PRACTICAL SERIES

TREATISE

ON

GAS AND VENTILATION

A

PRACTICAL TREATISE

ON

Gas and Ventilation,

WITH SPECIAL RELATION TO

ILLUMINATING, HEATING, AND COOKING BY GAS.

INCLUDING

SCIENTIFIC HELPS TO ENGINEER-STUDENTS AND OTHERS.

WITH ILLUSTRATED DIAGRAMS.

BY E. E. PERKINS.

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ADVERTISEMENT.

This "Treatise" on Gas and Ventilation is addressed to all interested in the use of gas as a domestic and commercial article for illumination, heating, cooking, and other purposes.

The points dwelt upon have been divided; so that the consumers, while having the benefit of our experience and recommendation, may be made familiar with *causes* not generally understood, and *remedies* within their own resources; to the former of which they have been improperly and unnecessarily subjected—of the latter kept ignorant, either by the fitter or gas companies, or both. It is necessary to say, although all which is hereinafter to be said must be new, or nearly so, to the generality of consumers, much of it must, and all ought to be familiar to the fitter by his everyday practice, and philosophically known by every gas engineer.

INTRODUCTION.

Few persons, when occupied by gas-light, ever stop to think how modern this convenience is—unknown to our grandfathers, not dreamt of a hundred years ago! *Washington* read by the light of candles instead of *gas*. *Franklin* died half a century before the invention of "*Hoe's Last Fast*." *Jefferson* travelled on horseback instead of by railroad and steamboat, carrying a phosphorus bottle with matches and his own small wax candles as precautions.

Gas, now so common, was not even evolvent from coal until 1739. Half a century elapsed before it was used for purposes of illumination; and to Mr. *Murdock*, of Redruth, Cornwall, England, about 1789, belongs the credit of this. At first he amused himself and astonished his neighbours, by riding about in a little steam-carriage, which at night was lighted by means of bladders filled with coal gas. In 1805 it became general in the *Manchester* factories, England; in 1807 the invention was announced in London, England; and by it London may be said to be brought, for at least half the twenty-four hours, out of darkness into light. The feeble glimmer of oil lamps, the glare of torches, the shouting of link-boys, and the lanterns always at hand, with the great-coats and umbrellas—the latter themselves then a novelty—were in full muster fifty years ago; but have now given way to a nightly illumination so splendid, and so happily adapted to great cities, that it may be said of them, "*Solemque suum sua sidera norunt.*" The invention itself was incredible till it could no longer be doubted; and it could hardly be said that even seeing was believing, for people would not understand, for several years, that it was possible on a large and economical scale; and now it lights up villages in *New Zealand*, where fifty years ago no white man had built a residence; and in California of a more subsequent date. Had *Swift* but heard of such a scheme and proposed results, he would have put it among the dreams of *Laputa*. Napoleon laughed and said, "*C'est une grande folie*," and Sir Walter Scott gravely said, "he feared *London* would be on fire by it from *Hackney Gate* to *Tyburn*." *

To the most reflecting it offered subject-

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* East and west extremities, then, of London, each beyond the city proper.

matter of high consideration; proposing, as its advocates did, to carry light, like water, underground for miles, and supply it to every house and room in the metropolis.

Lord Brougham Vaux, then Harry Brougham, on first seeing gas, said, "*The idea was worthy of the philosopher who proposed to extract sunbeams from cucumbers.*"

When the discovery had been appreciated and adopted, and when the *smell*, the *headaches*, the *drowsinesses*, the *closeness of the air*, the *injury to the eyes and lungs*, that appeared to attend the use of gas, had seemed for a time to qualify its value, a fresh triumph came to its rescue, in the discovery of means by which it could be purified of its injurious properties. Assurances were given that it could be made harmless to the eyes and to the lungs; and certainly there was a great improvement, and a great difference between the better and the bad gas; and there are *now* abundantly multiplied simple means to render the gas of the present day not only *completely* innoxious, but an active co-operative agent to incipient ventilation. To follow this object further here would be contrary to our proposition: it belongs properly to the body of the work; consequently, we will resume it as indicated.

GAS AND VENTILATION.

Advantages of Gas in Private Houses.

THE superiority of coal gas, as compared with every other material, for producing light and heat, has been too long acknowledged to require arguments or illustrations. The only point respecting gas which seems still to be imperfectly understood is its general applicability to domestic purposes; and which is the effect of defective information, rather than of prejudice. There are thousands of families who would readily avail themselves of the various comforts and conveniences of gas, provided its relative cost and other matters were properly explained to them. On whom does this duty devolve?

On those who manufacture, or those who live by the profit of gas furniture? Neither the one nor the other: it devolves on the engineer, who is not an employee of any particular person or company. Taking the office, therefore, upon ourselves, as in that capacity, we will proceed to say: The use of gas in dwelling-houses has already made considerable progress, and is daily increasing. The practical benefits of the science of gas-lighting are not yet developed, as they may be, by what are already known; and although much has been done, much remains to be put into daily use. The prospect is encouraging, and success is attainable by well-directed efforts.

The superiority of gas consists not merely in the relative cheapness of the light obtained from it, as compared with that from *tallow*, *wax*, oil, camphene, &c.: there are other circumstances connected with its use which are of a far greater importance—namely, its convenience, cleanliness, brilliancy, manageability, and safety. Requiring no preparation by the consumer, it is lighted in a moment, can be increased or diminished at pleasure, and retires with the rapidity of thought. It saves labour and time, as compared with oil and other lamps, and where candles are used. The *odour* so peculiar to coal gas has often been urged as an objection to its use; a stronger ground of objection would exist if it was free from odour: its presence in an unburnt state is thereby infallibly detected, and thus fair warning is given that something requires remedying.

WHEN GAS IS DETECTED ESCAPING, OPEN EVERY WINDOW, EVERY DOOR OF THE APARTMENT, WITHOUT A LIGHT OF ANY KIND. *Search for it immediately: the cause will very readily be detected; if it should prove to be a split in the pipes, or any joint broken, &c., send for the fitter, and do not attempt to light the gas in any part of the house till the repairs are made.*

A very common objection to the use of

gas in private houses is, that the *heat* generated by its combustion is insupportable, and that ceilings, and picture-frames, and furniture generally, are liable to be injured, discoloured, &c. Now, the products resulting from the combustion of gas are precisely similar to those from tallow, wax, oil, camphene, &c. If *the gas be well purified*, there will be less risk of discoloration of walls and ceilings, or of injury to the most costly articles of furniture, picture-frames, &c., than from the use of either candles, tallow, wax, or sperm, or from lamps of oil or camphene, giving out an equal volume of light.

When gas is first introduced into a house, the duty of the fitter is to distribute the pipage judiciously, so as to have it declining to the meter; to see that every joint, connecting piece, bend, elbow, T-piece, be properly screwed and connected; that the syphon or syphons (if any) are placed in proper depressed situations; that the tops and burners be severally well screwed home;

bells, reflectors, and ceiling hooks, shields on; that the meter is properly placed and fixed square—properly charged with water; the index correctly registered for starting, and then the whole honestly tested by the pump. *It is just as necessary* to take into consideration the dimensions of the rooms, their relative situations, as respects the access of daylight and the uses to which they are applied, as it is, in the erection of a house, to determine upon the number, dimensions, and situations of the doors, windows, and fireplaces; for it is too frequently the practice to sacrifice utility and comfort to appearances, placing a certain number of gas-burners against walls or suspending them from the ceiling of a room, without estimating beforehand the quantity of light they will produce, or adopting any plan for getting rid of the heat. When gas is consumed under the most favourable conditions, the heat generated is very nearly in equal proportions with the light obtained;

hence the importance of using burners of the best construction.

As a general rule, it is desirable, in drawing and dining-rooms, to suspend the burners from the ceiling; by which arrangement the light is more equally diffused, and by being above the eye, its position is more natural, and, for all practical purposes, more useful and agreeable.

When a small room, in which two, or at the most four, candles were previously used, is fitted up with gas, and if we suppose that one argand burner be fixed, the light from which is equal to that from ten or twelve candles, is it surprising that the room should be considered inconveniently warm? So also, when gas takes the place of oil lamps, or camphene and spirit lamps, it commonly happens, that an equal, and not unfrequently a greater, number of burners is introduced, without considering that the quantity of light, and consequently of heat, from each burner, will be very nearly in the proportion of two to one. The additional quantity of heat diffused and the more rapid deterioration of the air in one case as compared with the other, are due, therefore, to the quantity of light obtained from gas being greater than from the candles and lamps previously used. If the quantities of light were equal, the other effects would in both cases be similar.

These are conditions which should always be taken into account when gas is first introduced, and show how important it is, by suitable arrangements, to provide for effective ventilation.

It is just as easy to ventilate as it is to talk about it; the object to be obtained is the withdrawal of the heated and vitiated portions of the atmosphere of a room, and the simultaneous introduction of an equal volume of fresh and pure air. This should be accomplished by a process certain at all times in its operation, but sufficiently under control as to be adapted to changes of temperature of weather and of seasons. Moreover, an essential condition to ventilation is a gentle and equable movement in the air, sufficient to produce entire and complete displacement, but not sufficient to create any perceptible current.

A constant, and not an intermittent, supply of air must be obtained, for the perfection of gas-lighting consists in having a good light just where and when it is most needed; and a constant supply of fresh air —without its producing the sensation of a draught—is peremptorily demanded. These conditions are partially attained by the use of a perforated plate inserted in the ceiling, which being connected with a hood and pipe, carry the heated air out of the apartment in which the light is burning, and convey it into a chimney or any covert duct; thereby also promoting the salubrity of the atmosphere within the room, by causing the withdrawal of large portions of the air which would have become vitiated by respiration, and impure from other sources of contamination.

We do not desire to be considered sentimental; we believe we are by far too practical for all that "*would-be refinement;*" but we will admit we are continually grieved at seeing the shocking neglect of all rational attempts to ventilate, even in the latest and best-erected houses and public buildings—palaces, built and being built here, there, and scattered with a lavish liberality over large tracts of the cities of this empire country. Gorgeously finished, furnished, and appointed with all that wealth can command and good taste suggest; inhabited by high, intellectual, philanthropic, and tried men, wealthy, surrounded by their families,—yet each and all, even the delicate, high-souled fair ones, mothers and daughters, liable to, and positively, though unwittingly, contributing by their presence to a deleterious in-doors atmosphere; all, all this, and its concomitant evils, its baneful influences, exist for the want of a mechanical arrangement for a proper ventilation—a matter at once simple, not expensive, a real luxury in winter, and particularly grateful in summer—at all times positively and absolutely necessary for the intellectual and physical development of the young; in the highest degree demandable by the middle-aged and the more advanced members of the human family, for other but equally intrinsic results. In return, however, there is another objection to the use of gas, which is so frequently made, that it must not be forgotten. We refer to the commonly-expressed opinion that gas-light is injurious to the eyes. This is fallacious; no eye was ever injured by the use of gas more than from any other kind of light; besides, the means are so exceedingly easy, by which the exact quantity of light by gas required in any particular occupation may be had, that there is no need for an excess which would be even unpleasant. On the contrary, it has been found that a deficency of light in performing the most ordinary matter in life, as reading, writing, sewing, &c., has produced more injury than will be willingly acknowledged. Let it be remembered too, that the situation of a light is of as much importance as its intensity: it should, moreover, always be above the eye; the light from candles and lamps for tables is commonly too near the line of vision to be either comfortable or harmless.

It may not amount to an error if, on the first fitting up a house with gas, that all the pipage should be of a larger *calibre* than at first appears necessary, for thereby a more uniform supply of gas is insured; and should it be ultimately desirable to increase the number of the lights, the additions can be made by the mere extension of the pipes at a very trifling cost, without the necessity for removing those already in use.

The most direct course to each burner should be always aimed at.

The use of wrought-iron pipe should be used in every case possibly consistent.

Stop-cocks should be placed for safety and convenience where the fittings will allow, and out of sight, so as to regulate or turn off the gas when required, on either floor in the house.

Fitters should bear in mind *that all right-angles are condensers;* consequently, in laying pipage and supplies to burners, curves or bends should be introduced in every available locality instead of elbows or T's; it will cost a trifle more, but it will economize gas to ten-fold its extra amount.

When gas-fittings are put up by intelligent and experienced workmen, judiciously arranged, and constructed of good materials, they constitute the most durable fixtures of a house; if on the contrary, there is not a more dangerous, expensive, and disagreeable adjunct.

The forms of gas-furniture are so various, that their selection is wholly a matter of taste; but never definitely order from any pattern-card or book; see a working specimen of the form, size, or sizes you require, also of the *material* and *finish* of *same* you *propose, because* the colour of the walls, ceilings, and style of furniture of a room is a very important condition to be thought of, for lighting effectively and economically: a combination of those colours which reflect light are the most pleasing, since they preserve, under a variety of modification, the natural tints of the countenance viewed through artificial illumination.

Attention may be properly directed to movable lights for library tables, experimental and professional slabs, and a variety of domestic requirements: for such no provision suggests itself better than the flexible tubing, with spiral wire encased, or the ordinary India-rubber tubing, attached to service-pipe or branch, conveying the gas to the pedestal and burner.

For many purposes the most useful form

of burner is the argand; and of the various sizes the most economical is that of fifteen holes. With this burner the gas is consumed under as favourable conditions as it is generally susceptible by metallic burners of brass, &c.; and hence the light obtained from a given quantity of gas is greater than by many other of great pretensions. The principle of the argand consists in admitting a current of air simultaneously to the interior and exterior surfaces of a (hollow) cylindrical column of gas; and the most beneficial effects are obtained when the quantity of air so supplied is sufficiently equalized and controlled, that it cause perfect, but not vivid, combustion. Many of the burners brought into notice are very inferior to this common argand in respect to economy. Many more are under probation, but we have not had as yet sufficient evidence to render a reliable opinion upon them. Others, constructed with the intention of producing vivid combustion, by deflecting a current of air upon the gas-flame, are well adapted for situations where a brilliant, commanding light is required in a limited space, and where a constant supply of air is available. Such burners ought not to be used in private or other closed apartments, unless there be free and unlimited ventilation obtainable. The more tranquil and perfect the combustion, (for private rooms, &c.,) other conditions being equal, the greater will be the quantity of light from a given quantity of gas. The more intense the combustion, the greater will be the quantity of gas consumed and of heat generated, to produce a proportionate volume of light, and the greatest liability to do damage to furniture, &c. by the probable escape of unconsumed carbon. If, however, persons complain of heat, and make no effort to get rid of it, we only remind them that the gas is not to be blamed, but the burner first, and themselves next.

Burners, therefore, which are well adapted for illuminating stores and public buildings, are not equally applicable to private houses and apartments. Store-doors are nearly always open while the lights are burning; therefore there is less difficulty about ventilation. A larger quantity of light is required in stores, because it frequently occurs that there is more competition in lighting premises than displaying goods. The most *economical* style of burners are now but little thought of by storekeepers; a *brilliant light*, with the *most pleasing* effects, being considered of greater importance; and any trifling reduction in the price of gas, would tend to increase this mania, and *increase the revenue of gas corporations*, if they would but see in the right direction.

For cleanliness and economy, the *fishtail* is the most useful and effective burner which can be used in dwelling-houses. It is made of various powers of delivery; can be adapted to any style of fittings, and, when enclosed in glasses, has a pleasing, satisfactory effect.

In almost every house there are particular situations where a light will be a great convenience, but where the least possible quantity will be sufficient for all useful purposes; in such cases a single-jet burner will be most appropriate, which, with careful management, will yield light equal to that of a mould candle, spirit one-light lamp, or graduated to half that volume, costing about seventy-five cents a year.

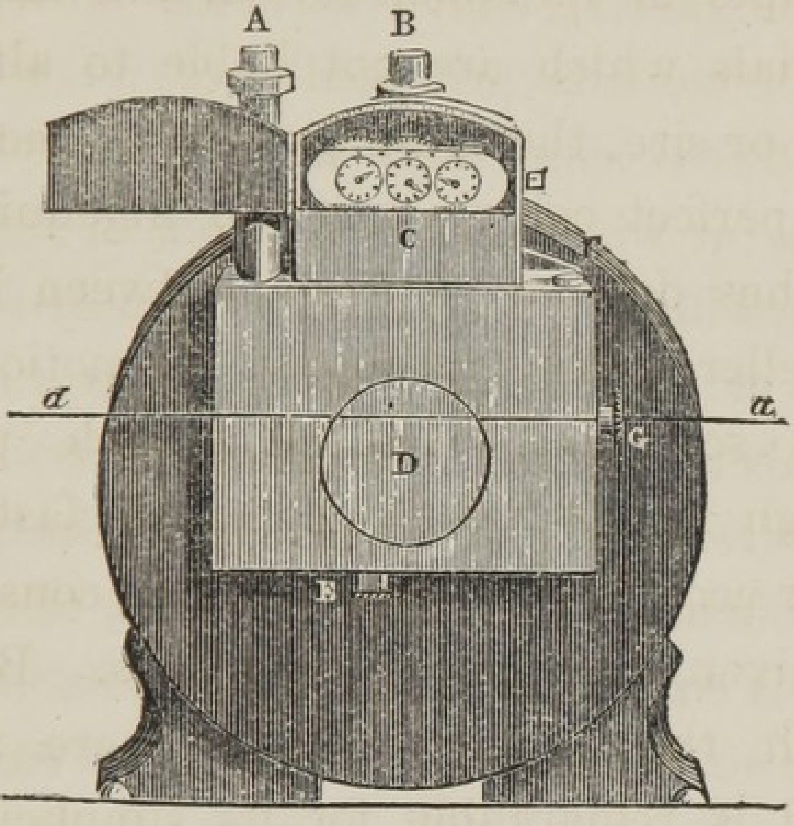
When gas is first introduced, it rarely happens that persons are satisfied with the same quantity of light as they had previously possessed; so long, however, as this extra supply is kept within moderate limits, it will cause no material difference in the result at the end of the year. While we impress upon our readers the importance of distributing light as much as possible through the various parts of a house, we beg them to observe the same rule which prevails in every well-regulated family with regard to lamps and candles—viz. that it be used only in such quantities, and at such times, as is really necessary; in which cases it will be found less expensive than either lamps or candles.

