it purifies the air when contaminated with the poisons

of malaria. Smoke, in truth, is nothing more than minute flakes of carbon, or charcoal. Carbon in this state is like so many atoms of sponge, ready to absorb any of the life-destroying gases with which it may come in contact. In all the busy haunts of men, or where men congregate together, the surrounding air is, to a certain extent, rendered pernicious by their excretions, from which invisible gaseous matter arises, such as phosphoretted and sulphuretted hydrogen, cyanogen, and ammoniacal compounds, well-known by their intolerable odour. Now, the blacks of smoke—that is, the carbon—absorb and retain these matters to a wonderful extent. Every hundredweight of smoke probably absorbs twenty hundredweight of the poisonous gases emanating from the sewers, and from the various works where animal substances are under manipulation. Smoke is the very safeguard of the health of the population; it is unquestionably the mechanical purifier of a chemically deteriorated atmosphere; when, however, all our underground sanitary reforms are carried out, gas leakage prevented, houses well-drained and ventilated, then—but not till then—we may attempt to settle the problem—how to have a coal fire without smoke.”

Professor Roscoe, of Owen’s College, Manchester, instituted a series of carefully conducted experiments, the details of which have been frequently published, from which it was shown that the maximum quantity of carbonic acid gas contained in Manchester air, even in a dense fog and when there is no wind, does not exceed six volumes per ten thousand volumes of air; whilst the mean quantity closely agrees with that of the average composition of the atmosphere as regards carbonic acid. Hence we may conclude that the combustion of coal and the respiration of animals exert no appreciable influence on the quantity of carbonic acid contained in the town air of Manchester, collected in an open situation; gaseous diffusion and the great motions of

the atmosphere serving completely to disperse the millions of tons of this gas which every year are evolved by the above-mentioned causes in that neighbourhood.

Now, after this statement concerning a city regarded as the most dirty (in some parts only) of any in the world, if we except Edinburgh, from whence, by-the-by, nearly all the health-officers come, are we to be told that the same absorbing power of the atmosphere is absent in the dry air of Australia ?

It is very far from my intention to speak slightly of the sanative value of good drainage and clean streets ; but it really appears that the concentrated energies of our present Health Officers are directed against wandering goats, city stinks, smoky chimneys, and unswept channels—all of them bad enough in their way—but wholly innocuous when compared with the monster evil of non-ventilation. This, however, is scarcely to be wondered at, for the word ventilation occurs only once, and that incidentally, in the Health Act of the Colony ! It is not the size of the room, but the provision made for the ingress of fresh air and the exit of the foul, upon which health and life depend. Dr. Bence Jones, years ago, told the world, that if a single man constantly inhabits the largest room, without proper ventilation, he may be poisoned in it just as certainly, although not so quickly, as in the smallest room. In either case, to live healthily, he would require the same amount of ventilating space, to remove the expired air and admit the oxygen from the outer atmosphere.

The diving helmet may be designated the smallest room that a man can healthily respire in ; and yet, with an air-pump and an exhaust-pipe, the few cubic inches of space are completely ventilated. On the other hand, the wealthy, but ignorant invalid, is being gradually poisoned in a vast apartment, where the most accurate joiners' work, aided by paste and paper, has made it as impervious to fresh air as the grave to which he is hastening.

Where so vast an interest as the preservation of the public health is concerned, a Ventilation Act should forthwith be passed by our Legislature, making it imperative for all house-owners to cause every room in their houses to be properly ventilated, in a manner to be approved by a competent officer appointed for that purpose. This power would be necessary in regard to ventilating existing houses; but in the case of those hereafter erected, the matter would be simple and easy, and the extra cost (except where mere decoration was an item) need not exceed ten shillings for an average-sized house. The same Act should apply to all public buildings, such as Churches, Law Courts, Assembly Rooms, and the like.

I have now, with as little prolixity as the subject would permit, laid before this Society my views upon the two branches of Hygienic Science comprised in the heading of this paper, namely, "The Philosophy of Stinks which do not affect Public Health, whilst the Neglect of House Ventilation fills our Grave-yards;" and I feel that I might here properly conclude my observations; but, in order to lead to some beneficial result, it seems to be incumbent on me to adduce two recent corroborative testimonies, one from England and the other from India, both converging to the same end, and marking in a wonderful manner the soundness of the basis whereon my remarks have been founded. These authorities are Professor Tyndall, who recently lectured at the Royal Institution, London, on the subject of "Dust and Disease," and Dr. Bryden, a man of great research, and a high authority on medical science, whose long Indian experience has lately enabled him to map out the aerial highway of the Asiatic cholera, commencing at its very breeding grounds.