Experience has shown that a small light in a house, provided it be so situated that its effects may be visible from the outside, is one of the most efficient means of protection against nocturnal depredations. If conveniently placed, such a light will be no less useful to the inmates of the house; in cases of sudden alarm or illness at night, is not a light the first thing required, and can it be too promptly obtained?

As regards the payment for Gas, and description of the Meter.

THE *only* equitable and by far the most economical method of using gas is by the meter, which is attached to the pipe leading from the street-main to the house, and through which the gas must pass before it is conveyed to the burners. By this apparatus the gas is measured, and a faithful record kept of the quantity consumed; it performs the duty of an accountant; and, to insure perfect accuracy, requires only a few minutes' attention once a month, on the average. To their instrumentality we are chiefly indebted for an equality of charges for gas, protecting both consumer and manufacturer, when made honestly, without any very active interference on the part of either.

Simple in its construction, and made of materials which are not liable to alter in shape or size, the gas-meter is at once the most perfect contrivance the ingenuity of man has devised as agent between buyer and seller. When adjusted, its motion depends solely on the gas which passes through it, and which motion is faster or slower according as the quantity consumed in a given time is greater or less. But although the meter which is here represented is remarkable for its simplicity, it is not so very easy, by description only, to convey an intelligible idea of its action.



A is the pipe by which the gas enters from the street-main. B, that by which it is conveyed to the fittings. C the index-box. D, the badge-plate, on which is inscribed the maker's name, and the date, number, and size of the meter. E, F, G are apertures stopped by screw-plugs; the first for allowing the escape of any condensed vapour which may collect in the inlet-pipe, the second for supplying water to the meter, and the third for ascertaining if it contains the exact quantity required.*

* This is the usual form of the meter. By some manufacturers the exterior case is made of cast-iron, and differs considerably from that shown above. Others have altered, and in some instances improved, both the exterior form and the interior arrangements; but, whatever be its configuration, its principle of action remains unaltered.

The meter, which is made entirely of metal, consists principally of an external cylindrical case, and an internal hollow drum (or wheel) supported on an axis, and divided into four equal, but obliquely-formed, cells or chambers; the openings to these chambers (*called inlets and outlets*) are at opposite sides, and so arranged that, while one chamber is filling with gas, that next to it is emptying; it being impossible that any two of them can be full or empty at the same time. The action of the meter depends on its being filled with water to the height indicated at *a a*. The use of the water is to close (*seal*) the aperture in the centre of the drum, through which the gas, by means of a bent pipe, enters; it also opens and shuts the inlets and outlets of the respective chambers, as they successively rise above and descend below its surface.

It has been mentioned that the chambers into which the drum (or wheel) of the meter is divided are composed of metal.

This is the case, however, with respect only to five of their sides; the sixth and last side of each chamber being formed by the surface of the water.

To this arrangement the machine is indebted for its justly-merited reputation as a correct measurer, for its noiseless and steady motion, for the small amount of friction consequent thereon, and for the facility with which its accuracy can at any time be tested, when properly constructed.

The source of motion in the meter is the impulse (pressure) communicated to the gas at the manufactory, and by which it is forced along the pipes with greater or less velocity as the pressure is there increased or diminished. When a meter is first set to work, those parts of the drum above the water are full of air; on opening the main-top and one or more of the burners, the gas immediately enters that chamber whose inlet is above, but whose outlet is below the surface of the water; and before any gas can pass to the burners, this chamber must be filled, and while that process is going on, the chamber next in advance will be discharging the air it contained through the fittings. By the time the first-mentioned chamber is full, and consequently has risen above the water, the latter will be empty, and have descended below it; and so on with the others in succession. Gas will now enter the fittings, and, as soon as it has displaced the air, may be lighted at the burners. Understand, the gas does not pass through the water, but only over its surface; and, by successively emptying and filling each of the four chambers before described, causes the wheel to rotate on its axis. While, therefore, gas cannot enter the house without passing through and imparting motion to the meter, so also there cannot be any motion except when gas is passing.

The axis on which the drum of the meter revolves projects beyond its front bearings, and, by means of an endless screw (snail-motion) working in a toothed wheel, turns a vertical shaft, the upper end of which enters the index-box; it there communicates the motion it receives from the drum to a simple train of wheels, (like clockwork,) and, by hands adapted to a series of dials, the gas, as it is measured, is registered: the index on the diagram of meter as shown (p. 35,) is capable of recording any quantity, from one hundred to one hundred thousand cubic feet; and at the upper right-hand corner of the dials is a cylindrical index, with a pointer in front, which marks smaller quantities, say from a foot to twenty feet.

Every meter, according to its gauged capacity, and which varies in proportion to the number of lights to be supplied—from two to five hundred lights—is so constructed that each entire revolution of the drum (of small meters) delivers some definite aliquot part of a cubic foot, or (of large ones) a definite number of feet. For example: suppose a meter, each of whose four chambers will contain one-sixteenth of a foot, to have made one entire revolution of the drum, then four-sixteenths, or one-fourth of a foot, will have passed through; and when the same drum has made four revolutions, one foot will have passed, and so on, as long it continues in operation. It will thus be understood how easily the exact amount of work done is, by the aid of clockwork, recorded.

It is a great mistake to place too many lights on a meter; in all instances where this has been done, sufficient gas could not be obtained for the burners.

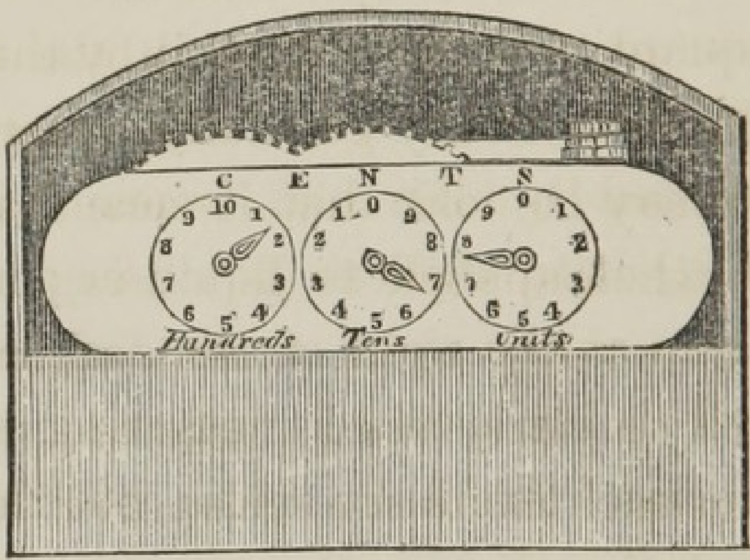
The best situation for a meter is in some well-to-be-got-at place, as near on a level with the main service-pipe as possible; the place to be dry, cool, (not draughty,) sheltered from extremes of temperature as much as possible, and where it may not be liable to be shaken by carriages passing, &c.

If it be fixed in a warm room, the water will evaporate too quickly, and cause more than occasional inconvenience. In order to prevent the liquid freezing in the meter during winter the water, wholly or in part, should be drawn off, and the same quantity of *alcohol* substituted.

Dry meters are of various forms, differing considerably both in appearance and in construction from that just described; they are made partly of metal and partly of leather or prepared bladder, &c., each of the latter being peculiarly prepared, to render them, if possible, permanently flexible, durable, and impermeable to gas. The machine consists of separate chambers—the number of which is immaterial, depending entirely on the choice of the maker: one or more of the sides of each chamber moves freely on a leather, &c. hinge or joint, somewhat resembling the connection of the two parts (wooden parts) of an ordinary bellows. By opening and shutting valves, communicating with the respective chambers, the latter are alternately filled and emptied; the gas which passes through them is measured, and, by means similar to that already described, the quantity is recorded on the index. The day is gone by for saying a thing cannot be done, and that it must fail; we have had too much experience not to fully acknowledge this; and we are free to confess, a dry meter, reliably turned out of hand, we should hail with pleasure, and give it all our support; but, hitherto, we have not seen one, which, for any ordinary length of time, rendered satisfactory results.

Many persons who have had a *gas-meter* for years on their premises have never taken the trouble to learn the way to read the index. This is wrong. This knowledge can be acquired in a very few minutes, and, when obtained, not readily forgotten. It is more conformable to our habits to have greater reliance, even in the most trivial matters, when we know them ourselves, than when obliged to trust to others.

The word *cents*, as shown in the following engraving, denotes that the least quantity recorded by the dial is one hundred cubic feet; two ciphers (00) being always understood at the right of the dial, marked *units*. This mode of computation is adopted to obviate the inconvenience of taking into account any less quantity of gas than that just mentioned. Each division on the *units* dial is equal to one hundred, and an entire revolution of the hand is equal to one thousand. On the *tens* dial each division is equal to one thousand, and an entire revolution of the hand to ten thousand. Each division of the *hundreds* dial is equal to ten thousand, and an entire revolution of the hand to one hundred thousand. When, therefore, the hand of the *units* dial has moved once round, that on the *tens* dial will have moved from 0 to 1, and that on the *hundreds'* dial one-tenth of the distance from ten to one.



We have lately compiled a dial facial card, practically illustrating the mode of marking off at sight and correctly registering the index; and as we have disposed of the copyright, it would be unjust if we were here to enter more fully upon this subject. The card is called "*Pear's Gas Register*," and we can candidly commend it to the public as calculated to aid the desire to economically burn gas, and tending to arrest abuse and any attempt at dishonesty or carelessness of the manufacturers' employees. It may fairly lay claim to the power of saving the consumer from 15 to 30 per cent. on his gross gas-burning.

The quantity of gas indicated by the term *cubic foot* is not very generally understood. Persons may be told that it means a *solid foot*, or, when applied to liquid or aeriform bodies, a quantity equal to the capacity of a perfectly square vessel measuring twelve inches on each of its six sides; but this latter description is equally vague and indistinct, as to actual quantity, as the former. Every person must not only be familiar with the term gallon, but be able to form a tolerably correct notion of the size of that vessel; a *cubic foot* of *gas* is equal to rather more than *six* gallons, (6·232.) Therefore, at whatever price gas is per 1000 *cubic feet*, it follows that for that sum the consumer has been supplied with rather more than 6·232 gallons. A fair average rate of consumption in a 15-*hole* argand-burner is 5 *cubic feet* per hour; the quantity of gas so consumed, therefore, in that time, is rather more than 31 gallons.

There are many purposes to which gas can be applied with the highest economical success, other than that of illumination. Its value as fuel is no new discovery. By means of a simply-constructed apparatus, gas performs the respective processes of *roasting*, *baking*, *frying*, *boiling*, *broiling*, *steaming*, &c., with a precision that cannot be attained by an ordinary open fire or stove. Two or three days' experience is sufficient to enable any one of ordinary capacity to conduct any of the above-named operations with success and certainty, while the trouble and attention required are considerably less than by the ordinary methods. *Roasting* by gas is the very perfection of the culinary art; the meat being cooked uniformly, and the juices, on which its nutritious qualities and delicacy of flavour so much depend, being retained until brought to table.

In England and France, gas-cooking stoves are made in every variety of shape and size; and it is with pleasure we are enabled to say, in New York, now, too. As boiling, &c. can be conducted simultaneously, as well as separately, an ordinary fire in many families will, in summer, be but seldom required. For preserving fruits and other delicate processes, in which a steady heat, easily controlled, is of importance, a gas heat is superior to every other yet discovered. Let it be particularly remembered that, in using gas as fuel, there is no waste of time or materials, no noise, no dirt, dust, or smoke. The full effect of the heat is obtained, and can be applied on the instant just where it is needed; and, when it has done its duty, it can be removed. In a bed-room, a dressing-room, or nursery, a small burner may be kept all night at the cost of a *cent;* and this is not its only convenience: in an instant it can be increased to warming food for children or invalids, and heating water for washing, shaving, &c.

The promptitude with which gas can be applied imparts to it a special value for heating water; in ten minutes a quantity of water sufficient for an adult's bath can be heated, say from 46° to 98°, for about ten or twelve cents.

A gas-stove placed in the entrance-hall is a simple, convenient, and economical method of diffusing an agreeable warmth over the whole house, the products of combustion being conveyed away either by ascending or descending flues. Gas may likewise be used for the general purposes of heating greenhouses and conservatories.

An important consideration connected with warming by gas is the comparative cheapness of the apparatus, its safety, the facility with which it can be fixed in any particular apartment, and, if necessary, removed to another, or taken entirely away, without altering or disfiguring any part of the house.

Much has been attempted in warming and ventilation without the aid of open fires, but the prevailing error has been *warming too much and ventilating too little.*

In the following left-hand column are the causes of difficulties to which consumers are subjected, and by which imperfect deliveries of gas to the burners so frequently occur; on the right-hand column, their remedies.

CAUSES.	REMEDIES.
1. Freezing of pipes from the mains to the meter.	1. Protect these beforehand, as you would greenhouse plants.
2. Freezing of the liquid in meters.	2. Draw off, beforehand, half or more, or the whole of the contents, and substitute alcohol.
3. Oscillation, or a bobbing up and down of the gas, when attempted to be lighted or when lighted.	3. This is occasioned by there being either too much or too little water in the meter. *Turn off the gas at the main,* undo the screw at the right of centre, (see diagram of meter,) and if too much water is there, it will be evidenced by its

running out freely; let it run till it DROPS FREELY; that is the proper level; if on the contrary, fill up till it *will* DROP *freely.*

4. A paucity of light from another cause may occur, viz. from condensation in the pipes.

4. In this case *shut off the gas at the main,* and turn the tops of the syphon or syphons, thereby drawing off all condensation which may have accumulated, which you will discover to be of a very disagreeable odour.

5. From condensed vapour collected in the inlet-pipe from the main.

5. In this event unscrew the plug found immediately below the "badge plate" on meter, (see diagram,) and allow it to remain so for half a minute or so. *Be sure* NOT *to have a light any way near you; and in* THIS CASE, *and for the time specified, do* NOT *turn the gas off at the main.*

6. From the exit orifices of the burners being worn out, or corroded by ammoniacal contact and deposit, or choked up with a sub-

6. If the first, replace them by new burners.

If the second, wipe the orifices and parts adjacent with a rag dipped in a weak stance, called napthaline, smelling very much like coal-tar, and of a substance akin to bird-lime, which could not possibly have been there if the gas had been half purified.

7. If annoyances occur beyond these, they must arise from a want of gas, or pressure at thegas-works; or,

8. From flaws in the out or in-doors pipes, a loosing of connecting pieces, nuts, screws, elbows, bends, T-pieces, tops, or the screws of burners.

solution of muriatic acid, and from the hardware store obtain an instrument (costing about six cents) called a rymer, small enough to enter the holes of the burner, whose form is *lanceolate and triangular;* with which carefully clear out the holes so as not to enlarge them beyond their original diameter.

If the third occur, take the burner off, grease it well outside, and so let it remain for six or eight hours; then scrape off as much of the foreign matter as you can; work it in a weak solution of muriatic acid, and ryme out the holes.

7—8. In either of which cases send immediately for the fitter.

Concerning Gas-Fitters.

The "Household Words on Gas and Ventilation," brief as it is, would be far from complete, if a notice of these gentlemen were omitted; but the least said about them the better. With very many special exceptions on behalf of individuals, who would do honour to any occupation, we have no hesitation in stating that gas-fitters have, as a body, hitherto hindered, more than helped, the progress of gas-lighting. Employers and workmen have been equally to blame. High charges, unsuitable materials, bad workmanship, and an amount of ignorance and culpable ignorance, and in some cases both combined, that would be deemed a disgrace to other artificers, have been the too common characteristics of this branch of business.

Companies enforcing certain rules for pipage is a salutary measure. The "*mysteries*" (?) of the art having been exposed and discovered to be closely allied to quackery: serving only as excuses for frequent attendances, perpetual annoyances, injury to property, and very long and questionable bills, have gone vastly to render signs of amendment, and they have been greatly needed. In fitting up a house for lighting it with gas, there need be no difficulty.

A fair allowance of common sense, with just as much thought and foresight as are required of a bricklayer in fixing a stone, or a carpenter in hanging a door, will be found quite sufficient for arranging gas-fittings. It is not too much to say that a decent workman of almost any craft, who possesses ordinary intelligence, and is willing to be taught, would make a better gas-fitter, by one month's application, under rational instructions, than many who have been at it constantly during the past ten or twenty years.

Ventilation.

HAVING endeavoured to be explicit on the "*Advantages of Gas in Private Houses*," &c., we will in this division submit our views on ventilation, holding it, as we do, of *vital importance.*

The object of a good system of ventilation is to quickly remove such air from any room, building, or locality, which militates against health or life; and to keep up a continual volume of pure, cool air therein and thereat.

All systems of artificial illumination, either from wax, composition, mould, or dip candles, either from oil, or camphene, or from gas made from any substance, have a deteriorating effect upon the air of an apartment, and, if possible, more so than the respiration of an equivalent number of human beings. Now each of the six substances named previously to gas have, in equal volumes, a redundancy of carbon over gas from coal, and which, during combustion, are qualified to, and do, inflict alarming injury, which is increased materially if either be moved from place to place; this is an evil much speculated on, but not yet satisfactorily combatted. Gas from coal, as it may be served to the public, is in this particular far superior to every other mode of artificial illumination, if, in addition to its proper purification, it be laid on right, the meter tight, all the pipage, joints, bends and elbows sound, syphons placed in properly depressed places and of easy access, burners screwed tightly on, fully down to the shoulder, and advantage taken of the Improved Patent Gas Regulators; add to which a proper and effective ventilation of the apartment. There would not, there could *be no reason* of complaint, should not the whole of these be attended to. If not, it will be as Sir Humphrey Davy found it, that, when he breathed a mixture of two parts air and three of carburetted hydrogen, he was attacked with giddiness, head-ache, and transient weakness of the limbs; but common gas is often contaminated with *sulphuretted hydrogen,* as the blackening of white paint proves: in spite of all the purifying processes at the gas-works, as at present followed, this gas is the most deleterious of all the aerial poisons. It has been found, by experiment, that air impregnated with $\frac{1}{500}$th part of this gas kills a bird in a very short space of time; and that with about twice that proportion, or $\frac{1}{800}$th, it will soon kill a dog. This gas is emitted by cesspools and sewers, and has been a frequent cause of death, when breathed in a state of concentration. The person who breathes it becomes suddenly weak and insensible, falls down, and either expires immediately, or, if he be fortunate enough to be quickly extricated, he may revive in no long time: the abdomen remaining tense and full for an hour or upward, and recovery being preceded by vomiting and spitting of bloody froth. When the noxious emanations are less concentrated, the symptoms are still very alarming; and in the dilute form, as in emanations from the street sewers, persons have, in inhaling them, often been attacked with sickness, colic, imperfectly-defined pains in the chest, and lethargy.

If our readers are not yet of opinion that urgency for ventilating is imperatively called for, we will, in addition to all these contaminating agents, add the following well-known components of an unventilated atmosphere—viz.:

Carbonic acid,
Nitrogen,
Animal effluvia,
Carburetted hydrogen,
Sulphuretted hydrogen, &c.;

beyond which the air of an unventilated room is liable to *a still increased cause of injury to health in the disturbed electrical con-*

dition of vitiated air. This is a subject as yet but partially developed in the highest chemical works; but of this fact we *are* certain: pure air, such as is fit for respiration, is *positively* electric, while *the air which has become impure, and consequently unfit for respiration, is* NEGATIVELY ELECTRIC! *Physicians, aid us!*

Fathers of families: we charge ye, on your love and duty to child, to wife, home, and country, to look to this.

Mothers of families, and ye suckling mothers, fostering your little ones, pledges of love and your honour, born of you, as many of them necessarily are, for high trusts and political responsibilities—called, as they will be, to exhibit all the heroism, the virtue, piety, and wisdom of the ancients and more recent honoured dead, for the maintenance, teaching, and governing this mighty modern republic, whose destiny is written as it were "*with a pen of iron and in letters of brass,*"—I say, will not you urge the necessity of inhaling pure air in your homes, so that the future man may in his earliest childhood lay the foundation of a robust constitution? for listen to what medical and other qualified men have said on the effects of vitiated atmosphere on children, normally and by descent.

Mr. Carmichael, in his Essay on the Nature of Scrofula, before gas was used as now, charges vitiated domestic air, particularly in sleeping-rooms, with being the primary cause.

The whole of the medical men's evidence taken before the committee of the House of Commons, England, 1840, pointed to the same cause, adding, that in the cases of those who pass *their* lives in close, confined, unventilated apartments, their children are peculiarly subject to *scrofula and softening of their bones.*

Dr. Arnott states that an individual, *the offspring* of persons successively living in bad air, will have a constitution decidedly inferior to one born of a race living in the pure air, and that the mischief does not end here; but from that first injury, the further descendants further degenerate; that defective ventilation deadens both the mental and bodily energies, leaving its corrupting influence upon the person.

Some of the details in these reports, of the effects on children habitually breathing air vitiated by a number of human beings, are so frightful, that we withhold saying more than that each little one, instead of breathing the air of *heaven*, breathes poison; and that his position at the time is but little above the level of the "*between-decks of a slaver*."

Daughters of America! second not to any—not to the *ultra aristocratic belles of Almack's*, nor to the boasted beauties of the present *court of the Tuilleries*—which will you honour with your suffrages—pure air, or cosmetics?—countless crudities, which but multiply "the ills flesh is heir to," with a *physician* on full pay in perspective!—Pray, *remember:* fresh air, pure air gives elasticity to the step, buoyancy to the spirits, secures serenity to the pure of heart, adds a sparkle to the eye of innocence, induces good digestion and sound, refreshing sleep, expands the chest to the full development of true womanly beauty, and braces all its organic powers for emitting sweet, sonorous sound for song, and is an antidote for dyspepsia and ennui. It will cause the "human face divine" to rival the fairest damascene for delicacy, the breath for its sweetness, and shames forever the art of Italy's vain enamellers.

Sons, and citizens generally! you who sternly judge of new matters by the results of their promised merits, in submitting what we have and are about further to state, we have only respectfully to add, we refer you to, and abide ourselves by, the admirable and notable aphorism bequeathed to his country by one of your mighty dead: "Be sure you are right—then go ahead!"

At the risk of being blamed for repetition, on account of the good hoped for, let us consider the grounds which render a proper supply of pure air necessary to health. In the process of respiration, the blood, in passing through the lungs, is exposed to the action of the atmospheric air, during which exposure it undergoes certain changes. The blood from the right side of the heart, when it enters the lungs, is of a dark-red colour; it is then dispersed in a state of most minute subdivision through the ultimate vessels of the lungs; and in these vessels is brought into contact with the atmospheric air, when it becomes of a *bright*-red colour; in other words, if the blood changes in the lungs its *venous* appearance, and assumes the character of *arterial* blood, the blood thus arterialized returns to the left side of the heart, from whence it is propelled through the whole arteries of the body. In the minute terminations of the arteries the blood again loses its florid hue, and reassuming its dark-red colour, is returned through the veins to the *right* side of the heart, to be exposed, as before, to the influence of the atmospheric air, and to undergo the same succession of changes.

On examining the respired air, it is found that a portion of its oxygen has disappeared, and a similar bulk of carbonic acid has been substituted. While oxygen gas is passing inward through the membrance of the lungs, carbonic acid is at the same time passing outward through the same membrane; in fact, the oxygen of the air is absorbed by the blood, and, in some unknown state of combination, reaches the extreme subdivision of the arteries, where it is emitted with a portion of carbon, and forms carbonic acid gas; which gas also, in some unknown state of combination, is retained in the venous blood, till in the lungs it is expelled, and oxygen is absorbed in its stead.

Along with the carbonic acid, a large quantity of aqueous vapour is at the same time separated from the blood.

One great object of this process is the production and maintenance of animal heat. From a comparison made by Professor Miller of the results of numerous experiments, it appears that a man of ordinary stature consumes, in the course of twenty-four hours, nine ounces (Troy) of carbon; that the heat generated during the combustion is sufficient to boil away eight pounds of water; that the consumption of oxygen in this process is equal to twenty-four ounces, or 19·4 cubic feet; that the quantity of air vitiated amounts to 97·2 cubic feet, and the product in carbonic acid to thirty-three ounces.

There have been many able experimentalists on this subject. In the Philosophical Transactions for 1808 will be found, for example, an exceedingly interesting memoir by Messrs. Allen and Pepys: it was concluded that a middle-sized man, aged about thirty-eight years, and whose pulse is 70 on an average, gives off 302 cubic inches of carbonic acid in 11 minutes; and supposing the product uniform for 24 hours, the total quantity in that period would be 39,534 cubic inches. Now 39,534 cubic inches of carbonic acid weigh 18,683 grains, and contain 5166 grains of carbon, or 10·7 ounces, (Troy.)

The estimate of Sir Humphry Davy (Memoirs, vol. iii. p. 255) agrees very closely with this—namely, 26·6 cubic inches per minute, or 38,304 cubic inches in the day. This quantity will weigh 18,102 grains, and contain 5006 grains of carbon, or 10·4 ounces, (Troy.)

The close coincidence of these experiments, and also with some of more recent date, were very remarkable.

The following are Dr. Scharling's general conclusions respecting the quantities of carbon actually disengaged, in the course of 24 hours, by six persons under mentioned, upon whom the experiments were made.

It is assumed that, in the case of the children, nine hours were passed in sleep, and in that of the adults, seven hours.

	Grains of carbon.	oz. (Troy.)
1. A man, 35 years old, weighing 131 lbs., gave off	3386 =	7·05
2. A young man, 16 years old, weighing 115½ lbs., gave off	3462 =	7·21
3. A soldier, 28 years old, weighing 164 lbs., gave off	3698 =	7·07
4. A girl, 19 years old, weighing 111½ lbs., gave off...........	2559 =	5·33
5. A boy, 9¾ years old, weighing 44 lbs., gave off.......	2054 =	4·28
6. A girl, 10 years old, weighing 46 lbs., gave off	1935 =	4·03*

These results are, as a matter of course, liable to much variation in the same individual at different times, in different individuals, and in different sexes. The quantity of aqueous vapour is also liable to much variation, but the average quantity has been stated at three grains per minute. We have seen that the carbonic acid is a deadly poison; and the water thus given off is not

* *Annalen der Chemie und Pharmacie*, vol. xlv. p. 214.

pure water, not such as is liberated in the process of distillation or evaporation, but is contaminated with the most offensive animal effluvia. *M. Leblanc* states that the odour of the air at the top of the ventilator of a crowded theatre or room is of so noxious a character, that it is dangerous to be exposed to it even for a short time. If this air be passed through pure water, the water soon exhibits all the phenomena of putrefactive fermentation. The water of respiration thus loaded with animal impurities condenses in the inner walls of the building, and trickles down in fœtid streams, scattering contagion all around; and mind, gentle reader, *M. Leblanc* here reports from *Almack's*, at the height of a *London fashionable season*, where all the wealth and ultra aristocratic belles of England and the whole of the European continent are vieing with each other in beauty and blandishments, holding their imperious *cour de ton* and reunions.

The composition of healthy human blood is on the authority of M. Lecanu (*Annales de Chimie et de Physique*, vol. xviii. p. 320,) as follows:

WATER	780·145—785·590
Fibrin	2·100— 3·565
Albumen	65·090— 69·415
Colouring matter	133·000—119·626
Crystallizable fat	2·430— 4·300
Oily fat	1·310— 2·270
Extractive, soluble in water and alcohol	1·790— 1·920
Albumen, in union with soda	1·265— 2·010
Chlorides of sodium and potassium; alkaline carbonates, phosphates, and sulphates	8·370— 7·304
Carbonates and phosphates of lime, magnesia, and iron	2·100— 1·414
Loss	2·400— 2·586
	1000 1000

The earthy and alkaline carbonates mentioned in the analysis probably exist in the state of organic salts in the blood.

The ultimate composition of blood, as a whole, is curious; it is precisely the same as that of muscular flesh. Ox blood was dried by exposure to gentle heat in a silver vessel, and compared by analysis with lean flesh of the same animal, also carefully dried.

	RESULTS. Blood in 100 parts.	RESULTS. Muscle in 100 parts.
Carbon	51·950—51·965	51·83—51·893
Hydrogen	7·165— 7·330	7·56— 7·590
Nitrogen	17·172—17·173	17·15—17·160
Oxygen, &c	19·295—19·115	19·23—19·127
Ashes	4·418— 4·413	4·23— 4·230

On the authority of Drs. Playfair and Bœckmann, and in which both Liebig and Poggendorf agree,* flesh is, in fact, organized blood, and blood fluid flesh.

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* See Liebig's and Poggendorf's *Handwörterbuch der Chemie*, art. "Blut."

A further argument on Ventilation.

The generalization of the baneful influences of a vitiated air must, as a matter of course, be admitted; but the urgency to remedy its immediate and proximate consequences has only been addressed to one section of citizens. How much is any other section affected by the squalor of another section; and that section the section of the poor and destitute, the fœtid exhalations and emanations from whose dwellings are no respecters of persons;—the fevers and other contagious diseases arising from whence find their way into the dwellings of their more fortunate neighbours in the goods of this world. The miasma of courts and alleys enters the lungs, and casts the recipient on a bed of sickness. If, through the mercy of God, he is permitted to rise again, ought *he* not to urge the necessity of a sanitary ventilation? Will any rational man contend that the science and legislation of this nineteenth century and in this country should not be exerted to that end? Every one who has knowledge or wealth at his disposal is bound to exert some portion of them as much for the benefit of his ignorant and poorer brethren as for his own pleasure, his profit; for it is to his own daily safety. Besides which, is there not a *moral law* requiring us to do so? Is there not also a *natural law*? There are both these laws, and they have this distinguishing proof of their divine origin—they are self-acting; they confer the reward of obedience, and they inflict the penalty of transgression, with a precision and certainty which find no parallel in mere human laws and institutions.

Do we not owe a deep debt of gratitude to those who, like the working members of home missions, that noble band of ladies, and that equally noble, self-sacrificing sisterhood of charity; and others, ministers of the gospel, who, at the imminent risk of their lives, seek out poverty, sickness, degradation, ignorance, and crime, in the very purlieus of contamination and jeopardy of person; to purge general society of an incubus horrid to contemplate, and to reclaim the fallen? And can we testify a more lively gratitude emphatically, than by *urgently advocating* a classification of this *Upas territory*—the scene of so many charitable labours gratuitously rendered?

Having gone thus far with the subject, and, I very sincerely hope, without giving offence, I will intrude my own convictions upon the results of construction of public buildings, selecting a few of (to my opinion) the best attempts at proper ventilation in other countries.

Invidious remarks on professional men will not form any feature in our further progress; nor do we intend to point out particular erections whereon to draw attention, nor by contrast to approach it; but on a general muster of the buildings on which the architect has lavished all his art and skill, for the most part they are entirely destitute of *special* means for ventilation, and are so constructed as to now render the application of such means extremely difficult in many cases. Such a contrivance rarely forms a part of a contract. A building capable of containing from eight hundred to a thousand persons, whether it be a church, a lecture-room, an assembly-room, a concert-room, or a school, is, in consequence of this neglect, the too frequent scene of much painful suffering.

When such a room is crowded, and the meeting lasts for some hours, especially in winter, the consequences are sufficiently marked; either such a multitude must be subjected to all the contaminating evils of an unwholesome atmosphere, or they must be partially relieved by opening the windows, and allowing a continual stream of cold air to pour down upon the heated bodies of those who are near them, till the latter are thoroughly chilled, and, perhaps, fatal illness is induced; and, unfortunately, even at such a price the relief is only partial; for the windows being generally all on one side of the room, and not extending much above half-way to the ceiling, ventilation is incomplete — is impracticable. Dr. Andrew Combe, in his "Principles of Physiology," says: "This neglect could never have happened, had either the architect or his employers known the laws of the human constitution." The same intelligent writer remarks, that in churches fainting and hysterics occur more frequently in the afternoon than in the morning, because the air is then at its maximum of vitiation. Indeed, in a crowded church the effects of deficient air are visible in the expression of the features of a majority present;—either a relaxed sallow paleness of the surface or the hectic flush of fever is observable; and, as the necessary accompaniment, a sensation of mental and bodily lassitude is felt, which is immediately relieved by getting into the open air. Some persons, however, do not find this relief; the headache often lasts for hours, and sometimes ends in a bilious or nervous attack.

School-rooms also are as sadly defective in respect to ventilation; and cases may be multiplied where, with all the windows open, a proper supply of air could not be introduced into the crowded apartments. When the weather did not admit of open windows, the atmosphere of the room was most unwholesome; it was positively loathsome to a visitor entering it from the fresh air. All the inmates complained of a sensation of tightness in the forehead, and headache more or less acute. Command of temper on the part of the teachers, and mental progress on the part of the pupils, are, of course, next to impossible under such circumstances. We would take it upon ourselves to appeal to the experience of teachers in general, whether the slow comprehension and listlessness of children in school, who are sharp, smart, and clever in the playground, may not be traceable, in a great measure, to the vitiated air which they are compelled to inhale?

In curious (but accountable) contrast to the defective arrangements of most of our public buildings with respect to ventilation, are the public theatres. These are, for the most part, tolerably well ventilated, or at least some attempt has been made to procure ventilation, of which the managers do not fail to make the most of, in their announcements at the opening of their season. *They are practical men;* they know that for some years past the attention of the public has been directed to the subject of ventilation, and that a studious attention to the comfort of the house is as likely to bring people to it as attractive performances.