Professor Tyndall has demonstrated, by a series of very

beautiful experiments, that throughout Nature there is an organic dust which fills the atmosphere, not alone in the rooms and streets of crowded cities, but even in the comparatively pure open air of the country, and it needs, he says, only a sufficiently powerful beam of light to make the air appear as a semi-solid rather than a gas. "Nobody," says the Professor, "could in the first instance, without repugnance, place the mouth at the illuminated focus of the electric beam, and inhale the dirt revealed there. Yet we are inhaling it every moment, and the wonder is that so small a portion of it should be injurious to health." What is the portion of this ever-present and all pervading dust which is injurious to life? Now, it was long believed that epidemic diseases were propagated by malaria, which consisted of organic matter in a state of motor-decay; that when such matter was taken into the body through the lungs or the skin it had the power of spreading in it a similar decay—yeast was a case in point. Why should not a bit of malarious matter operate in the body as a little leaven, leavening the whole lump? But in 1836, De la Tour discovered the yeast plant, which, when placed in a proper medium, grows and spreads and produces what we call fermentation. In the next year, Schwann, of Berlin, discovered the plant independently. He also proved that when a decoction of meat is effectually excluded from common air, and supplied solely with air which has been raised to a high temperature, it never putrefies. Putrefaction, therefore, he said, came from the air, and could be destroyed by a sufficiently high temperature. Pasteur finally exploded the notion that putrefaction was caused by oxygen, and proved that the true ferments are organised beings who find in what we call ferments their necessary food. Side by side with these discoveries grew up the germ theory of epidemic disease; that is, that epidemic diseases are due to germs which, floating in the atmosphere, enter the body and

produce disease by the development of parasitic life. As an acorn planted in the soil gives birth to an oak which produces a whole crop of acorns, each of which has power to reproduce its parent tree, and thus from a single seed a whole forest may spring, so a germ of disease planted in a human body grows and shakes abroad new germs, which, meeting in other human bodies with their proper food and temperature, finally take possession of whole populations. Thus Asiatic cholera, beginning in a small way in the Delta of the Ganges, spread itself in seventeen years over nearly the whole habitated world.

Whilst Professor Tyndall was engaged in these investigations, Dr. Bryden, in a remote part of the globe, was occupied in demonstrating by facts, statistical evidence, and by argument, that the cholera of every year has a self-defined geography, which is definite, and which can be mapped. He states that every epidemic is a repetition of epidemics which have preceded it, and that the parallels between different epidemics are as fixed and stable as are the phenomena of the meteorology of an invaded area. The disease does not in its progress necessarily move along lines of the usual human communications. The track taken is an "aerial highway," yearly leading the cholera to the same terminus in each epidemic, with but very little variation as regards time and date. Dr. Bryden's idea of cholera then is briefly this. That there is a specific *spore* or germ originating in certain localities, and which, though "earth-born," is "air-conveyed," in the direction of the prevailing monsoon winds. Thus the accepted popular theory holds good so far that the germ has no locomotive power in itself. Its movement is dependent on the existence of some vehicle, and this vehicle, the Doctor maintains, is in all cases a humid atmosphere. "The region of endemic cholera—the birth-place of the spore,—is a region of perennial moisture, of moisture which is both air conveyed and universally and

permanently lodged on the surface of the earth, or immediately beneath it. Here it is that, in the dry months, cholera is extricated as soon as the breeding-grounds appear above water, and it is here that it appears epidemic, when, in the spring and summer, the permanent moisture causes vegetation to sprout into luxuriant life. In early spring, the south-eastern breezes carry cholera on the brim of the endemic basin; their steady continuance gives promise of an early season, and, but too frequently, of a cholera season also. These are the moist winds of the eastern division of the epidemic area, which are met and opposed by the dry or hot and healthy winds, of the west and north."

In September, 1868, the Municipal Commissioner and Health Officer warned people in Bombay to prepare for epidemic cholera advancing down country. But such movement of the disease, even along the most frequented route, was, according to Dr. Bryden's theory, all but impossible. The "aerial highway," by which Death "walks on the wings of the wind," was at that season effectually interrupted, and all communication from that direction was cut off by the sea breeze beating back the foul spirit to his inland and eastern habitats.