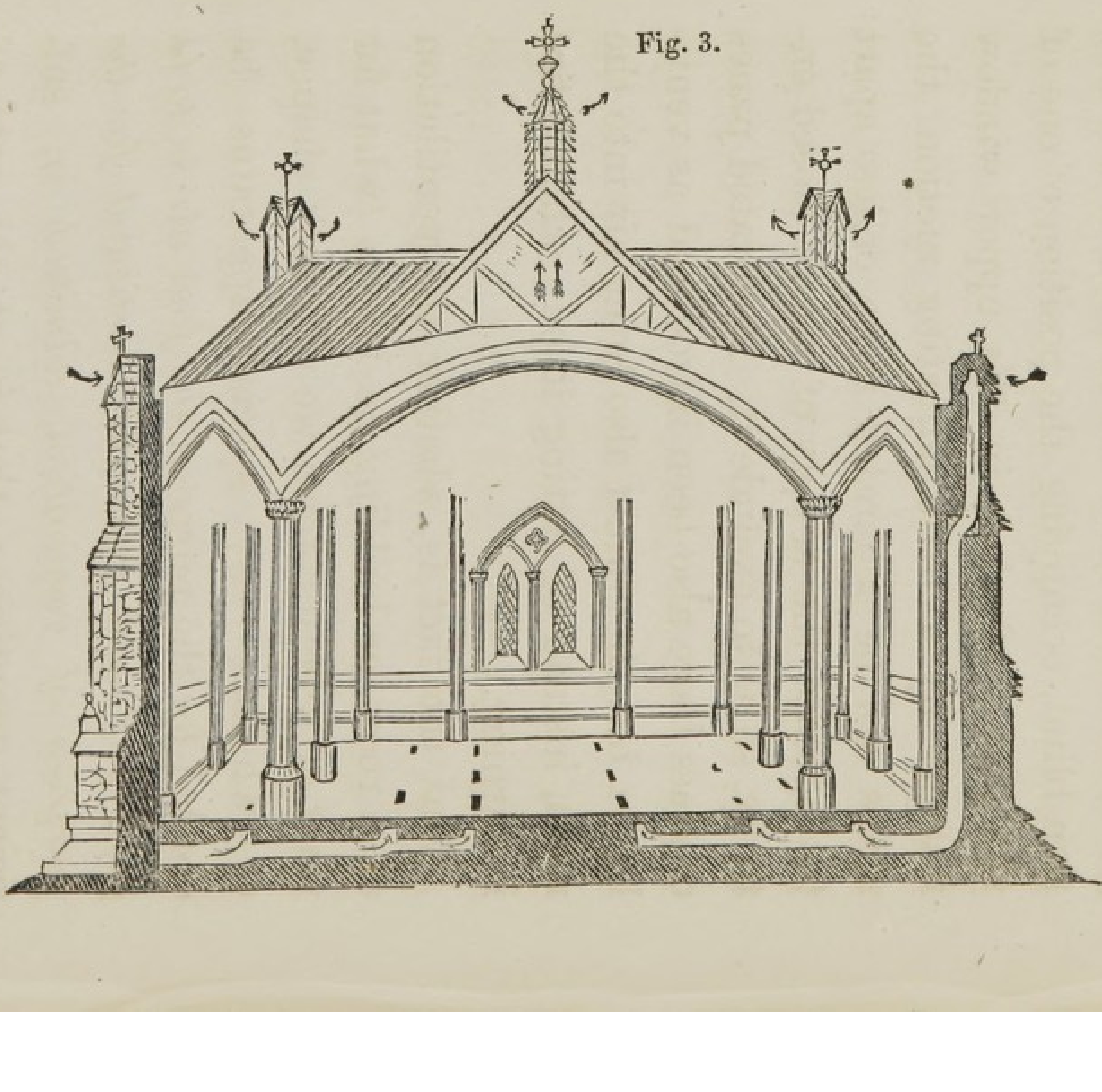
They know, too, that people are more likely to enjoy and applaud the business of the stage when they can breathe freely, than when the head is aching and the senses are stupid in the drowsiness of a mephitic atmosphere. Some of the methods of ventilating theatres are clever and efficient, as will be noticed hereafter, and *could* perhaps be applied to those highly important buildings, the church, the lecture-room, and the school.

Well, here is the traveller, in pursuit of health, or business, or pleasure; ask him if he finds ventilation to his satisfaction as he prosecutes his journeying. He answers you peevishly, No! Your carriages are bad for that necessary comfort; railroad cars bad, too; steamboats, an abomination for breathing during sleeping, and your hotels little better. You are subject, sir, to be broiled in one, steamed in another, frozen in a third, or liable to currents or rather blasts of cold air that really do "*make your hair to stand on end; there is no medium,* sir; *no medium.* We shall be all poisoned, suffocated, or blown to pieces, sir!"

The naval and military services of every country are so well reported on, that I may fearlessly say the naval committee of the United States could readily endorse more than I may advance upon ventilation afloat, simply from their unpublished statistics, if such a matter was within my privilege or province to petition for; but it is not. In respect to the mercantile marine, room is open for as great improvements in ventilation, although more humane or liberal builders and owners do not make their ventures on the face of old Neptune's element, than are found in the United States.

A contrivance has lately been introduced for ventilating rooms; but when there is a fire in the room, it must serve the purpose

Fig. 3.

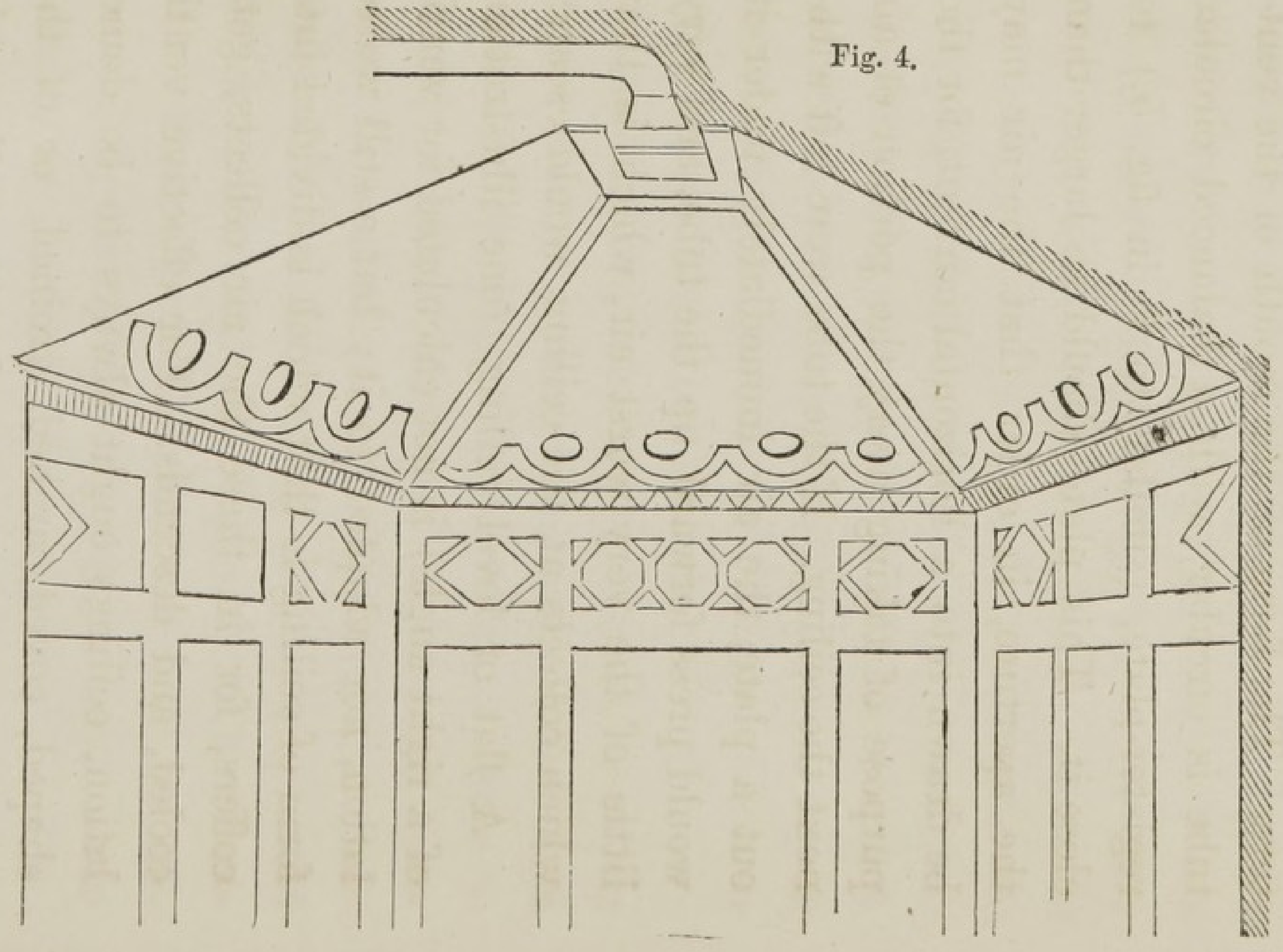


of introducing air rather than letting it out. It consists of a number of strips of plate-glass, arranged after the fashion of a Venetian blind, occupying the position of one of the panes of glass in the upper window frame. By a little adjusting motion, the strips can be separated more or less apart to regulate the supply of air, or closed entirely, so as to exclude it. Perforated panes of glass have also been introduced as ventilators, but they must also bring air into the room, instead of letting it out, when a fire is burning.

But the fact is, whether the ventilation of a room or building be left to (what for want of a better term we will call) chance, or whether any special apparatus be erected for the purpose, *the foul air is to be got rid of, and fresh air substituted for the purposes of respiration, admitted* in sufficient quantities; that is, at the rate of about four cubic feet per minute for each individual in the said room or building.

Tredgold, in his work on warming and ventilating, (second edition, London, 1836,) has given some very sensible directions for the ventilation of a church, which, of course, apply equally to any other public building, and, to a certain extent, to private houses. He advises that the spaces for the admission of cold air be abundantly large, and divided as much as possible; they should be in or near the floor, (see fig. 3, p. 80,) so that the air may not have to descend upon any one; by making the openings large, and covering them on the inside with rather close wire-work, (sixty-four apertures to the square inch,) most of the current may be prevented; and it may be still further prevented by bringing tubes under the paving to admit fresh air into the central parts of the church. Of course, these openings must be provided with shutters, so as close wholly or partially, when desirable. Provision should be made for the escape of the warm air at different parts of the ceil-

Fig. 4.



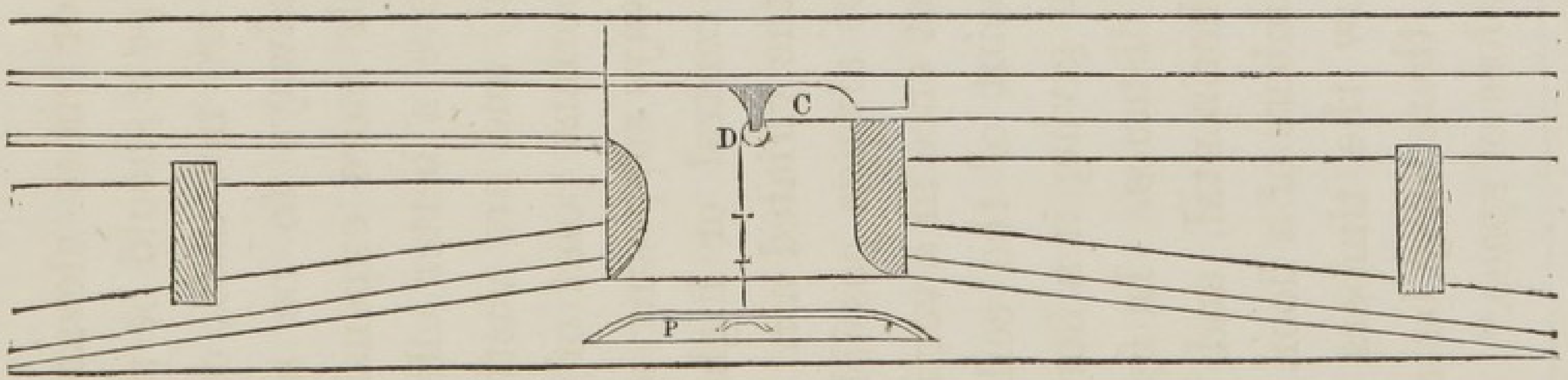
ing, through air-trunks furnished with registers. The form of the mouth of the vent-tube is circular, with a balanced circular register-plate, (similar to P in fig. 5,) to close it. This plate should be larger than the aperture, in order that the air may be drawn into a horizontal current, for the purpose of taking away the portion of air next the ceiling. If the tube were left without a plate, the air immediately under it would press forward up the tube, and very little of the very worst air, which is that which collects at the ceiling, would escape.

A flat or level ceiling (one illustration of a right angle) is not calculated for ventilation, nor adapted to it; but a still worse form of ceiling is that which is divided into coffers, for in these the air collects, gets cooled, and descends. For effective ventilation, ceilings ought always to be dome-shaped, coved, arched, groined, or of the form of a truncated pyramid, as shown in fig. 4, so as to rise in the centre; and at the centre, or most elevated point, the ventilating pipe *a* should be placed. When curved lines are not used, ceilings of this form ought always to be adopted; they are not much more expensive than flat ones; they have a better effect to the eye and for sound, and are vastly superior as far as the important point of ventilation is concerned, always supposing an opening be made in the central or highest point for the escape of the vitiated air.

As it is not always possible to conduct the vent-tube at once in a vertical line from the highest point of the ceiling, there is no objection to giving it a horizontal direction for some distance. In fig. 5 the vent-tube A B is horizontal, and is conducted between the timbers of a floor. This figure also shows how the timbers may be disposed, so that there may be a rise in the centre without loss of space.*

* In Mr. Tredgold's figure, the timbers on each side the ventilating opening D are made to dip, as shown in

Fig. 5.



C is a cord passing over a pulley D, for raising or lowering the register-plate P. This plate is balanced by a weight attached to the lower part of the cord, which passes down nearly to the floor of the room, where it is secured by a hook.

In designing and constructing a new building, flues might be made for the special purpose of supplying the interior with fresh air. Each flue might open in the cornice, pass down between the piers, and under the flooring of the church or other building, and terminate in apertures which could be covered with gratings. By disposing some of these flues on each side of the church, they would act with the wind in any direction. These exterior openings should, however, be covered with a grat-

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the dotted line at *t*. This ought always, if possible, to be avoided, as it prevents the free passage of the air; and even so slight an impediment as this might cause a stratum of air near the ceiling to cool and descend before it had time to escape up the openings.

ing, to prevent foreign matter blocking them up.

Fig. 3, which is one of that talented man's (Mr. Garbett) designing, will show at a glance one special arrangement for the ventilation of a church or any other large building. But before the desirable objects of properly warming and ventilating churches, &c. are fully attained, it will be necessary for architects to combine a profound knowledge of their art with a good acquaintance with chemical and physical sciences.

In some of the old buildings which still excite the admiration of persons of cultivated taste by the beauty of their arrangements and architectural details, we sometimes meet with very special provision for ventilation, arranged on the truest principles. Thus, in the "*Hall of the Baths*," in the Alhambra, in Granada, the roof is perforated with ventilating openings; and is not only of the best possible form for the purpose of ventilation, but the openings

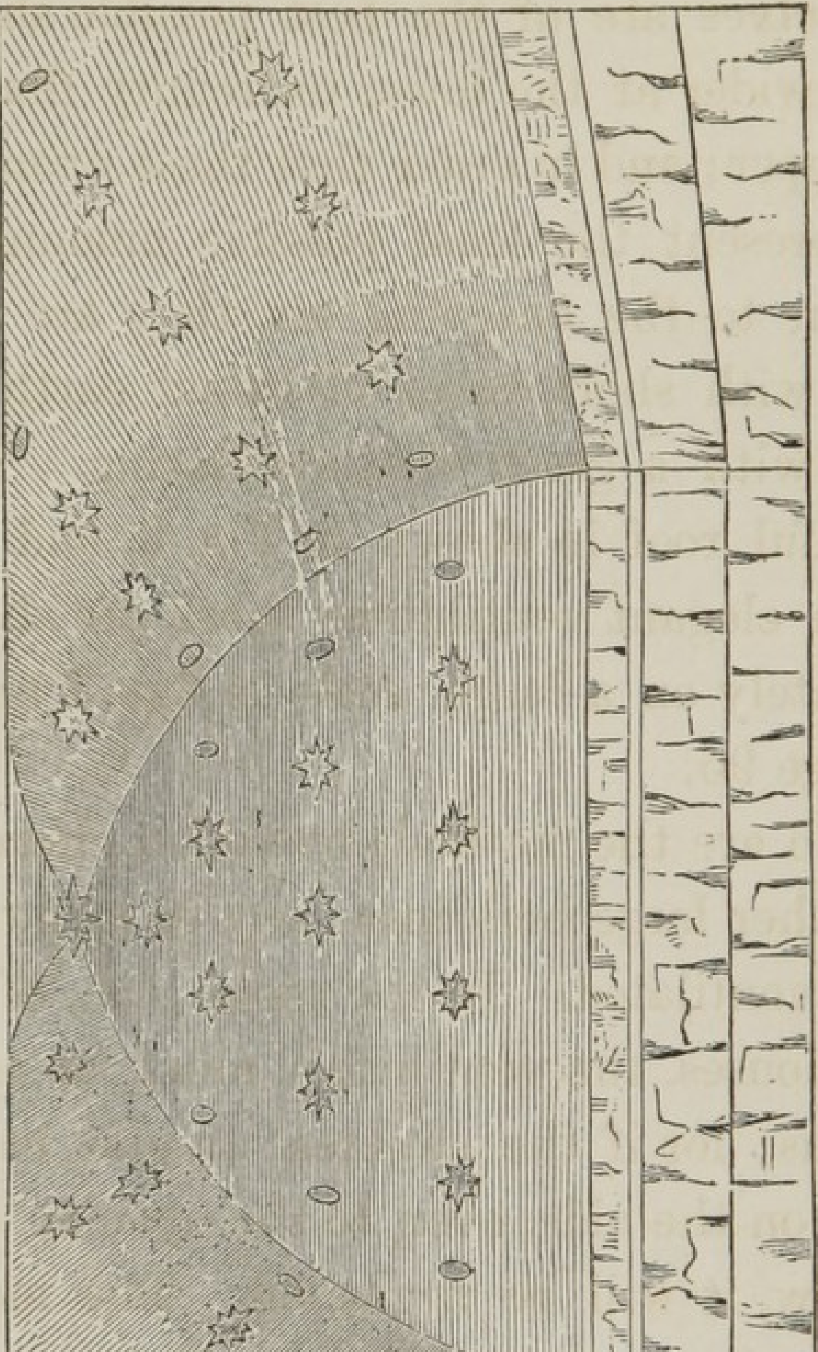

Fig. 6.

themselves are of the best possible shape, being wider at the lower extremity than at the upper; and in order that these openings may present the least possible amount of friction to the outgoing air, they are provided with short tubes of baked earth, covered with a green vitreous glazing. This beautiful roof is shown in Fig. 6, and two of the elegant ventilating tubes are shown separately on a larger scale in figs. 7 and 8 on page 95.

Such are the methods by which churches and other large buildings may be spontaneously ventilated. In the rooms, too, of private houses, the ventilation must be spontaneous; for if the slightest trouble be entailed on the aids, even to the opening of a window, it will be neglected. The means for ventilation must also be cheap, easily procurable, always in place, self-acting, not liable to get out of order, requiring no adjustment when once fixed, and requiring *no care whatever* on the part of the inmates.

It would seem impossible, at first view, to contrive any thing at all likely to answer these conditions, and yet it has been done in the most perfect manner by that good man, Dr. Arnott, without seeking or desiring any emolument to himself.

Before entering upon what Dr. Arnott did, or proposed to do, I am desirous to appeal to the right feelings of the proprietors of tenant property in the cities in particular, and to those of every town and village in the United States, and proceed to say—

Gentlemen :—As personally unknown to you, we will presume to address you with a frankness generally considered equivalent to an apology, and which is most certainly the best passport to a patient hearing upon any subject; but when what we have to say relates to the listener's benefits and duties, he is tolerably sure of being attended to. Then, if what we have to say be true, the more directly we state what we have to state, the better. Now, gentlemen, this is

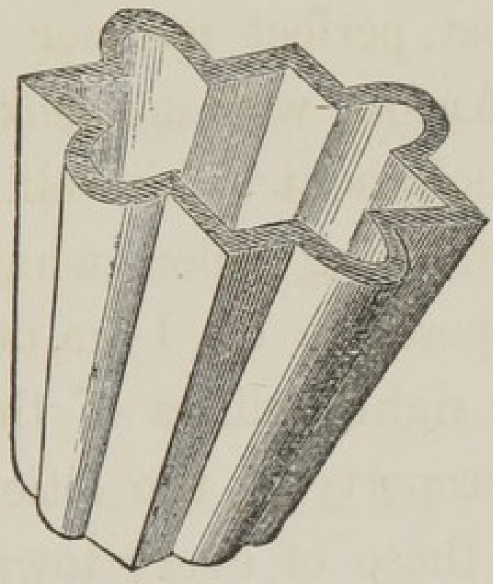

Fig. 7.

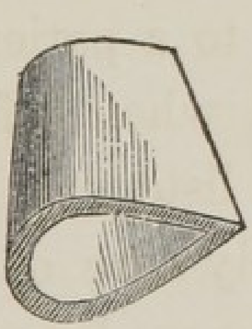

Fig. 8.

just your case and ours; and we, without reserve, ask you urgently at once to advocate *ventilation,* by practically putting it into operation in every apartment upon your rent-roll, agreeably or proximate to the plan Dr. Arnott suggested, and which you will find detailed in the ensuing pages.

We ask you fearlessly—

1. Because it will cost you nothing.

2. Because it will better the health of the poor individually.

3. Because it will be a step in the right direction, to prevent sickness and check contagion among the poor generally.

4. Because the whole community will be bettered by it, yourselves included.

5. Because your tenants, by having good health, will be able to pay their rent regularly.

6. Because labour will not be so impeded as when epidemics are rife, and which are generally caused by a want of ventilation.

7. Because taxes will not (or ought not to)

be so heavy, by reason of a less number of paupers or poor being in the hospitals.

8. Because, if properly ventilated, your property is and will be from four to twelve per cent. benefited, by less repairs being required in conseqence of the same.

9. Because the trouble of removing but one brick *to do so much good*, including the same to yourself, as before said, will, I am willing to believe, be sufficient inducement for your willingly urging ventilation to its fullest extent.

What Dr. Arnott did and suggested.

In the autumn of 1849, when the cholera was raging in England, the Board of Health recommended, in one of their notifications published in the London Gazette, that in every badly-ventilated dwelling "*considerable* and IMMEDIATE relief may be given by a plan suggested by *Dr. Arnott—of taking a brick out of the wall near the ceiling of the room, so as to open a direct communication between the room and the chimney.* Any occasional temporary inconvenience of down-draught will be more than compensated by the beneficial results of this simple ventilating process."

A few days after this recommendation, applications for further information on the subject were made, on which Dr. Arnott addressed a letter to the *Times* newspaper, dated Sept. 22, 1849. This admirable letter is so interesting and so pertinent to the subject of this affair, that we venture to transfer nearly the whole (all, indeed, of a practical character) of it to these pages:—

"I assume," says the doctor, "that most of your readers already understand, or will now learn, that the air which we breathe, and which is used to stuff air-pillows, consists of material elements, as much as the water which we drink or the food which we eat,—indeed, consists altogether of oxygen and nitrogen; the first of which forms also seven-eighths by weight of the substance of water, and the other nearly one-fifth by weight of the substance of flesh,—and that there is surrounding our globe, to the depth of about fifty miles, a light fluid ocean of such air, called the atmosphere, into which, near the surface of the earth, certain impurities are always rising from the functions of animal and vegetable life, and the recombination of substances by fermentation, putrefaction, combustion, &c., just as into the sea and great rivers some impurities are always entering from the sewers; all which impurities, however, are so quickly diluted or dissipated in the great masses, as to become absolutely imperceptible, and eventually, by the admirable processes of nature, changed, so that the great oceans of air and water retain even their states of perfection. I assume, further, that your readers know *that fresh air for breathing is the* MOST IMMEDIATELY URGENT OF ALL THE ESSENTIALS TO LIFE, as proved by the instant death of any one totally deprived of it through drowning or strangulation, and by the slower death of men compelled to breathe over again the same small quantity of air, as when lately seventy-three passengers were suffocated in an Irish steamboat, of which the hold was shut up for an hour by closely-covered hatches; and by the still slower death, accompanied generally by some *induced* FORM

OF CHRONIC DISEASE, *of persons condemned to breathe habitually impure air, like the dwellers in crowded, ill-ventilated rooms and foul neighbourhoods;* and, lastly, as proved by the fact that pestilence or infectious diseases are engendered or propagated almost only where impurities in the air are known to abound, and particularly where *the poison of the human breath and other emanations from living bodies are allowed to commingle in considerable quantity,* as instanced in the jail and ship fevers, which, so lately as in the days of the philanthropic Howard, carried off a large portion of those who entered jails and ships; and as instanced in that fearful disease which, at the Black Assizes at Oxford, England, July, 1577, spread from the prisoners to the court, and *within two days had killed the judge, the sheriff, several justices of the peace, most of the jurors, and a great mass of the audience,* and which afterward spread among the people of the town. This was a fever which did its work as quickly as the cholera does now.

"Assuming that these points are tolerably understood, I shall proceed to show that from *faults in the construction and management of our houses*, many persons are unconsciously doing, in regard to the air they breathe, nearly as fishes would be doing in regard to the water they breathe, if, instead of the pure element of the vast rivers or boundless sea streaming past them, they shut themselves up in holes near the shores, filled with water defiled by their own bodies and from other foul sources. And I shall have to show that the spread of *cholera in this country has been much influenced by the gross oversights referred to.*

"All the valued reports and published opinions on cholera go far to prove that in this climate, at least, any foreign morbific agent or influence which produces it comes comparatively harmless to persons of vigorous health, and to those who are living in favourable circumstances; but that if it find persons with the vital powers much depressed or disturbed from any cause, and even for a short time, as happens from intemperance, from improper food or drink, from great fatigue or anxiety, BUT, ABOVE ALL, *from want of fresh air, and consequently from breathing that which is foul, it readily overcomes them.* It would seem as if the peculiar morbid agent could as little, by itself, produce the fatal disease, as one of the two elements concerned in a common gas explosion—namely the coal-gas and the atmospheric air—can alone produce the explosion. The great unanimity among writers and speakers on the subject, in regarding foul atmosphere as the chief vehicle or favourer, if not a chief efficient cause, of the pestilence, is seen in the fact of how familiar to the common ear have lately become the words and phrases, '*malaria, filth, crowded dwellings, crowded neighbourhoods, close rooms, faulty sewers, drains, and cess-*

pools, or a total want of these, effluvia of graveyards,' &c.; all of which are merely so many names for foul air, and for sources from which it may arise. Singularly, however, little attention has yet been given from authority to the chief source of poisonous air, and TO MEANS OF VENTILATION, *by which all kinds of foul air may with certainty be removed.*

"A system of draining and cleansing, water supply and flushing, for instance—to the obtainment of which, chiefly, the Board of Health has hitherto confined its attention—can, however good, influence only that quantity and kind of aerial impurity which arises from retained solid or liquid filth within or about a house; but it leaves absolutely untouched the other and really more important kind, which, in *known quantities,* is never absent where men are breathing—namely, the filth and poison of the human breath. This latter kind evidently plays the most important part in all cases of a crowd, and therefore such catastrophes as that of the Tooting school, with eleven hundred children, of whom nearly three hundred were seized by cholera,—of the House of Refuge for the Destitute,—and of the two great crowded lunatic asylums here, where the disease made similar havoc;—for places so public as these, and visited daily by numerous strangers, could not be allowed to remain visibly impure with solid and liquid filth, like the rookery of St. Giles* and other such localities.

"Now, good ventilation, although few persons comparatively are as yet aware of the fact, is easily to be had, (as I have shown,) and it not only entirely dissipates and renders absolutely inert the breath-poi-

* A locality in London, at a point where the east end of *old* Oxford street did, and where the west end of High Holborn still does, terminate; with the south termination, also, of Tottenham Court Road on the north adjunct—chiefly occupied by Irish labourers and their families; not unlike the Five Points, New York, in every particular.

son of inmates, however numerous, and even of fever patients, but, in doing so, it necessarily, at the same time, carries away at once all the first-named kinds of poison, arising from bad drains or want of drains, and thus acts as a most important substitute for good draining, until there be time to plan and safe opportunity to establish such. It is further to be noted that it is chiefly when the poison of the drains, &c. is caught and retained under cover, and is then mixed with the breath, that it becomes very active, for scavengers, nightmen, and grave-diggers, from the time of Hamlet, who work in the open air, are not often assailed with disease; and in foul neighbourhoods, persons, like butchers, who live in open shops, or policemen, who walk generally in the open streets, or, in Paris, the people who manufacture a great portion of the town filth into portable manure, suffer very little.

"To illustrate the efficacy of ventilation or dilution with fresh air in rendering quite harmless any aerial poison, I may adduce the explanation given in a report of mine on fevers, furnished at the request of the Poor Law Commissioners in 1840, of the fact that the malaria or infection of marsh fevers, such as occur in the Pontine marshes near Rome, and of all the deadly tropical fevers, affects persons almost only in the night. Yet the malaria or poison from reconstructing organic matters which cause these fevers is formed during the day, under the influence of the hot sun, still more abundantly than during the colder night; but in the day, the direct beams of the sun warm the surface of the earth so entirely, that the air touching the surface is similarly heated, and rises away like a fire-balloon, carrying up with it, as a matter of course, much diluted, all poisonous malaria found there. During the night, on the contrary, the surface of the earth, no longer receiving the sun's rays, soon radiates away its heat, so that the thermometer lying on the ground is found to be several degrees colder than one hanging in the air a few feet further above. The poison formed near the ground, therefore, at night, instead of being heated and lifted, and quickly dissipated, as during the day, is rendered cold and comparatively dense, and lies on the earth a concentrated mass, *which it may be death to inspire.* Hence the value in such situations of sleeping apartments near the top of the house, or of apartments below which shut out the night air, and are large enough to contain a sufficient supply of the purer day air for the persons using them at night, and of some mechanical means of taking down pure air from above the house to be a supply during the night. At a certain height above the surface of the earth, the atmosphere being nearly of equal purity all the earth over, a man rising in a balloon, or obtaining air for his house from a certain elevation, might be considered to have changed his country, any peculiarity of the atmosphere below, owing to the great dilution effected before it reached the height, becoming absolutely insensible.

"Now, in regard to the dilution of aerial poisons in houses by ventilation, I have to explain that every chimney in a house is what is called a sucking or drawing air-pump of a certain force, and can easily be rendered a valuable ventilating pump. A chimney is a pump; first, by reason of the suction or approach to a vacuum made at the open top of any tube across which the wind blows directly; and secondly, because the flue is usually occupied, even when there is no fire, by air somewhat warmer than the external air, and has, therefore, even in a calm day, what is called a chimney draught proportioned to the difference. Therefore, in olden times, when the chimney breast was always made higher than the heads of persons sitting or sleeping in rooms, a room with an open chimney was tolerably well ventilated in the lower part when the inmates breathed.

"The modern fashion, however, of very low grates and low chimney openings, has changed the case completely, for such openings can draw in only from the bottom of the rooms, where generally the coolest, the last-entered, and, therefore, the purest air is found; while the hotter air of the breath, of lights, of warm food, and often of subterranean drains, damp cellars, &c., rises and stagnates near the ceilings, and gradually corrupts there. Such heated, impure air no more tends downward again to escape or dive under the chimney-piece, than oil, in an inverted bottle, immersed in water, will dive down through the water to escape by the bottle's mouth; and such a bottle, or other vessel, containing oil, and so placed in water, with its mouth open downward, even if kept in a running stream, would retain the oil for any length of time. If, however, an opening be *made into a chimney-flue through the wall, near the ceiling of the room*, then will all the hot, impure air of the room as certainly pass away by that opening, as oil from the inverted bottle would instantly all escape upward through a small opening made near the elevated bottom of the bottle.

"A top window-sash, lowered a little, instead of serving, as many people believe it does, like such an opening into the chimney-flue, becomes generally, in obedience to the chimney draught, merely an inlet of cold air, which first falls as a cascade to the floor, and then glides toward the chimney, and gradually passes away by this, leaving the hotter, impure air of the room nearly untouched. For years past, I have recommended the adoption of such ventilation by chimney-openings, as above described, and I devised a balanced metallic valve to prevent, during the use of fires, the escape of smoke to the room. The advantages of these openings and valves were soon so manifest, that the 'referees,' appointed under the '*Building Act*,' added a clause to *their bill*, ordering the introduction of the valves,

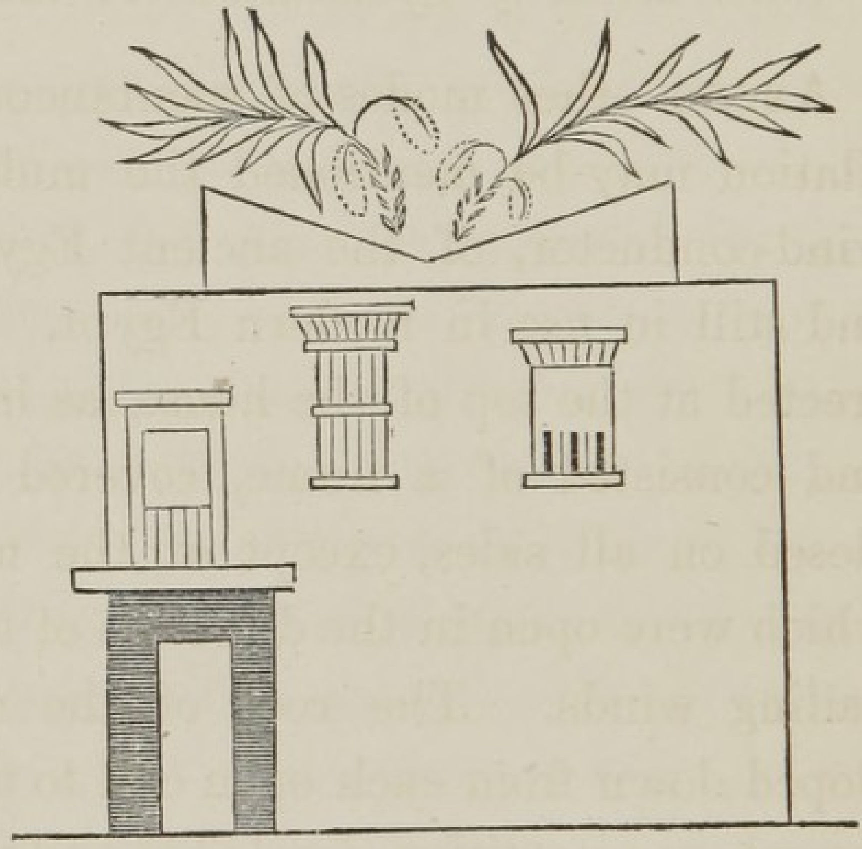

Fig. 9.

and directing how they were to be placed; and they are now in very extensive use."