Whilst Dr. Bryden, in his painstaking and philosophical treatise, does not promise immunity from the malady as the result of the best system of sanitation, he admits that foul air, whether arising from a densely-domiciled population, or from foul sewers and cesspools, may afford a congenial vehicle for the cholera germ, and so tend to localise and intensify the affection where it might not otherwise have tarried. Disinfectants, so much lauded during recent years, and the principle of disinfecting or "devitalising" the discharges from the cholera-stricken, he dismisses as of little value in a national sense, because of the very limited applicability of such precautions during a wide-spread cholera epidemic. "Such epidemics," the doctor says, "are not

under human control. I fear," he adds, "we must come to the conclusion that at present we are in the midst of an epoch, in which not only are the different epidemics of extremely rapid recurrence, but in which each succeeding epidemic surpasses the other in the virulence of its effect on the human constitution." Despite this desponding avowal, Dr. Bryden confesses that fear and depression are very active agencies in the development of cholera, and we all know that a folding of the hands during epidemic seasons is certain to be followed by loss of confidence, and the spread of that panic fear which kills even more than the disease.

From this authoritative opinion, we might infer that neither deodorising nor even disinfecting—or, as Dr. Bryden phrases it, "devitalising"—the sewage of our towns could avert the inroad of the dread epidemic; but then, we must remember the admission, which is consonant to our own experience, that "foul air affords a congenial vehicle for the fatal germ;" that the poisonous exhalations of animals yield the vital air of plants; and that the refuse of man and beasts reproduces the fertility that yields their food. We know that to deodorise is not to disinfect; and that to disinfect by neutralisation is to destroy the fertilising power of the sewage. That which is a hotbed of pestilence in crowded towns becomes a vivifying garden when translated to the country; but the difficulties in the way of the application of sewage to agriculture arise from three sources: 1. From the large admixture of sewage with water; 2. From certain ideas of its prejudicial influence on health; and, 3. Owing to the nuisance occasioned by its removal.

All plans for the utilisation of this important material have been more or less interfered with, in consequence of the assumption that there was something pestiferous or unhealthy in the fermentation, exposure, and smell of sewage. That celebrated civil engineer, Mr. Rawlinson, when examined before a committee of the House of Commons,

said, that the health of the people was the first consideration; but he laid down the following propositions:—

1. That atmospheric air, strongly impregnated with odours of various kinds, was not necessarily injurious to health. 2. That atmospheric air, without smell, was often most deadly. From these two propositions he inferred: 3. That there was no necessary connection between smell and deleterious gases. Smells by themselves he considered to be non-injurious. They were not even a nuisance to those who lived among them. The sense of odour was very easily paralysed. 4. That deleterious gases arising from excreta were injurious when inhaled from pent-up drains. 5. That emanations from drains and sewage entering running streams were in no way dangerous. 6. That costly drainage works would not necessarily diminish the amount of disease. The general conclusion at which he arrived was this: that so far from sewage being poisonous or injurious to man, it was a source of growth to the vegetable, and through that to the animal world.

We have the testimony of Dr. Livingstone, that stinks were not the cause of fever in Africa; although he and his companions remained a whole night in water literally as black as ink, and having a most abominable smell, turning the white paint of the vessel quite black, no fever followed, and the natives had no disease in consequence. From all his other experience, Dr. Livingstone came to the conclusion that it was very desirable to get rid of bad smells as soon as possible, but he thought it would be a great mistake if medical men or others supposed from the presence of a bad smell that there must be fever.

In conclusion, I have only to offer a few practical observations upon the sewage and drainage of Melbourne.

With a full appreciation of the extreme gravity of this question, I fearlessly assert that those whose duty it is to initiate a sewer system for Melbourne, and who delay it on the

plea that it is necessary to make a complete survey of the city and suburbs, with a view to the construction of one concentrated sewer system, are acting injudiciously, and without a true knowledge of the insurmountable difficulties in disposing of the gross sewage of the city in one or more focal outlets. The thing is utterly out of the question, for the putrid solids would poison the waters of our river, and if let into the sea, they would infest the promenade shore of the Bay, now so clean and healthy.

All methods for disposing of the excretal sewage which may depend on domestic aid in carrying out, will fail, as the plan, wherever it has been tried, has failed. The cart and tub system will prove offensive, expensive, intrusive; and, to outlying houses, the service on the part of the contractor will be evaded, as is the dust contract in some of our suburbs at the present time.

Men who have travelled extensively agree that they have seldom seen a town so free from foul smells, or so admirably situated as Melbourne with regard to its facilities for drainage; wherever we may direct our steps we find high and low levels exactly suited for independent excretal drainage, carried from the high to the low levels, and thence into cemented blue stone collecting tanks, whence the sewage would be removed by the pneumatic cart system, and given back to the land. It needs no demonstration to show that, as we draw from the soil its fertilising strength, it must become weak and used up, unless the decomposed matter be again returned to it.