Other Modes of Spontaneous Ventilation.

Among other modes of spontaneous ventilation may be mentioned the mulgap, or wind-conductor, of the ancient Egyptians, and still in use in modern Egypt. It was erected at the top of the house, as in *fig.* 9, and consisted of a frame, covered or enclosed on all sides, except at the mouths, which were open in the direction of the prevailing winds. The roof of the mulgap sloped down from each open end to the centre, where a partition divided it and diffused the wind down into the apartments below. This contrivance acts on a similar principle to the wind-sail.

For factories and other places, where a steam-engine is constantly at work to supply the required moving-power, the fanning-wheel or blower is commonly used for ventilating; it was invented by Dr. Desaguliers, in 1734. Its object was stated to be for "*changing the air of the room of sick people in a little time, either by drawing out the foul air, or forcing in fresh air, or doing both successively, without opening doors or windows.*" This, it was supposed, would be of very great use in all hospitals and prisons, and would also serve to convey air into a distant room, "nay, to perfume it occasionally." The wheel was seven feet in diameter, and one foot wide, and had twelve radii or partitions, (see *fig.* 10.) *Fig.* 11 represents the former, and fig. 12 represents the concentric case, furnished with a blowing pipe on the upper part.

In theatres and similar places, where a large central chandelier is used for the purposes of illumination, advantage may be taken thereof as a powerful ventilating agent. This was done many years ago by

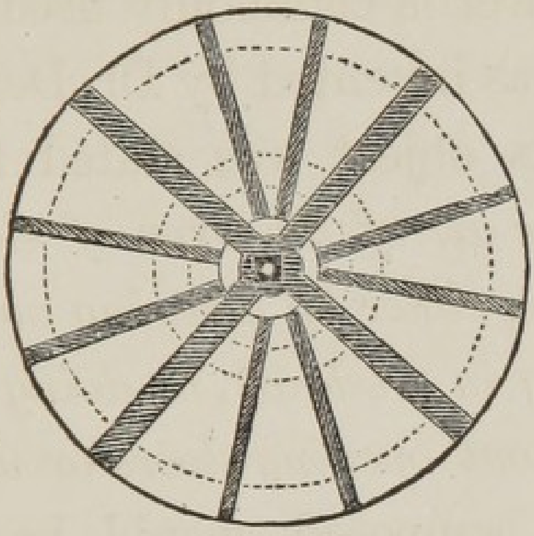

Fig. 10.

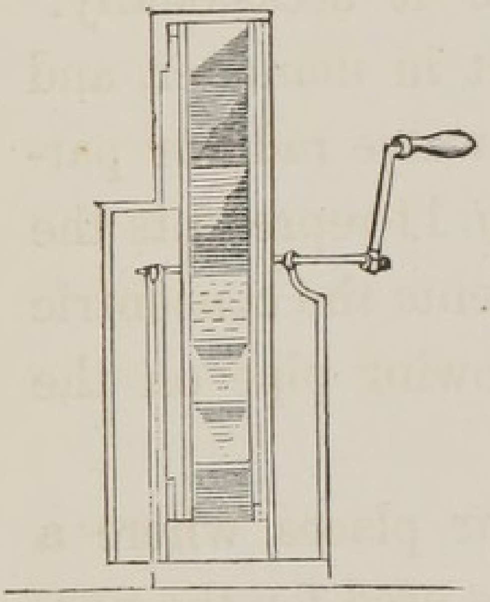

Fig. 11.

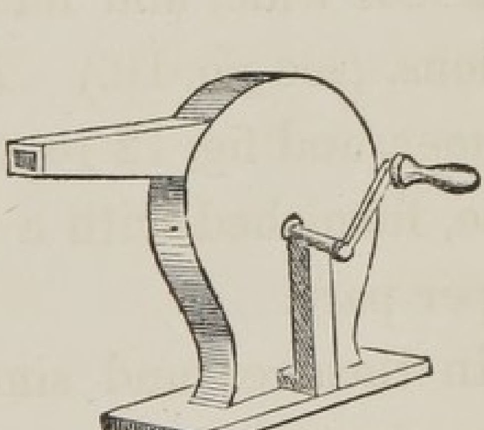

Fig. 12.

the Marquis of Chabonnes, who was engaged to warm and ventilate Covent Garden Theatre, and his arrangements will be understood by referring to *fig*. 13. *Fig*. 14

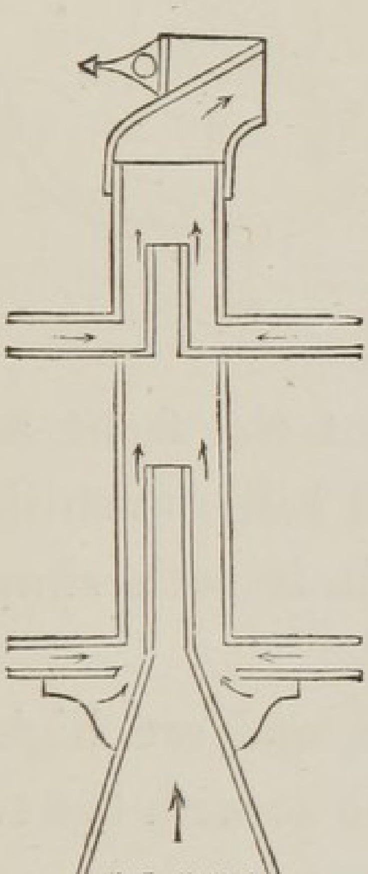

Fig. 13.

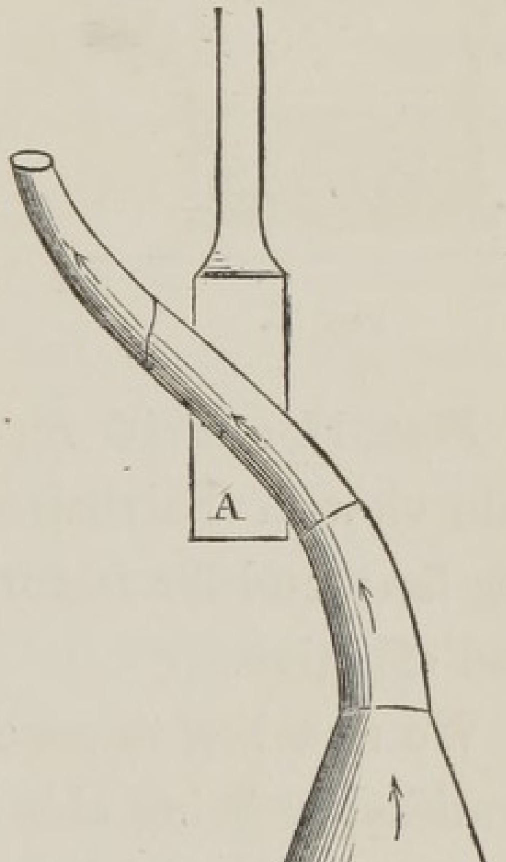

Fig. 14.

represents Sir Humphry Davy's plan—simply a ventilator in the ceiling, with a small furnace, marked A, fresh air being admitted by the floor.

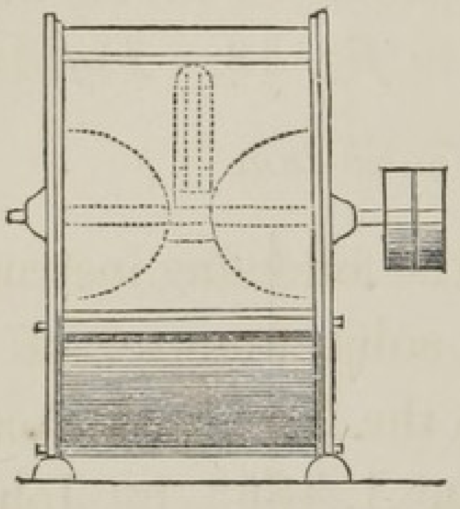

Fig. 15.

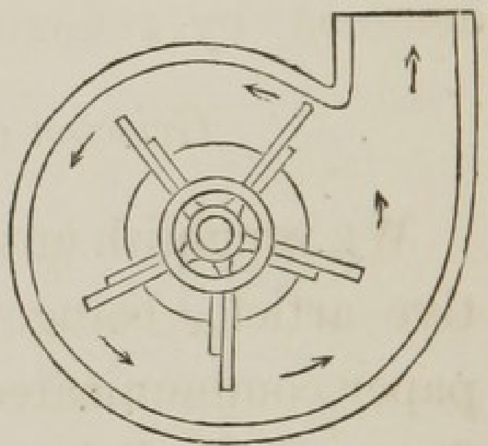

Fig. 16.

Figs. 15 and 16 represent the front and side view of Fairbairn and Lillie's ventilating fan; and for factories it is both simple and effective.

We now beg to conclude, and are highly gratified in being able to do so with the two able extracts which follow.

Griscom on Ventilation.

We republish entire the following instructive article, being the subject-matter of a paper communicated to the New York Academy of Medicine, June 1, 1853, by John H. Griscom, M.D., and since published in pamphlet form. Dr. G. is far in advance of his brethren of the allopathic school, in attention to the remedial influences of that part of our system of hygienic medicine which relates to atmospheric air. He has also contributed not a little to the physiological enlightenment of our people, by lecturing to them on the functions of the respiratory system, and the necessity for a better system of ventilation in dwelling-houses, churches, public halls, hospitals, &c.

"The main object in soliciting the attention of the Academy of Medicine, at the present time, is to place on more durable record, and to make more extensively available for good, two extraordinary cases—one, of the propagation and extension, the other, of the treatment, of a now too common and virulent disease. Though each is, of its kind, but a single case, and hence, according to medical philosophy, might be considered as demanding further observation to confirm the principles it inculcates, yet their nature is such that, independent of the fact of each being a multiple case, and hence entitled to the force of several cases, they seem to the writer most fully to establish the important laws which they illustrate.

"Probably no place on this continent has been so prolific of experience, especially during the past few years, in the habitudes of typhus or ship fever, as the port of New York. The vast immigration hitherward from transatlantic ports, averaging, in the past four years, two hundred and fifty-six thousand per annum, has brought with it an amount of suffering, disease, and death perhaps unparalleled in modern times. Such have been the severity and devastating effects of this disorder, it has claimed and received the attention of the government as well as of the profession.

"It has been an occasional visitant at this port since the commencement of the present century, but until within a few years its visitations, as it now *frequently* appears, attacking large cargoes of immigrants, were fortunately only occasional. Badly-infected ships were now and then noted, and the prevalence of the disorder in them was more reasonably attributable to protracted and stormy passages, during which the passengers were, from the state of the weather, obliged to confine themselves below a great part of the time, with the hatches closed, thus preventing the frequent exposure of persons, clothing, and bedding to the fresh air, and the execution of the proper measures for cleanliness and ventilation of the steerage, which are absolutely necessary for its prevention. Either this, or the criminal neglect of these matters by the officers of the ship, was the general cause of its endemic prevalence.

"The same remarks, however, will not apply to the etiology of the infection which pervades so greatly increased numbers of vessels at the present time. The history of the present irruption of the disease dates back to the famine which began to prevail in Ireland a few years ago, and which continued its devastations for a long period. So closely is the disorder believed to have sprung from, and to have been dependent upon, this terrible visitation of that unfortunate country, that in my estimation it might, with much propriety, be denominated the *famine fever*.

"We need not stop here to attempt an explanation of the connection between them, nor to show the nature of the dependence of one upon the other; these will suggest themselves to any one at all familiar with this class of patients; nor is it necessary to make any further comment upon the havoc the disease has made among the members of our profession. The sad story is doubtless known to all. It will suffice for this simply to express the belief, that no shock of contending armies, in their efforts at mutual destruction, ever caused so many killed and wounded among their officers, in proportion to their numbers, as has resulted from the protracted struggle between humanity and disease, as displayed in the devotion of medical men in typhus hospitals during the past five years.

"The first case I desire to present is one illustrative of the extraordinary intensity of the poisonous power of the infectious principle of this form of typhus fever, and of its occasional rapidity of action. It occurred in the New York Hospital, in the winter of 1851–52, in the building known as the 'North House.' This edifice is a very substantial stone structure, of two stories, exclusive of the basement, which is partly below ground. It is placed at a considerable distance from any other building, on very elevated ground; its halls are very spacious; the ceiling of the principal story is fifteen feet six inches high; the apartments are well lighted, and, in the ordinary, but not always correct, acceptation of the phrase, would be regarded as *well ventilated*, though there are no artificial means by which proper ventilation can be effected, the windows and doors being the only reliance for this purpose. The principal floor contains four large, square wards, two on each side the hall, each pair communicating by a large door and window in the dividing partition, so that when these are open the two form one great room. The upper story is divided into a larger number of (and, therefore, smaller-sized) rooms, with less advantages of natural ventilation. In this respect, however, the basement is the worst of all. As already stated, it is partly under-ground; the ceilings are only ten feet high; it is less accessible to the light, and it is more subdivided than the uppermost story.

"This cursory description of the house is given chiefly to show that it possesses no extraordinary disadvantages as a hospital; but, on the contrary, it would be regarded by almost any person who should visit it as possessing, in elevation, general situation, and internal arrangements, advantages superior to a great majority of buildings devoted to hospital purposes. It was built in 1839, in the most substantial manner, solely for its present use, and accommodates one hundred and nine beds.

"Prior to the month of January, 1852, a part of the basement of this building had been allowed to be used for two or three years as a receptacle for sick immigrants, for whom a temporary night-lodgment was required, but who were generally, and except in cases of too great exhaustion or too severe illness, removed the next day to the hospital expressly provided for them on Staten Island. A great proportion of the six hundred and fifty cases thus temporarily received in 1851 were of ship fever, and their number often amounted to double the capacity of the accommodations for them. Thus, though the patients remained but a few hours in the house, and were then removed, and the premises aired and cleansed as well as might be, yet the vacant places were soon reoccupied with a less or greater number of cases of the severest form of petechial typhus, whose persons were imbued with filth and vermin to the most nauseous degree, but which, under the circumstances, could not be removed or avoided.

"In addition to these 'night-cases,' the other parts of the building contained an average of about forty cases of typhus, which were then deemed legitimate subjects for admission; a proportion of numbers not, at that time, regarded as dangerous to the other patients, distributed, as they were, through separate wards.

"This state of things had continued throughout the year 1851, and until the commencement of the writer's regular term of attendance, in January, 1852. By this time, the atmosphere of the whole house seemed to have become infected with the miasm; patients with rheumatism or other benign complaints began to succumb to its power in various parts, even in some of the wards into which no typhus cases had been admitted. Notwithstanding that thorough cleanliness and as free ventilation as possible were maintained, and the immigrant cases were rigidly confined to their particular apartments, the difficulty increased to such a degree as at last to render necessary an entire change in the economy of the establishment with respect to this disease. At the suggestion of the visiting physicians, the board of governors first prohibited the reception of any more immigrant night-cases; and, secondly, a thorough purification of all the typhus wards was ordered. The number of patients was reduced, so as to allow one or two wards to be vacated, and successively the infected rooms were disinfected, and exposed to the external air night and day for several weeks, until the whole was renovated. It was during this operation that the particular case occurred which is presented as an example of the extreme virulence of the typhus poison, even under circumstances so favourable to its dilution and dispersion.

"Four men, three of whom were masons, the other a labourer or helper, were employed to cleanse the walls and ceilings, and whitewash them where necessary. They wrought only in the wards which had been vacated, and then only after each had been thoroughly aired by open doors and windows. These men did not enter any of the wards occupied by the sick; they had no occasion, in going to and fro, to see any part of the premises but the large halls, the stairways, and the apartments they were at work in.

"They were engaged there one week. The helper passed a great deal of his time in the open air, preparing and carrying materials for the others, and hence visited the building only occasionally, remaining but a short time in it, except when, being otherwise unoccupied, he aided the others a little at their work.

"The effect of this exposure, which, *à priori,* would scarcely have been regarded as involving any danger, was as follows:

"McCoy (the boss) was attacked with the disease a few days after finishing the work, was sick eighteen days, and died. Fleming, a workman, sickened five or six days after being there, was ill seventeen days, and died; and William (the labourer) was taken sick the last day of the week he worked there, was ill nearly four weeks, and barely escaped with his life. The other workman (Haight) was not sick at all.

"Thus, out of four persons, thus lightly exposed to the miasm, three were attacked by it, of whom two died. They were treated at their own homes, which are represented as having been comfortable residences, and they were all temperate and respectable men. During my attendance in January, the house physician was off duty with the same disease. His place was supplied by the senior, Walker, until he too was attacked with it, and was obliged to leave.

"In this extremity it became necessary to seek extraneous aid, and a former house physician was called from his home at a distance to resume the labours of the post. His ready willingness, alas! proved fatal, and in a manner strikingly illustrative of the occasional *rapidity*, as well as intensity, of the action of the poison on the human system. Dr. Colton had been on duty about three weeks, when the miasm seized upon him also, and in seventy-two hours from the incipient rigour he was a corpse.

"The mortality of the typhus cases in the New York Hospital in 1851 was about thirteen per cent.

"From the contemplation of this picture of desolation, let us turn to a second and more pleasing one—its contrast in almost every particular. This will be given in the graphic language in which it was first related to me, in a letter from the Hon. James Parker, a distinguished citizen of New Jersey, and President of the Board of Trustees of the State Lunatic Asylum.

LETTER FROM MR. PARKER.

"PERTH AMBOY, N. J., March 15, 1852.

"DR. JOHN H. GRISCOM:

"*Dear Sir:* Having read your treatise on the 'Uses and Abuses of Air,' I send you an account of what occurred in this place some years since, and which proves the efficacy of fresh and pure air, not only in preventing, but curing disease:

"In the month of August, 1837, a number of ships with immigrant passengers arrived at Perth Amboy from Liverpool and other ports, on board of some of which ship fever prevailed. There was no hospital, or other accommodations in the town, in which the sick could be placed, and no person could admit them into private dwellings, fearing the infection of the fever. They could not be left on board the ships. An arrangement was made to land the sick passengers, and place them in an open wood, adjacent to a large spring of water, about a mile and a half from the town. Rough shanties, floored with boards and covered with sails, were erected, and thirty-six patients were taken from on board ship with boats, landed as near to the spring as they could get, and carried in wagons to the encampment, (as it was called,) under the influence of a hot sun, in the month of August. Of the thirty-six first named, twelve were insensible, in the last stages of fever, and not expected to live twenty-four hours.

"The day after landing there was a heavy rain; and the shanties affording no protection with their 'sail' roofs, the sick were found the next morning wet, and their bedding, such as it was, drenched with the rain. It was replaced with such articles as could be collected from the charity of the inhabitants. The number at the encampment was increased by new subjects, to the amount of eighty-two in all.

"On board the ship, which was cleansed after landing the passengers, *four* of the crew were taken with ship fever, and two of them died. Some of the nurses at the encampment were taken sick, but recovered. Of the whole number of eighty-two passengers removed from the ship, *not one died*. Pure air, good water, and perhaps the rain, (though only the first thirty-six were affected by it,) seem to have effected the cure.

"No report has been made of these circumstances, and I send this from my recollection, and the information derived from the physician, Dr. Charles M. Smith, who still resides here, and to whom I refer you.

"Very respectfully,

"JAMES PARKER.

"A few further particulars of this case have since been derived from a statement of Dr. C. McKnight Smith, the gentleman referred to by Mr. Parker.

"The ship was the Phœbe, with between three and four hundred passengers; a number of them had died on the passage. The shanties spoken of were two in number, thirty feet long, twenty feet wide, boarded on three sides about four feet up, and over them old sails were stretched. Of the twelve who were removed from the ship in a state of insensibility, such appeared the hopelessness of their condition, that the overseer (who is a carpenter) observed, 'Well, doctor, I think I shall have some boxes to make before many hours.' 'The night after their arrival at the encampment,' says Dr. Smith, 'we had a violent thundergust, accompanied by torrents of rain; on visiting them the following morning, the clothes of all were saturated with water; in other words, they had had a thorough ablution: this, doubtless, was a most fortunate circumstance. The medical treatment was exceedingly simple, consisting, in the main, of an occasional laxative or enema, vegetable acids, and bitters; wine was liberally administered, together with the free use of cold water, buttermilk, and animal broths.' The four sailors who sickened after the arrival of the vessel were removed to the room of an ordinary dwelling-house; the medical treatment in their case was precisely similar, yet two of them died. Two of the number suffered from carbuncle while convalescing. The doctor adds: 'My opinion is, that had the eighty-two treated at the encampment been placed in a common hospital, many of them would also have fallen victims. I do not attribute their recovery so much to the remedies administered as to the circumstances in which they were placed; in other words, a good washing to begin with, and an abundance of fresh air.'

"The first of these cases I regard as presenting a type of the average hygienic character of hospitals in general, as *they are;* the last, a type of what they *should be* in this respect, excepting, of course, the materials and style of structure. In making a few remarks upon them, I will ask attention to one fact, which contrasts them still further. Two of the most frequent troubles which the physician meets with in the treatment of typhus, under ordinary circumstances, are erysipelas and pneumonia, which supervene in no inconsiderable number of cases. It is very generally believed that the former complication is a more or less direct result of the impure air, causing it, oftentimes, to become endemic in a ward or hospital; while pneumonia, on the other hand, is more commonly attributed to exposure of the patient to a draught of air, in some way or another, even when the manner or period of the exposure cannot be defined. In the last of the two cases I have presented, it does not appear that either of these complications occurred in a single instance, notwithstanding the unusual exposure of all the sick; while it is well known that in ordinary hospitals, as I have stated, both are frequently noticed.

"In one of the shanties at the Ward's Island Emigration Hospital, then occupied by typhus cases, it was once remarked to me by the physician on duty that pneumonia seemed to run from patient to patient along the whole length of the ward,—a circumstance which he attributed to the cold air from the windows impinging upon the patients' heads, although no windows were open; but which, to my mind, was rather caused by a *want* of pure air, the atmosphere of the ward being exceedingly foul, and there being no way by which the external could find access. And I respectfully submit the question—Whether, if erysipelas (as undoubtedly is the case) is caused by the action of a foul and infected atmosphere upon the patient—be such action indirectly through his general system or directly upon his external tegument—pneumonia may not be regarded as an erysipelas of the pulmonary tissues produced in the same manner, seeing that they are exposed, both directly and indirectly, to the influence of the same foul atmosphere?

"Regarded in its general aspect as a source of life and health, an ample supply of pure air, in conjunction with the immediate removal of secreted and exhaled impurities beyond the possibility of reinhalation, is a subject of profound interest to all humanity; but to the practitioner of medicine it presents itself with increased force. There is imposed upon us a double obligation. The question should be constantly before our minds, Whether we shall deny, or allow to be denied, to our patients the use of oxygen, in the fullest measure in which it can be found in the atmosphere? Whether, while searching our materia medica for the most appropriate remedies according to our theories of disease and treatment, we will continue to overlook the most potent of all restoratives—that derived from nature's own laboratory?

"If we can believe and understand that, by the influence of the rays of the sun upon its different aspects, the towering pile of granite on Bunker Hill is caused continually to sway to and fro upon its base, with equal readiness may we comprehend that the refined and delicate living animal organism will vary in its phases of health with the varying quality of the air upon which it depends, every moment, for its actual existence.

"It was about the middle of the seventeenth century that Thomas Sydenham burst the trammels of prejudice in which both the medical and the popular mind of his country and the world had long been bound, in reference to the innocuousness and availability of the operations of nature, and demonstrated the value, in the management of diseases, of the great medicament which she had furnished from the beginning of creation. When he tore away the bed-curtains, drove his patients from their sweltering beds, threw up their windows, or ordered them on horseback, the community thought him crazy; such kind of treatment was opposed to all their experience, and he had no authority for it from books. But, holding them in light estimation when they contravened the obvious dictates of reason and nature, he consulted only the latter, and saved many from loathsome death by small-pox and from premature graves by consumption.

"One century later, the world was shocked by receiving from Calcutta a horrible lesson of the consequences of confining human beings in a close and unventilated atmosphere. Ten hours sufficed to produce intolerable thirst, intense fever, delirium, and death in one hundred and twenty-three, out of one hundred and forty-six persons, and a high putrid fever in those found alive at the end of that time. That 'black hole' has ever since been a by-word and a reproach to humanity, while its lesson has been too little heeded.

"And now, one century later still, and there comes from Perth Amboy, in the New World, a lesson of the omnipotent sanitary influence of that same subtle, invisible agent—a lesson which should be treasured in the memory of all upon whom rests the responsibility of administering to the relief of their fellow-men.

"Let it never be forgotten for a moment that this agent, to procure which we have neither to dig into the earth, nor transport from foreign climes, nor distil from the alembic, nor refine in the crucible, but which is pressed upon us with a force and in a measure equalled only by the Supreme Benevolence which furnishes and unceasingly renews it,—this agent, when left free to act its part, removes the effete poison from the blood, and imbues it with continual health and freshness; but when stifled and confined, whether intentionally or by accident, turns, like a viper, upon the arm that nourished it, and plants a deadly venom in its veins."

Influence of Human Effluvia.

WE find in *Ranking's Abstract* a sensible article on this subject, by Mr. Grainger, from which we extract the following paragraph. If physicians would study such subjects vastly more, and the *modus operandi* of drug-poisons vastly less, they might, perhaps, soon find themselves on the platform we are compelled to occupy:

"According to my own opportunities of observation, the most injurious of all the causes operating in the diffusion of epidemic diseases are the effluvia proceeding from the human body, and especially from the lungs and the skin. The special deleterious agent consists of the effete and—as it has been proved experimentally—highly putrescent organic matter, mingled with the expired air. That it is, when reintroduced into the living body, liable to be highly injurious, may be inferred from the fact of the careful provision made by nature for its incessant elimination from the system. That it is small in amount, is no objection to the intensity of its action; for to the physiologist it is well known that a minute quantity of a powerful agent—the putrid matter introduced on the point of a needle in the inspection of a dead body—a single drop of concentrated prussic acid placed in the mouth of an animal—is sufficient to destroy life. It is in overcrowded bedrooms, in unventilated schools, workhouses, dormitories, &c. that this effete matter taints the air, and, entering the blood, poisons the system. That the remarkable diminution in the amount of carbonic acid evolved from the lungs, where persons, as in crowded and unventilated apartments, breathe an impure atmosphere, acts in such cases injuriously, admits of no doubt; but the evil, *quoad* the development of fever, scarlatina, cholera, &c., depends on the organic, and not on the chemical products of respiration. As one indication of this, it may be explained that it is possible, under certain circumstances, to observe the action of the former when separated from the latter. As soon as the expired air quits the body, the matters of which it consists have a tendency to separate; and as regards the two substances under consideration, the carbonic acid mixes with the atmosphere on the principle of diffusion; while the animal excretion, no longer held in solution by the colder external air, is deposited, and particularly clings to woollen articles, as bedding and clothes; which last, as it is well known to medical men, clergy, and others, will often retain for hours, or even longer, a foul smell from this cause alone. When this matter, from neglect, is allowed to accumulate, it will affect the health. An instance of this was mentioned to me by the surgeon of a large pauper school, where the health of the boys was decidedly improved by substituting, for the usual dress, clothes capable of being readily washed."

When cellars are damp, the air in the upper part of the house cannot be pure, and the aroma of every thing in the cellar must pervade the superincumbent atmosphere. Provisions will not keep well in damp cellars, and indeed the whole economy of housewifery is materially interfered with in such cases.

SCIENTIFIC HELPS TO STUDENTS AND OTHER GENTLEMEN.

There are many attainable improvements for generating, purifying, and distributing gas to the public, for the general purposes of illumination, &c., beyond what is now practised; and be assured we will not, on this occasion, advance any thing which is not desirable and practicable for your consideration; on the contrary, we will be careful, so as to be supported by a summary of natural laws, endorsed by the practical experience of the highest professors of organic chemistry, and others of equal authority.

We beg to be, gentlemen, your obedient servant, The Author.

We propose it to be practicable to augment the intensity of combustion by concentrating the electric forces eliminated within all furnaces: this to be effected by construction of furnace, so that all redundant heat shall be applied to secondary purposes; and this to be obtained from furnace materials possessing the properties ascribed to dielectrics. This secures increased heating action without increased supply or combustion of fuel, deriving its efficiency from the well-known natural law, "*That the available temperature of any* ACT OF COMBUSTION *is proportionate to the* PLUS ELECTRIC *condition of the combustion.*" Thus, boiling water is two degrees hotter in a vessel of *glass* than in one of *metal*, and *boiling mercury* is twenty-two degrees hotter in an *electro non-conductor*. This object is attained by *excluding* from the *construction* of a *furnace* all *electric conductors*, except the *vessel* to be heated, whose contents become powerfully *electrolized*. This principle of rendering a furnace *plus electric*, and the vessel to be heated *plus thermic*, would enable the *gas manufacturer* to *carbonize* the same weight of coal or bones in half the usual time.

OPINIONS FOR THIS.

1. *The heat-conducting power* of matter varies with each substance. Thus, when the conducting power of *charcoal* may be represented by 1, *porcelain* is 12; *iron*, 374; *steel*, 500; *brass*, 750; *copper*, 900; and the *electric powers* are nearly in the same order and power, except the two first, which ought to change places.—*Professor Daniel.*

2. *Electric accumulation* favours the concentration of heat, producing increase of evaporation, acceleration of molecular disintegration, and organic decomposition.—*Becquerel, Traité de l'Electricité,* &c.

3. The *utility* of *combustion* in a *furnace* depends more upon the *intensity* of *combustion* than *quality* of *combustible;* and *this intensity* upon the *initial temperature* of the

fuel and supply of air to the ash-pit.—*Sir H. Davy, on Flame.*

4. *Fuel in combustion,* in contact with an *electric conductor,* is electro-negative, while the *flame and hot air* arising from its upper surface are, by being *insulated, electro-* and *thermo-positive.—Becquere, Traitél de l'Electricité et du Galvanisme.*

5. ELEVATING the TEMPERATURE of AIR entering a *furnace* produces an *economy* of *fuel,* greater out of all proportion than the quantity *due* to increase of *aerial temperature.*

Thus, without *hot blast, five tons* of fuel were required to smelt *one ton* of *iron;* but *with hot blast, three* tons are sufficient, including the heating the blast.—*Davy, on Flame; Mushet, on Manufacture of Iron.*

A practical application of this principle of *electro-thermic* concentration may be entered on in the formation of *gas*-burners and *wick*-holders, by substituting *concentric conoid rings* of *porcelain,* &c. for those of *metal*, so adjusted, the one within the other, as to form *thin sheets of flame*, whose highly electric condition, by favouring intensity of temperature, augments the *evolution* of *light* fifteen per cent. upon that of the ordinary metallic burner.

AUTHORITY.

1. *The combining affinities* of *vapours* and *gases* are *increased* by *diminishing*, and *diminished* by *increasing*, their *elastic forces* by mechanical and *electrical compression*, or *thermic expansion* and dynamical dilation. *Saussure, Journal de Physique.*

2. *The brilliancy of flame* is, *cæteris paribus*, proportionate to its temperature, and its illuminative faculty to its surface, independent of its volume.—*Sir John Leslie.*

3. *A small volume of gas*, spread out into a sheet infinitesimally thin, and ignited under great intensity of *temperature*, will *evolve more light*, both in volume and intensity, than if burnt in a *solid jet* from

a *cylindrical* aperture or slit.—*Sir John Leslie.*

Heat, rapidly and energetically applied, *increases the quantity*, as well as the *quality*, of *gas* generated from *coal* or *bones*, fully fifteen per cent. respectively.

AUTHORITY.

1. *The nature of the products* of decomposition of organic bodies varies with the temperature and intensity of decomposing energy.—*Reichenbach, in Poggendorf's Annalen.*

2. *Heat expands all bodies* in quantities respectively proportionate.—*Biot, Traité de Physique.*

We will now refer to the practicability to an *augmentation* in the quantity of *heated contact* of the *charge* with the *retort,* without a corresponding increase of weight of retort, by which the same weight of retort can effectually carbonize *two-fifths more coal or bones* in a given time; this to be effected by setting the *retort vertically* on one *end*, instead *of horizontally* on its *side*, whereby the *red-hot* upper *surface* incidental to the latter position will be in contact with the extra charge. By this method the effluent *gas*, traversing from the *hot* exterior to the *cold* interior of the *charge*, will *economically* cool the *gas* and elevate the temperature of the central portions of the charge, producing *an incipient refrigerator of the gas, an economy of fuel in heating the charge of the retort, a diminution of time requisite for carbonization, and a total cessation* of *the destruction* of *rich gas* by preventing its contact with a *red-hot surface*, and consequent *scurfing* of the *retort*.*

To *economize fuel* for the use of *furnaces* for heating retorts, equal to a substantial saving upon the present usages, may be effected by *elevating* the *initial temperature*

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* See *Peckson on Clegg's Rotatory Retort*, third edition.

of the *air*, previously to its entering the *ash-pit* of the *retort furnace*, by allowing the *ingredient air* to sweep through the *vault* into which the red-hot coke is projected from the retorts, so as to absorb the heat which arises from the coal or animal charcoal lying in the bottom of the vault. *Let us see how we are supported.*

INTENSITY of COMBUSTION and *volume of light* are much impaired by the *watery vapour* held in solution by all *gases.—Sir Humphry Davy, on Flame.*

The CAPABILITY of FLAME to develop heat is proportionate to its *volume of transparency*, and inversely proportionate to its *illuminative power.—Ib.*

THE SUPPLY OF GAS from *coal, or cannel*, to the *gas-holders, mains, services,* and *metres, suffers continual diminution from* "CONDENSATION," by REPOSE within these *reservoirs* and *conduits.—Peckson, Clegg, and Ors.*

On our own authority and experience,

this "*condensation*," as it is very improperly termed, consists in the reformation of *rich gas* into the destructive elements respectively termed *naphthalic acid*, *para-naphthaline*, and *aldehyd-ammonia*, by contact of the *gas* with *fluid deposites* within those cavities, which we propose may be prevented by the means offered.

We endorse all that relates to a *method* of *diminishing* the *temperature* of *useful carbonization* twenty per cent., and *time* thirty per cent., by *generating gas* from *coal*, *bones*, &c., in *partial vacuum*, produced by the *action* of an *exhausting pump* on the interior of the retort, whose influence is—1. *Indirect increase* of the *intensity* of *heating power*, on the principle that "compounds suffer reorganization at lower temperatures and increased activities under diminished pressures;" 2. *Increase* in the *density* and *illuminating power* of the *evolved gases*—the *richest gases* being, according to *Peckson* and *Clegg*, evolved at the lowest temperatures, whence results an augment in the WEIGHT, HARDNESS, and BITUMINOUS quality of the COKE; 3. A GAS GREATER in VOLUME and RICHER in ILLUMINATIVE QUALITY; 4. An INCREASE in the VOLUME of AMMONIACAL PRODUCTS; 5. A DIMINUTION in the WEIGHT and VOLUME of TAR, with INCREASE of its value, *producing*—1. *Economy in fuel* to work the charge; 2. *Economy in time* to carbonize the charge; 3. *Diminution* of filthy operations and cost of labour; 4. *Increase* in annual performance of *working* utensils and machinery.

Let us see how we are supported:

Sir James Hall, in his experiments, in Phil. Trans., says: "SUBSTANCES DECOMPOSABLE by HEAT at mean ATMOSPHERIC PRESSURE altogether resist decomposition under augmentation of the diversities of their *circumambient* atmospheres."

RADLEY, *on the Constitution of Matter, in An. de Ch. et de Physique*, says: "DIMINUTION of DENSITY of surrounding atmosphere by *mechanical exhaustion*, *reduces* the temperature of *decomposition*, and *accelerates* its *rapidity*, obeying the same laws as the evaporization of liquids '*in vacuo*.'"

Refer back to and read No. 2, p. 152.

LYELL says: "SPECIFIC GRAVITY is dependent on QUANTITY of MATTER in a given bulk. *Thus*, GAS-COKE and ANTHRACITE are *identical in substance*, *but different* in *gravity*, the LATTER having been *produced at mean*, the FORMER at *higher*, *temperature*."

Again, "EXHAUSTION TO ONE-THIRD of an *atmosphere* DOUBLES *the quantity* of evaporation at mean pressure," says WOHLER, in *Crell's Annals*.

5. DIMINUTION IN THE PRODUCT of *incidental impurities*, the temperature of their production being seldom attained, and from the evidence of the following authority:—

1. The SULPHURIZED COMPOUNDS of coal *gas* are generated above the temperature of 800°.—*Dr. Edward Turner*.

2. GAS OF RICHEST QUALITY, and in great-

est quantity, is produced when the production of NAPHTHA is small, (and, he should have added, AMMONIA is *large.*)—*Peckson.*

3. SULPHURIZED GASES are very prejudicial to illuminative power, from the *cooling effects* upon the FLAME exercised by SULPHUR *in all its forms.—Sir H. Davy, on Flame.*

6. REDUCTION in REQUIREMENT of PURIFICATION by *arresting* the *carbonization* of the *charge,* when the rise of *temperature* and *diminution* of *barometric column* indicate the *cessation of useful production.*

The ATMOSPHERE is more highly charged with moisture in summer than in winter; and this it is which so *reduces* the *useful effects* of an *iron-smelting furnace,* as either to reduce the quality of the product, or increase the demand for fuel fully five per cent. in summer, compared to winter.—*Mushet, on Hot Blast, and Karsten, an Eisenhüttenkunde.*

A DUTY as *much owing to the public from* GAS CORPORATIONS, as it evidently is to their own commercial interests to effect, is a PREVENTION of GASEOUS EXUDATION from *bad joints*, *flaws*, and *crystalline pores* of *cast-iron* pipes, &c., and which may very readily be effected by making the joints by METALLIC CONTACT, which is performed by *scouring* and *tinning* the *inner surface* of the *faucet* and *outer surface* of the *spigot ends* of the *mains*, and insertion of the one within the other, while the two *metallic surfaces* are in a *molten state*, produced by heating the *spigot* to 500° and the *faucet* to 700° Fahrenheit, or thereabouts, and *shrinking* the *faucet* upon the *spigot*—GROUTING the PORES and FILLING the FLAWS of PIPES, &c. and MAINS with MELTED PITCH by HYDRAULIC PRESSURE. The loss of *gas* in ordinary from these sources may be estimated at twenty per centum on the gross manufacture.

While on the subject of pipes, &c., we would desire to recapitulate a little. We have said and can prove that no pipes should be connected by *T-pieces*, nor any other *right angle* formed, but under the most pressing urgency, *because* all *right angles are condensers*, producing confluent actions, and, consequently, eddies in the gas in its passage forward. The same phenomenon must occur, whether it be in liquids or atmospheric air travelling through pipes; *it is the same in all rooms and buildings of the present day*, although not so readily discovered; and we have no doubt it is one of the *normal* causes of bad ventilation. But the most prominent and conclusive evidence offered is that of rivers: rivers which *debut* in the ocean, large arms of the sea, or the superior lakes, at right angles, have, without exception, *bars* at what are technically called their mouths; while rivers debuting at any *obtuse* angle have not bars. In the former, the sea is to the *river* what the right angle of iron is to the *gas*—the *stronger;* and the sea, in resisting its passage, (the river water,) a confluent action takes place, during which the earthy and other foreign matters in suspension, and brought down by the river, precipitate. This being continued, a *bar* is formed; the right angle resists the gas in the same way, and *condensation* is the injurious result.

On the contrary, in the latter, the river falls at an obtuse angle to the ocean, &c., and in consequence glides quietly away, and no bar is formed. The same result would be obtained in the flow of gas, of liquids, of air in pipes or in rooms, if the same *natural law was observed.* Verily, we are a *wise generation!* we aim at beggaring nature.

1. *Gases are vapours* of liquids of low cohesive forces.—*Gay Lussac, An. de Ch. et de Physique.*

2. *Cyanogen*, in its liquid state, in contact with watery vapour, ammonia, and carbonic oxide, produces mutual combination. —*De Saussure.*

A further method may be followed for rendering the otherwise pure gas free from all remaining hygrometric vapour and easily condensable naphthalic fluids, so as to keep the mains and service-pipes free from all liquid substances of a tarry or ammoniacal nature; the former of which largely absorbs the richest portions of the gas—the *hyduret of acetate*—and conveys it to the syphon wells, to be pumped out and thrown away; and the latter not only absorbs this rich *olefiant gas,* but dehydrogenizes it in large quantities, converting it into *aldehyd-ammonia.*

On this important point, Dr. Thomas Thompson says: "Naphtha absorbs *two and a half times its volume* of olefiant gas; and from *fifteen to twenty-five per cent.* of this rich component of coal or cannel gas disappears rapidly by absorption within the tanks, mains, and syphons of every gas factory."

Dr. Wm. Henry says: "The solutions of *sulphate and hydro-sulphate* of *ammonia,* found in purifiers, condensers, tanks, mains, and metres, prove to have continually absorbed and decomposed large quantities of olefiant gas, the most valuable product of the destructive distillation of coal.

CONSEQUENCES.

Provided such improvements which have been here referred to were carried into effect, the results would be—

1. The manufacturer would be enabled to generate and consume richer gases in less time, with less labour, less wear and tear, and less outlay, than at present.

2. He could have the option and power of reserving rich and rejecting poorly illuminative gases, seeing that, as *Selligal*, in *La Journal de Physique*, says, "Carbonic acid gas absolutely increases the luminosity of transparent flames, and hence it is positively prejudicial to extract it from coal gas."

3. The *total* absence of condensable substances from the gas in the mains, and of

all corrosive impurities, will confer upon his *wet metre* a lasting duration by keeping its aqueous contents perfectly pure.

4. He would be enabled to diminish the spongy constitution of his coke, and increase its commercial value thirty per cent.

5. He would be enabled to increase the volume and intensity of light evolved from flame inexpensively.

By the separation of watery vapour, in the early stages of the process of manufacture, and before the rich gas is brought into contact with the products of compression, all chances of absorption and destruction of the rich parts of the gas are entirely prevented.

VALEDICTION.

WHETHER our present efforts are to receive the sanction of scientific readers, directors, and other officers of gas corporations, or be by them shelved, is a matter in which we are willing to admit we are a little interested.

We have performed a duty we conceived from our position to be a moral obligation due from us to the public, and have exhibited, we hope, an unselfish feeling toward the corporate bodies.

Of this, however, we are quite assured—the glaring injuries sustained and being sustained in London and other English cities and towns by the public health, are alike, in amount and in as grave results, existing in and entailed upon Washington, New Orleans, Philadelphia, New York, Boston, and in every city in which gas-mains are laid, gas made, and gas consumed, and this state of things must quickly lead to reformatory measures at any cost.

We respectfully conclude by inserting the following extract of a letter copied from the *Times*, London, England, January 14, 1854:

"We now have had the experience of fifty years. We have competition, we have gas used for every thing, in quantities hardly imagined by the sanguine inventors. We have thousands of miles of gas-pipes, and almost as many jets as there are lungs in the metropolis. It is time we should ask whether the system is perfect. Is our gas as good as it might be? Have we duly availed ourselves of the means discovered for its purification? We may also ask, Whether so great a boon is not necessarily attended with some drawbacks?

"Nobody can have seen the paving of our streets disturbed, as it all is disturbed once or twice a year, without perceiving with dismay that the whole subsoil of the metropolis is thoroughly saturated with some black, stinking ingredient, of a most sickening nature. It tells its own tale, for common sense assures us that where the effluvia from such soil can reach the lungs, it must impair strength and shorten life. As to its effect on vegetable life, we have heard repeated instances of healthy trees suffering by the approach of this underground foe. As the evil is cumulative, what will it come to? The question was answered the other day in some remarks by Dr. Letheby, addressed to the City Court of Sewers, on the subject of his report on the city gas companies. 'Then, again,' he says, 'there is a quantity of ammonia which holds in solution a large quantity of tar, and whenever there is a leakage in the streets, it oozes out. During the last fifty years, where it has got into the public roads, it has rendered the soil near to it so offensive that you can hardly move the pavement without doing a great deal of harm. What it may be in twenty years hence I cannot say, but I think it will be almost unsafe that you should then disturb the pavements at all. In twenty years, or at all events at the end of this century, we shall not be able to move the ground under our feet without the same results as if we were opening a common sewer; but as water-pipes, drains, and, more than all, the gas-pipes themselves, are frequently in want of repair, the ground must be disturbed, in winter or summer, as may be, and that for whole streets at a time. Thus far it has been found impossible to prevent this leakage, on account of the continual, but unequal, subsidence of the soil in which the pipes are laid. The only thing to be done is to take stringent measures to compel the utmost possible purification of the gas itself.'

"Perhaps a still more palpable proof of the deleterious properties of the gas now in use is to be found in its effects upon many substances in rooms where it is used. Dr. Letheby says, 'There is not a library in the metropolis the books on the upper shelves of which are not tumbling to pieces from this cause.' As it happens, we can bear witness to the truth of this remark. We have seen the bindings of books shrivel up and break after only two or three years' exposure, rather than use, in a room where gas is constantly burnt. The destructive effect of gas on furniture and perishable substances is a matter of universal complaint, and is only tolerated because furniture in London is commonly changed very soon, and few shopkeepers keep large stores of perishable substances. It is the oil of vitriol that does the mischief; and Dr. Letheby says, that so highly is the gas of one company charged with sulphuret, that he has obtained twenty-one grains of oil of vitriol from one hundred cubic feet of gas. Now, if the gas of this metropolis is so destructive to inert matter, how much more must it be so to the vital organs! It is true that gas is only one of the many deleterious agents at work in this metropolis. Dr. Letheby finds the snow itself, apparently so fresh from the purer regions of the sky, charged with sulphuric acid in combination with ammonia; and he has found the same with regard to the leaves of trees. But, if mischiefs are so rife about us, that is only the more reason why every thing should be done to diminish their number and influence. Gas is becoming one of the most formidable. It assails us everywhere. It oozes from the soil, it rises from every area, and fumes out of every neglected basement. What with leakage, imperfect combustion, and the original bad quality of the gas, it is seldom used without forcing itself on more senses than one. This is a heavy penalty to pay for an evening's illumination, and there is no real occasion why we should have to pay it. Gas can be brought under the public surveillance quite as easily as any other modern necessary of life. Parliament has lately enacted some stringent and costly regulations as to the part of the Thames from which water shall be drawn, and as to the filtering and reserving of that water. The air that we breathe is even more important than the water we drink; and, if Dr. Letheby's account of the gas in London be correct, it is high time that Parliament did interfere to neutralize the subtle poison we have admitted into our atmosphere and into the very ground that we tread on. The most dangerous poisons are those which accumulate, and only act when the quantity present in the system has reached a certain point. We may go on poisoning London with comparative harmlessness in our time, but leave it scarcely habitable to our children. Happily, the evil admits of inquiry, and of exact measurement. That inquiry should be made; and there can be no doubt the first result of it will be of an immense improvement in the manufacture of gas by every metropolitan company."

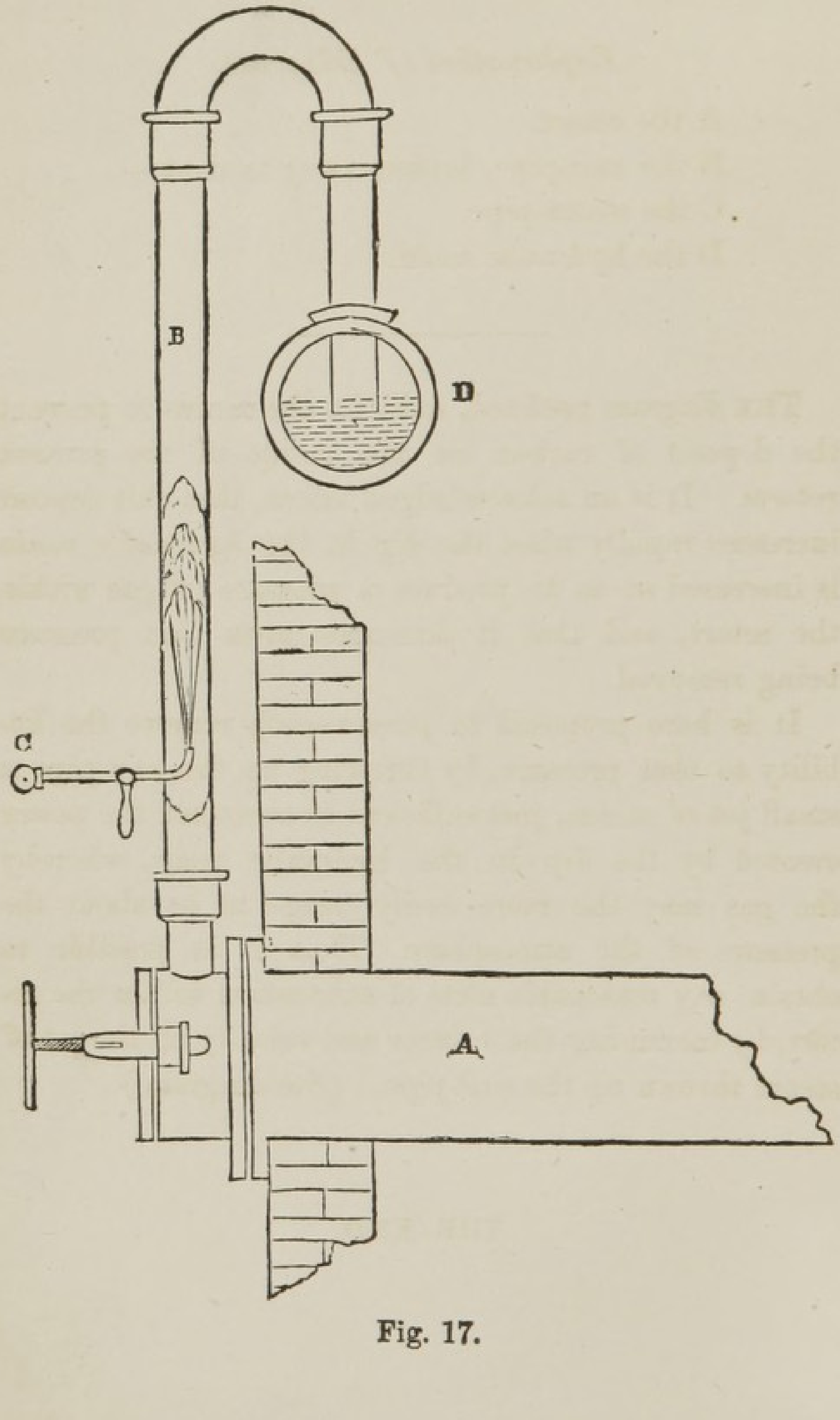

Fig. 17.

Explanation of Diagram.

A the retort.
B the exit-pipe, broken away to show—
C the steam-pipe.
D the hydraulic main.

The diagram prefixed, exhibits the means to prevent the deposit of carbon on the inside of the present *retorts.* It is an acknowledged axiom, that this deposit increases rapidly when the dip in the *hydraulic main* is increased so as to produce a pressure of gas within the retort, and that it decreases upon that pressure being removed.

It is here proposed to *permanently* remove the liability to that pressure, by throwing up the exit-pipe a small jet of steam, just sufficient to overcome the power created by the dip in the hydraulic main, whereby the gas may the more easily escape at or about the pressure of the atmosphere Thus it is possible to obtain any reasonable state of exhaustion within the retort, by increasing the volume and velocity of the jet of steam thrown up the *exit*-pipe. (See diagram.)

THE END.

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